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Microdistribution of Hemiedaphon in the Pasturelands and Typical Grasslands of Dachigam National Park, Kashmir.

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ABSTRACT

After surveying and random quadrat sampling of litter and surface soil dwelling, cryptozoic and hypolithic adult macro-invertebrates for six consecutive seasons in six clearly differentiable microhabitats of pasturelands, typical grasslands and an alpine meadow of Dachigam National Park (34° , 04' - 34° , 11' N and 74°, 54' - 75° , 09' E), Kashmir, 44 species of organisms belonging to 13 different groups comprised the hemiedaphic community. Seasonal and microclimatic evaluation of relative density, index of similarity 'S' and index of general diversity revealed both macro- as well as microclimate influencing the density and distribution of the species. Higher species number at microhabitats subject to higher degrees of biotic interference (e. g. extremely grazed and degraded site, grazed and recently protected location, burnt and subsequently protected site and alpine meadow in this study) and vice versa was a general observation. Outstanding representation was of the community of 13 species of coleopterans followed by 9 species araneids (predator component) with *Aphodius* sp. and *Copris* sp. as conspicuous populations in pasturelands and alpine meadow. Exclusiveness of Aphodius sp., *Copris* sp., and *Geotrupis* sp. in pastureland microhabitats; *Zebrina dextrosinister* at site with higher calcium content; *Lycosa* sp. at least interfered site; *Arctosa* sp. at grazed and recently protected location; *Allolobophora* spp. At extremely grazed and degraded site; *Julus* sp. *Leptoiulus* sp. and *Scorpiops* sp. at forest edge site and geophagous *Eutyphoeus* sp. at alpine site were among other observations reached at . index of similarity 'S' generally remaining higher at extremely grazed and recently protected microhabitats during the favourable seasons of spring and summer and summer and autumn while range of Shanon index of general diversity remained higher at the grazed and recently protected location.

Keywords: microdistribution, cryptozoic, hypolithic, hemiedaphon.

INTRODUCTION

Every where soil is a heterogenous system with its characteristic physical, chemical and biological features. Besides euedaphic organisms, many kinds of macro- and microorganisms live in it as hemiedaphon. These include annelids, arthropods, molluscs etc. and form an important component of all terrestrial ecosystems. The characteristic hemiedaphic populations of grasslands and pasturelands, as in all other ecological systems, are in the form of herbivores, carnivores, omnivores and detrivores(decomposers). Many of these live entire span of their life in soil while others spend it there only partially. The

Site S-1: This represented a typical overgrazed and degraded location subject to round the year grazing and browsing by hill cattle, sheep, goats and horses. Soil erosion denudation, run off, treading and trampling of plant and animal was quite apparent here. The dominant plant cover was that of unpalatable *Stipa siberica*, sweet edible *Cynodon dactylon*, *Thymus serpylum* and *Isodon plectranthoides*.

Site S-2: This was a previously round the year grazed but recently protected (fenced) location and had regenerated to a great extent. The conspicuous plant cover at this site was *Bothriocloa pertusa*, *T. serpylum*, *C. dactylon* and *I. Plectranthoides*.

Site S-3: This location was an overgrazed, then protected for the last about ten years and *S. siberica* dominated. In the dry spell of autumn, just prior to commencement of the study, the site suffered an accidental fire and in the ensuing spring it greened up earlier with *Themeda anathera* as its dominant cover replacing the long established *S. siberica*.

Site S-4: This site was subject to the treatment of periodical grass cutting and the dominant cover was that of the grass *T. anathera*.

Site S-5: This represented the *T. anathera* dominated least interfered location.

Site S-N: this was a high altitude nival / alpine zone site.

MATERIAL AND METHODS

For purposes of studying / recording litter and surface (5cm deep) soil, cryptozoic and hypolithic hemiedaphic macroinvertebrates, random quadrat sampling was performed at each of the five 100m square demarcated temperate zone microhabitats in the mid of each season for six consecutive seasons. The high altitude nival / alpine zone meadow was surveyed during first summer and autumn only and after demarcating 100m square area random sampling was observed for collection of samples. In case of litter dwelling organisms litter of 50cm square area was searched while on stony patches stones covering an area of 50cm square were overturned and the organisms collected. Surface soil organisms were hand sorted after isolating and carefully breaking a surface soil block of 25cm square area. The density of organisms was accordingly computed and recorded / m square. The organisms after isolation were dry and wet preserved as required. The relative density of organisms was evaluated by using Dwivedi and Chattoraj (1984) and Misra (1989) formula:

importance of hemiedaphic macroinvertebrate saprophages can be understood from the studies of Olechowicz (1976) wherein grazing animals were estimated to be consuming 80% Of the plant production in pasturelands, about 56% of this being returned to the soil as faeces and because of absence of macroinvertebrate saprophages the faeces depositted by cattle and sheep inAustralian pasturelands remained unaffected and thus created problems of fouling, plant killing and turning of about 1/3 of the pasture as non-palatable.

The present investigation was carried out for a period of six consecutive seasons with the objective of estimating the diversity and density of native adult hemiedaphic macroinvertebrates in a variety of clearly differentiable microhabitats of pasturelands and typical grasslands of Dachigam with the ultimate aim of assessing their microhabitat preference.

STUDY AREA, CLIMATE AND STUDY SITES

Under the existing topographic conditions the study area , as the rest of the valley, enjoys alpine- temperate alpine or sub-mediteranean climate. In the valley proper it is predominantly temperate climate with four distinct seasons of spring (March -May), summer (June - August), Autumn (September - November) and winter (December- February) a year. Generally the lowest mean temperature during winter ranges from - 2°C to - 8°C and the highest mean temperature of 35°C is touched during summer. The annual total rain fall ranges between 500mm and 700mm of which about 40% is precipitated in the form of snow during winter. During the year relative humidity is found to range between 40 and 95 % generally.

This study was carried out in some pasturelands, typical grasslands and an alpine/ nival zone meadow of Dachigam (34° , 04' - 34°, 11' N Latitude and 74° , 54' - 75° , 09' E Longitude) National Park, Kashmir. The area of study was located within the natural boundary of the park on the south facing aspect in the altitudinal range of 1680m and 1750m for temperate zone microhabitats at 20% to 30% slope. The field trips to nival zone meadow (4000m alt.) were approachable only in summer and autumn.

After identification of five clearly differentiable locations / microhabitats, subject to biotic treatments of different natures in the study area, a 100m square area was demarcated at each location. The sites were distant apart in a consecutive manner by at least an intervening distance of not less than one km each in the form of a gorge (nalla) with a plant cover of forest scrub and forest trees. The salient features of five temperate zone locations were:

Relative Density =

Total number of individuals of a species / Total number of individuals of all species x 100

Index of similarity was calculated by using the formula:

'S' = 2C / A + B (Misra, 1989) A = Number of species in one sample/site/ season

B = Number of species in the other sample/site/ season

C= Number of species common in both samples

Shanon index of general diversity H was computed as:

H = S (ni / N) log (ni / N) ni = Importance value of one species

N = Total of importance values of all species (Odum, 1971)

The taxonomic determination of most of the specimens was performed at ZSI, New Alipur, Kolkata. A few specimens were got identified at Entomology Division, IARI, New Delhi. While others were identified from surveying of the available literature.

OBSERVATIONS

Species Organization, Number and Index of Similarity 'S'

During the present investigation carried out for six consecutive seasons for macroinvertebrate hemiedaphon in relation to both micro- as well as macroclimate, 44 species that were recorded from the six subhabitats of the study area included: *Allolobophora* spp.,*Eutyphoeus* sp., *Lumbricus terrestris* (Megadrilli); *Mesoniscus* sp., *Protracheoniscus* sp. (Oniscoidea); *Archelithobius* sp., *Scolopendra morsitans* and *Scutigera* sp. (Chilopoda); *Julus* sp., *Leptoiulus* sp. (Diplopoda); *Blatella* sp. (Dictyoptera); *Gryllus* sp., *G. bimacullatus* (Orthoptera); *Aphodius* sp., *Atheta* sp., *Amphimallus* sp., *Bembidion* sp., *Carabus* sp., *Calosoma himalayensis*, *Copris* sp., *Chlaenius* sp., *Cicindella* sp., *Geotrupes* sp., *Harpallus* sp., *Temnochila* sp. and *Onthophagus* sp. (Coleoptera); *Anechurus* sp., *Forficula* sp. (Dermaptera); *Lasius* sp. (Hymenoptera); *Scorpiops* sp. (Scorpionida); *Arctosa* sp., *Herphyllus goansis*, *Lycosa* sp., *Pardosa amentata*, *Pholcus* sp., *Pisaura mirabilis*, *Salticus* sp., *Sparassus* sp., *Xysticus cristatus* (Araneida) and *Zebrina dextrosinister*, unidentifie species, ?*Limax* sp. (Pulmonata). Seasonwise relative data for the variety of microhabitats in respect of these populations are depicted in Table 1.

Season wise highest number of 40 (90. 90%) and lowest of 14 (31. 81%) species were recorded during the first summer and the only winter of the study period respectively.

Table 1. Hemiedaphic (litter/surface soil dwelling/ cryptozoid/ hypolithic) macroinvertebrate species number (absolute) with percent of the species of the season in parentheses and index of similarity 'S' between the samples of successive seasons.

S.No.	Site	Spring	'S'	Summer	'S'	Autumn	'S'	Winter	'S'	Spring	'S'	Summer
0	—	37	—	40	—	31	—	14	—	27	—	35
1.	S-1	22 (59.45	0.70	18 (45.00)	0.74	17 (54.83)	0.56	8 (57.14)	0.61	17 (62.96)	0.52	21 (60.00)
2.	S-2	16 (43.24)	0.72	20 (50.00)	0.79	23 (74.19)	0.51	8 (57.14)	0.43	15 (55.55)	0.74	20 (57.14)
3.	S-3	14 (37.63)	0.50	22 (55.00)	0.66	14 45.16)	0.35	3 (21.42)	0.50	5 (18.51)	0.50	15 (42.85)
4.	S-4	11 (29.72)	0.50	17 (42.50)	0.47	13 (41.93)	0.47	4 (28.51)	0.50	4 (14.81)	0.23	13 (37.14)
5.	S-5	10 (27.02)	0.61	16 (40.00)	0.66	11 (35.48)	0.30	2 (14.28)	0.40	3 (11.11)	0.36	8 (22.85)
6.	S-N	-	-	15 (37.50)	0.75	14 (45.16)	-	-	-	-	-	-

Spring:

Of the 37 species of first spring a maximum of 22 were found to harbor the extremely grazed and degraded microhabitat while a minimum of 10 species existed at the least interfered grassland site. 16 species occurred at the grazed and recently protected site, 14 species at the grazed- burnt and subsequently protected site and 11 species occurred at the grassland site subject to cutting treatment.

Summer:

of the 40 species of first summer highest of 22 were found to occu: · S-3 while lowest of 15 at the least interfered site (S-5). The order in number of species at other sites was: 20 at S-2, 18 at S-1; 17 at S-4 and 15 at S-N.

The index of similarity 'S' between the samples of first spring and first summer was highest of 0. 72 at grazed but recently protected microhabitat (S 9) followed by that of 0. 70 at S-1 and lowest of 0. 42 at the cut grassland site(S-4) preceded by that of 0.50 at S-3 and at the least interfered grassland microhabitat it was 0. 61.

Autumn:

Of the 31 species of autumn the species number was found to vary between the highest of 23 at S-2 and lowest of 11 at S-5. The number at other microhabitats was: 17 at S-1; 14 at S-3; 14 at nival zone site(S-N) and 13 at S-4.
The index of similarity between the first summer and autumn was found to be of the maximum of 0. 79 at S-2 and of the minimum of 0. 60 at S-4. At the overgrazed and degraded site the 'S' was 0. 74 while at the grazed alpine/ nival zone meadow it was represented by 0.75.

Winter:

During winter highest of 8 species were found to exist each at the sites S-1 and S-2 and the lowest of 2 species (14. 28%) occurred at the least interfered sub-habitat S-5.
The resemblance between the samples of the consecutive autumn and winter was indicated by the values of 'S': 0. 56 at S-1; 0. 51at S-2 ; 0. 47 at S-4; 0. 35 at S-3 and 0. 30 at S-5.

Spring II:

The microhabitat wise order followed by the community of 27 species of second spring was: 17 species (62. 96%) at overgrazed and degraded site; 15species (55. 55%) at overgrazed but recently protected ; 5 species (18. 51%) at grazed burnt and subsequently protected (S-3); 4 species (14. 81%) at grassland subject to periodic cutting treatment and a minimum of 3 species (11. 11%) at the least interfered site (S-5).

Summer II:

The order during second summer was: 21 species (60%) at S-1; 20 species (57. 14%) at S-2; 15 species (42. 85%) at S-3; 13 species (37. 14 %) at S-4 and8 species (22. 85%) at S-5.

The similarity between the second spring and second summer was shown by the following values of 'S': 0. 74 at S-2; 0. 52 at S-1; s0. 50 at S-3; 0. 36 at S-5 and 0. 23 at S-4.

Relative Density, Index of Similarity and Index of General Diversity

The relative density evaluated during six consecutive seasons of study for the community of 44 litter/surface soil dwelling, hypolithic and cryptozoic species are depicted in Table 2.

Spring:

Overall 25 species were recorded in the first and second spring at the extremely grazed and degraded microhabitat (S-1). The population of araneid *P.amentata* exhibited itself as an opportunist with a fairly high relative density of 21. 95 during the second spring. During first spring also a fairly high density of 13. 95% was evaluated each for *P. amentata* and *Aphodius* sp. Among others *Protracheoniscus* sp., *Lasius* sp., *Harpallus* sp. and the unidentified pulmonate(terrestrial snail) were also seen to constitute the outstanding spring community. 14 0f the species (56%) were common and the index of similarity between the samples of two springs was 0. 71.

During the two springs 20 species comprised the hemiedaphic community of which 55% were common and the 'S' of 0. 71 was found to exist between the samples of two

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Table 2. Relative density of hemiedaphic macroinvertebrates.

S.No.	Animal Species			Spring			
		S-1	S-2	S-3	S-4	S-5	
	Megadrilli (Oligochaeta)						
1	*Allolobophora spp.*	2. 32	–	–	–	–	–
2	*Eutyphoeus sp.*	–	–	2. 63	–	–	–
3	*Lumbricus terrestris*	2. 32	–	5. 26	–	–	–
	Isopoda (Oniscoidea)						
4	*Mesoniscus sp.*	2. 32	–	–	–	–	–
5	*Protracheoniscus sp.*	9. 30	8. 33	–	15. 38	–	–
	Chilopoda						
6	*Archelithobius sp.*	4. 65	4. 16	2. 63	–	–	–
7	*Scolopendra morsitans*	–	4. 16	2. 63	–	–	–
8	*Scutigera sp.*	2. 32	–	–	–	–	–
	Diplopoda						
9	*Julus sp.*	–	–	–	7. 69	–	–
10	*Leptoiulus sp.*	–	–	–	7. 69	–	–
	Dictyoptera						
11	*Blatella sp.*	–	4. 16	2. 63	–	–	–
	Orthoptera						
12	*Gryllus sp.*	2. 32	4. 16	2. 63	–	9. 09	–
13	*Gryllus bimaculatus*	2, 32	–	–	–	–	–
	Coleoptera						
14	*Aphodius sp.*	13. 95	12. 50	–	–	–	–
15	*Atheta sp.*	2. 32	–	–	–	9. 09	–
16	*Amphimallus sp.*	2. 32	–	–	7. 69	–	–
17	*Bembidion sp.*	–	4. 16	–	–	9. 09	–
18	*Carabus sp.*	–	–	–	–	9. 09	–
19	*Calosoma himalayensis*	–	–	–	–	–	–
20	*Copris sp.*	–	4. 16	–	–	–	–
21	*Chlaenius viridis*	–	4. 16	–	–	–	–
22	*Cicindella sp.*	–	–	–	–	–	–
23	*Geotrupes sp.*	–	–	–	–	–	–
24	*Harpallus sp.*	6. 97	8. 33	2. 63	–	–	–
25	*Temnochila sp.*	–	–	–	7. 69	–	–
26	*Onthophagus sp.*	–	–	–	–	–	–
	Dermaptera						
27	*Anechurus sp.*	–	–	–	–	–	–
28	*Forficula sp.*	–	4. 16	–	–	–	–
	Hymenoptera						
29	*Lasius sp.*	4. 65	4. 16	5. 62	–	–	–
	Thysanura						
30	*Tenolepisma sp.*	2. 32	–	–	–	9. 09	–
31	*Machelinus sp.*	–	4. 16	–	–	–	–

	Scorpionida						
32	*Scorpiops sp.*	–	–	–	7. 69	–	–
	Araneida						
33	*Arctosa sp.*	–	–	7. 89	–	–	–
34	*Herphyllus goansis*	4. 65	4. 16	7. 89	7. 69	9. 09	–
35	*Lycosa sp.*	–	–	–	–	9. 09	–
36	*Pardosa amentata*	13. 95	20. 83	13. 15	15. 38	9. 09	–
37	*Pholcus sp.*	2. 32	–	–	–	–	–
38	*Pisaura mirabilis*	2. 32	–	2. 63	7. 69	–	–
39	*Salticus sp*	4. 65	4. 16	–	–	–	–
40	*Sparassus sp.*	–	–	–	–	–	–
41	*Xysticus cristatus*	2. 32	–	–	7. 69	9. 09	–
	Pulmonata						
42	*Zebrina dextrosinister*	–	–	36. 84	–	–	–
43	*Unidentified specimen*	4. 65	–	5. 62	7. 69	18. 18	–
44	*?Limax sp.*	–	–	–	–	–	–

	Animal Species			Summer			
		S-1	S-2	S-3	S-4	S-5	S-N
	Megadrili (Oligochaeta)						
1	*Allolobophora spp.*	–	–	–	–	–	–
2	*Eutyphoeus sp.*	–	–	–	–	–	16. 00
3	*Lumbricus terrestris*	–	2. 22	–	–	–	–
	Isopoda (Oniscoidea)						
4	*Mesoniscus sp.*	1. 85	2. 22	–	–	–	–
5	*Protracheoniscus sp.*	7. 40	4. 44	4. 54	9. 09	4. 54	–
	Chilopoda						
6	*Archelithobius sp.*	1. 85	4. 44	2. 72	9. 09	–	–
7	*Scolopendra morsitans*	–	2. 22	2. 72	–	–	8. 00
8	*Scutigera sp.*	–	2. 22	2. 72	–	–	–
	Diplopoda						
9	*Julus sp.*	–	–	–	4. 54	–	4. 00
10	*Leptoiulus sp.*	–	–	–	–	–	–
	Dictyoptera						
11	*Blatella sp.*	–	4. 44	2. 72	–	4. 54	8. 00
	Orthoptera						
12	*Gryllus sp.*	1. 85	2. 22	2. 72	4. 54	9. 09	–
13	*Gryllus bimaculatus*	–	2. 22	2. 72	–	4. 54	–
	Coleoptera						
14	*Aphodius sp.*	11. 11	6. 66	4. 54	–	–	20. 00
15	*Atheta sp.*	–	–	–	–	–	4. 00
16	*Amphimallus sp.*	–	–	2. 72	–	–	–
17	*Bembidion sp.*	–	2. 22	2. 72	4. 54	4. 54	4. 00

18 *Carabus sp.*	–	–	2. 72	4. 54	9. 09	4. 00
19 *Calosoma himalayensis*	–	–	–	4. 54	9. 09	–
20 *Copris sp.*	1. 85	2. 22	–	–	–	4. 00
21 *Chlaenius viridis*	–	–	2. 72	–	–	–
22 *Cicindella sp.*	–	–	–	–	–	8. 00
23 *Geotrupes sp.*	3. 70	–	2. 72	–	–	–
24 *Harpallus sp.*	–	6. 66	4. 54	–	–	–
25 *Temnochila sp.*	–	–	–	–	4. 54	–
26 *Onthophagus sp.*	–	–	–	–	–	–
Dermaptera						
27 *Anechurus sp.*	3. 70	–	–	–	–	–
28 *Forficula sp.*	1. 85	–	2. 72	4. 54	–	–
Hymenoptera						
29 *Lasius sp.*	31. 48	24. 44	20. 45	13. 63	13. 63	–
Thysanura						
30 *Tenolepisma sp.*	1. 85	2. 22	2. 72	4. 54	4. 54	–
31 *Machelinus sp.*	–	–	–	4. 54	–	–
Scorpionida						
32 *Scorpiops sp.*	–	–	–	4. 54	–	4. 00
Araneida						
33 *Arctosa sp.*	–	4. 44	–	–	–	–
34 *Herphyllus goansis*	1. 85	4. 44	4. 54	9. 09	9. 09	4. 00
35 *Lycosa sp.*	–	–	–	4. 54	4. 54	4. 00
36 *Pardosa amentata*	12. 98	13. 33	6. 81	4. 54	4. 54	–
37 *Pholcus sp.*	1. 85	2. 22	–	–	–	–
38 *Pisaura mirabilis*	–	2. 22	–	–	4. 54	–
39 *Salticus sp*	1. 85	2. 22	2. 72	4. 54	4. 54	–
40 *Sparassus sp*	1. 85	–	–	–	–	4. 00
41 *Xysticus cristatus*	1. 85	–	–	4. 54	4. 54	–
Pulmonata						
42 *Zebrina dextrosinister*	–	–	18. 18	–	–	–
43 *Unidentified specimen*	3. 70	–	4. 54	–	–	–
44 *?Limax sp*	–	–	–	–	–	4. 00

Animal Species			Autumn			
	S-1	S-2	S-3	S-4	S-5	S-N
Megadrili (Oligochaeta)						
1 *Allolobophora spp.*	–	–	–	–	–	–
2 *Eutyphoeus sp.*	–	–	–	–	–	11. 76
3 *Lumbricus terrestris*	–	–	–	–	–	–
Isopoda (Oniscoidea)						
4 *Mesoniscus sp.*	1. 47	–	–	–	–	–
5 *Protracheoniscus sp.*	7. 35	4. 34	–	9. 09	–	–

Chilopoda						
6 *Archelithobius sp.*	4. 41	2. 17	2. 32	4. 54	_	5. 88
7 *Scolopendra morsitans*	_	2, 17	_	_	5. 88	5. 88
8 *Scutigera sp.*	_	2. 17	_	_	_	_
Diplopoda						
9 *Julus sp.*	_	_	_	_	_	_
10 *Leptoiulus sp.*	_	_	_	_	_	_
Dictyoptera						
11 *Blatella sp.*	1. 47	2. 17	_	4. 54	_	5. 88
Orthoptera						
12 *Gryllus sp.*	2. 94	2. 17	6. 97	4. 54	_	_
13 *Gryllus bimaculatus*	_	2. 17	2. 32	_	_	_
Coleoptera						
14 *Aphodius sp.*	10. 29	6. 89	_	_	_	11. 76
15 *Atheta sp.*	_	_	_	_	_	5. 88
16 *Amphimallus sp.*	_	_	_	_	_	_
17 *Bembidion sp.*	_	_	2. 32	4. 54	5. 88	5. 88
18 *Carabus sp.*	1. 47	2. 17	2. 32	_	_	5. 88
19 *Calosoma himalayensis*	_	_	_	4. 54	5. 88	5. 88
20 *Copris sp.*	1. 47	2. 17	_	_	_	_
21 *Chlaenius viridis*	_	_	_	_	_	_
22 *Cicindella sp.*	_	_	_	_	_	5. 88
23 *Geotrupes sp.*	1. 47	2. 17	_	_	_	_
24 *Harpallus sp.*	7. 35	2. 17	2. 32	4. 54	_	_
25 *Temnochila sp.*	_	_	_	_	_	_
26 *Onthophagus sp.*	_	2. 17	_	_	5. 88	_
Dermaptera						
27 *Anechurus sp.*	_	_	_	_	_	_
28 *Forficula sp.*	_	2. 17	2. 32	_	_	_
Hymenoptera						
29 *Lasius sp.*	26. 47	26. 08	41. 86	9. 09	23. 52	_
Thysanura						
30 *Tenolepisma sp.*	_	2. 17	2. 32	_	5. 88	_
31 *Machelinus sp.*	_	_	_	_	_	_
Scorpionida						
32 *Scorpiops sp.*	_	_	_	_	_	_
Araneida		2. 17				
33 *Arctosa sp.*	_	_	_	_	_	_
34 *Herphyllus goansis*	5. 88	6. 52	9. 30	13. 63	5. 88	5. 88
35 *Lycosa sp.*	_	_	_	4. 54	_	_
36 *Pardosa amentata*	16. 17	15. 21	13. 95	13. 63	17. 64	5. 88
37 *Pholcus sp.*	_	_	_	_	_	_
38 *Pisaura mirabilis*	2. 94	2. 17	4. 65	4. 54	5. 88	_
39 *Salticus sp*	4. 41	2. 17	2. 32	_	5. 88	_
40 *Sparassus sp.*	1. 47	2. 17	_	_	_	5. 88
41 *Xysticus cristatus*	2. 94	2. 17	4. 65	9. 09	11. 76	_

	Pulmonata						
42	*Zebrina dextrosinister*	–	–	–	–	–	–
43	*Unidentified specimen*	–	–	–	–	–	11. 76
44	*?Limax sp.*	–	–	–	–	–	

S.No.	Animal Species			Winter		
		S-1	S-2	S-3	S-4	S-5
	Megadrilli (Oligochaeta)					
1	*Allolobophora spp.*	–	–	–	–	–
2	*Eutyphoeus sp.*	–	–	–	–	–
3	*Lumbricus terrestris*	–	–	–	–	–
	Isopoda (Oniscoidea)					
4	*Mesoniscus sp.*	–	–	–	–	–
5	*Protracheoniscus sp.*	11. 10	6. 67	–	–	–
	Chilopoda					
6	*Archelithobius sp.*	–	6. 67	–	–	–
7	*Scolopendra morsitans*	5. 55	6. 67	–	–	–
8	*Scutigera sp.*	–	–	–	–	–
	Diplopoda					
9	*Julus sp.*	–	–	–	–	–
10	*Leptoiulus sp.*	–	–	–	–	–
	Dictyoptera					
11	*Blatella sp.*	–	–	–	–	–
	Orthoptera					
12	*Gryllus sp.*	–	6. 67	–	–	–
13	*Gryllus bimaculatus*	–	–	–	–	–
	Coleoptera					
14	*Aphodius sp.*	22. 22	40. 00	–	–	–
15	*Atheta sp.*	–	–	–	–	–
16	*Amphimallus sp.*	–	–	–	–	–
17	*Bembidion sp.*	–	–	–	–	–
18	*Carabus sp.*	–	–	–	–	–
19	*Calosoma himalayensis*	–	–	–	–	–
20	*Copris sp.*	–	–	–	–	–
21	*Chlaenius viridis*	–	–	–	–	–
22	*Cicindella sp.*	–	–	–	–	–
23	*Geotrupes sp.*	–	–	–	–	–
24	*Harpallus sp.*	–	6. 67	–	–	–
25	*Temnochila sp.*	–	–	–	–	–
26	*Onthophagus sp.*	–	–	–	–	–
	Dermaptera					
27	*Anechurus sp.*	–	–	–	–	–
28	*Forficula sp.*	–	–	–	–	–

	Hymenoptera					
29	*Lasius sp.*	5. 55	6. 67	25. 00	–	–
	Thysanura					
30	*Tenolepisma sp.*	–	–	25. 00	–	–
31	*Machelinus sp.*	–	–	–	–	–
	Scorpionida					
32	*Scorpiops sp.*	–	–	–	–	–
	Araneida					
33	*Arctosa sp.*	–	–	–	–	–
34	*Herphyllus goansis*	5. 55	–	–	–	50. 00
35	*Lycosa sp.*	–	–	–	20. 00	–
36	*Pardosa amentata*	22. 20	13. 33	50. 00	20. 00	50. 00
37	*Pholcus sp.*	–	–	–	–	–
38	*Pisaura mirabilis*	5. 55	–	–	20. 00	–
39	*Salticus sp*	5. 55	–	–	–	–
40	*Sparassus sp.*	–	–	–	–	–
41	*Xysticus cristatus*	–	–	–	40. 00	–
	Pulmonata					
42	*Zebrina dextrosinister*	–	–	–	–	–
43	*Unidentified specimen*	–	–	–	–	–
44	*?Limax sp.*	–	–	–	–	–

No.	Animal Species			Spring II		
		S-1	S-2	S-3	S-4	S-5
	Megadrili (Oligochaeta)					
1	*Allolobophora spp.*	7. 31	–	–	–	–
2	*Eutyphoeus sp*	–	–	–	–	–
3	*Lumbricus terrestris*	4. 78	–	–	–	–
	Isopoda (Oniscoidea)					
4	*Mesoniscus sp*	2. 43	–	–	–	–
5	*Protracheoniscus sp.*	9. 75	7. 68	–	–	–
	Chilopoda					
6	*Archelithobius sp*	2. 43	3. 84	–	–	–
7	*Scolopendra morsitans*	2. 43	3. 84	6. 66	–	–
8	*Scutigera sp*	–	–	–	–	–
	Diplopoda					
9	*Julus sp*	–	–	–	20. 00	–
10	*Leptoiulus sp*	–	–	–	20. 00	–
	Dictyoptera					
11	*Blatella sp*	2. 43	3. 84	6. 66	–	–
	Orthoptera					
12	*Gryllus sp*	–	–	–	–	–
13	*Gryllus bimaculatus*	–	–	–	–	–

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S.No.	Animal Species	S-1	S-2	S-3	S-4	S-5
	Coleoptera					
14	*Aphodius sp.*	–	–	–	–	–
15	*Atheta sp.*	20. 43	–	–	–	33. 33
16	*Amphimallus sp.*	2. 43	3. 84	–	–	–
17	*Bembidion sp.*	–	–	–	–	–
18	*Carabus sp.*	–	–	–	–	–
19	*Calosoma himalayensis*	–	–	–	–	–
20	*Copris sp.*	–	3. 84	–	–	–
21	*Chlaenius viridis*	–	3. 84	–	–	–
22	*Cicindella sp.*	–	–	–	–	–
23	*Geotrupes sp.*	–	–	–	–	–
24	*Harpallus sp.*	7. 31	–	–	–	–
25	*Temnochila sp.*	–	–	–	–	–
26	*Onthophagus sp.*	–	–	–	–	–
	Dermaptera					
27	*Anechurus sp.*	–	–	–	–	–
28	*Forficula sp.*	–	2. 43	–	–	–
	Hymenoptera					
29	*Lasius sp.*	7. 31	3. 84	6. 66	–	–
	Thysanura					
30	*Tenolepisma sp.*	4. 87	–	–	–	–
31	*Machelinus sp.*	–	3. 84	–	–	–
	Scorpionida					
32	*Scorpiops sp.*	–	–	–	–	–
	Araneida					
33	*Arctosa sp.*	–	15. 38	–	–	–
34	*Herphyllus goansis*	4. 90	11. 53	–	–	–
35	*Lycosa sp.*	–	–	–	–	33. 33
36	*Pardosa amentata*	21. 95	19. 23	20. 00	20. 00	33. 33
37	*Pholcus sp.*	–	–	–	–	–
38	*Pisaura mirabilis*	2. 43	3. 84	–	–	–
39	*Salticus sp*	2. 43	–	–	–	–
40	*Sparassus sp.*	–	–	–	–	–
41	*Xysticus cristatus*	–	–	–	40. 00	–
	Pulmonata					
42	*Zebrina dextrosinister*	2. 43	–	60. 00	–	–
43	*Unidentified specimen*	7. 31	11. 53	–	–	–
44	*?Limax sp.*	–	–	–	–	–

S.No.	Animal Species			Summer II		
		S-1	S-2	S-3	S-4	S-5
	Megadrilli (Oligochaeta)					
1	*Allolobophora spp.*	–	–	–	–	–
2	*Eutyphoeus sp.*	–	–	–	–	–
3	*Lumbricus terrestris*	1. 47	–	–	–	–

Isopoda (Oniscoidea)					
4 *Mesoniscus sp.*	_	4. 00	_	_	_
5 *Protracheoniscus sp.*	_	8. 00	2. 70	13. 63	_
Chilopoda					
6 *Archelithobius sp.*	1. 47	4. 00	2. 70	4. 54	_
7 *Scolopendra morsitans*	_	2. 00	2. 70	_	_
8 *Scutigera sp.*	1. 47	2. 00	_	_	_
Diplopoda					
9 *Julus sp.*		_	_	_	_
10 *Leptoiulus sp.*	_	_	_	_	_
Dictyoptera					
11 *Blatella sp.*	1. 47	4. 00	2. 70	_	_
Orthoptera					
12 *Gryllus sp.*	1. 47	2. 00	2. 70	_	_
13 *Gryllus bimaculatus*	_	_	2. 70	_	_
Coleoptera					
14 *Aphodius sp.*	14. 70	_	_	_	_
15 *Atheta sp.*	_	_	_	_	_
16 *Amphimallus sp.*	1. 47	2. 00	_	_	_
17 *Bembidion sp.*	_	_	_	4. 54	6. 66
18 *Carabus sp.*	1. 47	_	2. 70	4. 54	_
19 *Calosoma himalayensis*	_	_	_	4. 54	6. 66
20 *Copris sp.*	1. 47	_	_	_	_
21 *Chlaenius viridis*	1. 47	_	_	_	_
22 *Cicindella sp.*	_	_	_	_	_
23 *Geotrupes sp.*	4. 41	_	_	_	_
24 *Harpallus sp.*	5. 88	8. 00	_	_	_
25 *Temnochila sp.*	_	_	_	_	_
26 *Onthophagus sp.*	_	_	_	_	_
Dermaptera					
27 *Anechurus sp.*	2. 94	_	_	_	_
28 *Forficula sp.*	1. 47	2. 00	_	4. 54	_
Hymenoptera					
29 *Lasius sp.*	35. 29	32. 00	32. 43	22. 72	33. 33
Thysanura					
30 *Tenolepisma sp.*	_	2. 00	2. 70	_	_
31 *Machelinus sp.*	_	2. 00	_	_	_
Scorpionida					
32 *Scorpiops sp.*	_	_	_	4. 54	_
Araneida					
33 *Arctosa sp.*	_	2. 00	_	_	_
34 *Herphyllus goansis*	1. 47	4. 00	5. 40	9. 09	20. 00
35 *Lycosa sp.*	_	_	_	4. 54	6. 66
36 *Pardosa amentata*	13. 23	12. 00	21. 62	4. 54	6. 66
37 *Pholcus sp.*	1. 47	2. 00	_	9. 09	_

38 *Pisaura mirabilis*	_	2. 00	_	_	6. 66
39 *Salticus sp*	2. 94	2. 00	2. 70	_	_
40 *Sparassus sp.*	1. 47	_	_	_	_
41 *Xysticus cristatus*	1. 47	_	2. 70	9. 09	13. 33
Pulmonata					
42 *Zebrina dextrosinister*	1. 47	_	5. 40	_	_
43 *Unidentified specimen*	_	2. 00	2. 70	_	_
44 *?Limax sp.*	_	_	_	_	_

springs at the grazed and subsequently protected site S-2. The highest density of 20. 83% and 19. 23% was shown by *P. amentata* during the two successive springs respectively. The other conspicuous organisms in order of theirrelative density at the microhabitat included: *Arctosa* sp. (15. 83); *Aphodius* sp. (12.50 in first spring); *H. goansis* (11. 53 in first spring) and *Protracheoniscus* sp. and *Harpallus* sp. each (8. 33 in first spring). At the grazed burnt and subsequently protected site 14 species formed the community , fairly low number of 5 (35. 71%) species were found to exist as commons between the two springs and the index of similarity was represented by 0. 52, most probably indicative of transformation of the microhabitat during the period of post-fire and protection. Th land snail *Z. dextrosinister* existed in the highest density of 60% during the second spring and 36. 84% in the first spring. The other outstanding populations were those of : *P. amentata* (13.15% in first spring nnd 20% in second spring), *Arctosa* sp. *H. goansis, Lasius* sp. and *Lumbricus terrestris*.

Site S-4 was inhabited by a community of 11 species of which 36% represented the commons and the index of similarity between the two springs was 0. 53. In first spring *Protracheoniscus* sp. and *p. amentata* each were found to exist in highest density of 15. 38% while during the second spring the highest of 40 % density was recorded for *X. cristatus*. *Julus* sp., *Leptoiulus* sp. and *Scorpiops* sp. were among others recorded at the location.

10 species were found to occur at the least interfered *T. anathera* dominated typical grassland subhabitat (S-5) during the two springs of which only 30%, accounting to 'S' of 0. 46, occurred as commons. Unidentified pulmonate (litter dwelling snail) exhibited itself in the peak density of 18. 18% during the first spring while density of populations of each of the three organisms *Atheta* sp. *Lycosa* sp. and *P. amentata* was recorded to be 33. 33% during the second spring of the study period.

Summer:

Populations of 25 species harbored the microhabitat S-1during the two summers. 56% of the species, which accounted to 'S' of 0. 71, were recorded to exist as commons. Outstanding populations in respect of their density were : *Lasius* sp. , *P. amentata* and *Aphodius* sp. Of the 24 species of grazed but recently protected site (S-2) 66%, with a significantly high 'S' of 0. 80, were common between the two summers. *Lasius* sp., *P. amentata* and *Harpallus* sp. were recorded as conspicuous in terms of their relative density.

23 species inhabited the site S-3 during the two summers with 60% (i. e.'S' of 0. 75) as commons. Outstanding populations during the first summer were those of *Lasius* sp. (20. 45%); *Z. dextrosinister* (18. 18%) and *P. amentata* (6. 81%) and during second summer were those of *Lasius sp.* (32. 43%), *P. amentata* (21. 62%) and *H. goansis* and *Z. dextrosinister* each (5. 40%).

Out of the 18 species of grassland site subject to periodical cutting treatment 66% represented the commons accounting to a significantly high index of similarity of 0. 80 between the samples of two successive summers. *Lasius* sp., *H. goansis* and *Protracheoniscus* sp. represented the outstanding species. Besides, during the first summer *Archelithobius* sp. showed a fairly high relative density of 9. 09 in first summer while each of the *Pholcus* sp. and *X. cristatus* also exhibited a high value of 9. 09 in second summer.

Of the 16 species that existed at S-5 the more conspicuous in respect of their relative density during the first summer were : *Lasius* sp. (13. 63), *Gryllus* sp. (9. 09), *Carabus* sp. (9. 09), *Calosoma himalayensis* (9. 09) and *H. goansis* (9. 09) while conspicuous of the second summer included: *Lasius* sp. (33. 33), *H. goansis* (20. 00), and *X. cristatus* (13. 33). A fairly high 'S' of 0. 66 was recorded for the site for second summer.

The nival zone meadow (S-N) surveyed in the first summer of the study was found to harbor 15 species with a highest relative density of 20. 00 for *Aphodius* spp. Followed by that of 16. 00 for Eutyphoeus sp. and 8. 00 each for *Scolopendra morsitans, Blatella* sp. and *Cicindella* sp. *Julus* sp., *Atheta* sp., *Bembedion* sp., *Carabus* sp., *Copris* sp., *Scorpiops* sp., *H. goansis* , *Lycosa* sp., *Sparassus* sp. and ? *Limax* sp. were evaluated to exist each in the density of 4. 00%.

Autumn:

Out of the 17 species that occurred at the extremely grazed and degraded pastureland site (S-1) *Lasius* sp. , *P. amentata* and *Aphodius* sp. were found to be the outstanding organisms with 26. 47, 16. 17, 10. 29 percent density respectively. Other populations with a fairly high density were: *Protracheoniscus* sp., *Harpallus* sp., *H. goansis*, *Salticus* sp., *Archelithobius* sp., Gryllus sp., *P. mirabilis*, *X. cristatus*, *Mesoniscus* sp., *Blatella* sp., *Carabus* sp., *Geotrupes* sp. and *Sparassus* sp. (Table 2).

Of the 23 species of S-2, *Lasius* sp. and *P. amentata* were prominent followed by *Aphodius* sp. *H. goansis*, *Protracheoniscus* sp. and other species as depicted in Table 2. Populations of *Lasius* sp. (41. 86%), *P. amentata* (13. 95%), and *H. goansis* (9. 30%)

represented as the outstanding out of the 14 recorded species at Site S-3.

Microhabitat S-4 was found be inhabited by 13 species of which *H. goansis* and *P. amentata* (13. 63%) each and *protracheoniscus* sp., *Lasius* sp., and *X. cristatus* (9. 09%) each appeared to exist as outstanding populations besides *Archelithobius* sp., *Blatella* sp., *Gryllus* sp., *Bembedion* sp., *C. himalayensis*, *Harpallus* sp., *Lycosa* sp. and *P. mirabilis* exhibiting density of 4. 50 % each.

At site S-5 hemiedaphic community was found to consist of 11 species in the following order of their relative density : *Lasius* sp. (23. 52), *P. amentata* (17. 64), *X. cristatus* (11. 76), *Scolopendra morsitans*, *Bembedion* sp., *C. himalayensis*, *Onthophagus* sp., *Tenolepisma* sp., *H. goansis*, *P. mirabilis*, and *Salticus* sp. 5. 88% each.

Out of the 14 species of the high altitude nival zone meadow microhabitat *Eutyphoeus* sp., ? *Limax* sp., and *Aphodius* sp., were found to co-exist in the density of 11. 76% each. Other species each in the density of 5. 88% at the site included: *Archelithobius* sp., *S. morsitans*, *Blatella* sp., *Atheta* sp., *Bembedion* sp., *Carabus* sp., *C. himalayensis*, *Cicindella* sp., *H. goansis*, *P. amentata*, and *Sparassus* sp.

Winter:

The major populations in five differently treated temperate zone sub-habitats in their order of relative density during winter of the study period included: *Aphodius* sp., *P. amentata*, *Protracheoniscus* sp., and *S. morsitans* at S-1; *Aphodius* sp., *P. amentata*, and *Protracheoniscus* sp.at S-2; *P. amentata*, *Lasius* sp., and *Tenolepisma* sp. at S-3; *X. cristatus*, *Lycosa* sp., *P. amentata*, and *P. mirabilis* at S-4 and only *H. goansis*,*P. amentata* at the least interfered grassland site S-5 (Table 2).

Index of general diversity H

The index of general diversity appeared to vary both macro as well as microclimate wise. On using the importance value of relative density for evaluation of Shanon index of general diversity the highest index of 2. 54 was recorded for site S-4 in autumn while the lowest of 0. 68 was observed for the least interfered grassland microhabitat S-5. During the period of study the index at extremely grazed and degraded site was observed to range between the maximum of 2. 37 of first spring and the minimum of 1. 59 in the second summer. At the grazed but subsequently protected site it was found to vary between the high of 2. 37 in spring I and low of 1. 58 in winter. The range at S-3 was between 2. 35 of summer 1 and 1. 02 of winter. 2. 54 was the highest value of the index in autumn and 1. 32 in winter at S-4. At S-5 it was between 2. 44 of Summer 1 and 0. 68 of winter. In general grazed but recently protected microhabitat appeared to show higher values of index of general diversity (i. e. >2. 00 for five out of six seasons).

Table 3. Shanon index of general diversity ?

S.No.	Microhabitat	Spring	Summer I	Autumn	Winter	Spring II	Summer II
1.	S-1	2. 37	1. 85	2. 04	1. 60	2. 22	1. 59
2.	S-2	2. 37	2. 35	2. 35	1. 58	2. 10	2. 33
3.	S-3	1. 86	2. 35	1. 76	1. 02	1. 10	1. 73
4	S-4	2. 09	2. 47	2. 54	1. 32	1. 34	2. 16
5.	S-5	2. 30	2. 44	2. 03	0. 68	1. 08	1. 74
6.	S-N	NA*	2. 41	2. 41	NA*	NA*	NA*

NA*= Not available

DISCUSSION

The roles of invertebrate saprophages in grassland systems are varied. Among other investigators Gilarov (1960); Tischler (1965); Phillipson (1970; Duffey *et al.* (1974); and Breymeyer *et al.* (1975) have worked on various functional aspects of saprophagous invertebrates in ecosystems. Breyemeyer et al. (1980) recognized, macrofauna (lumbricids, enchytreids, millipedes, gastropodsand some insect larvae), mosofauna (Acarina, Collembola, protura, and others, and microfauna (protozoa, rotifers, tardigrades and nematodes as the three categories of invertebrate saprophages. Duffey *et al.* (1974) and Breyemeyer *et al.* (1975), while describing the habitat alterations produced by herbivores, stated that about 10. 70% of the pasture consumed by herbivores was returned as faeces to the pastureland habitat, this constituted an excellent source of food for saprophagous invertebrates and the invertebrates together with saprophagous bacteria accelerated the minerallization of faeces and thus helped in releasing the nutrients available for plant growth.

During present study in general the species number during different seasons was recorded higher at sites subject to higher degrees of biotic interference or have during the recent past suffered the same viz; S-1, S-2, S-3 and S-N. Higher hemiedaphic species number in the biotically interfered habitats, like pasturelands , have been attributed to the structural complexity of these habitats where novel kinds of sub-microclimates or subniches are available and these harbor different kinds of populations (Anderson, 1978). Further, different populations of a habitat with identical ecological needs often partition up the available resources of that habitat in order to avoid or reduce competition. As such in a structurally complex habitat co-existence of more populations becomes a phenomenon.

A noteworthy feature of pastureland kind of grasslands is that both herbivores and carnivores form a continuous source of certain animal products. In this perspective Morris (1967) went to the extent of categorizing these products as: the living animal, carrion (flesh, bones, fur and wool); dung and urine and discarded fur and wool. Interestingly in the existence of species which feed on dead animals some authorities have gone to the extent of claiming successional phenomenon in them (Easton, 1967).

Urine and dung, mostly of herbivores both domestic and wild / natural, is a continuously available resource in grazing lands and supports characteristic community of macro-invertebrates of which conspicuous are the coleopterans and dipterans. Not much work has been done on the range of species in relation to their succession at variously utilized grassland sites.

During the present study also 13 species (29. 54%) of coleopterans appeared to comprise the outstanding hemiedaphic community in the microhabitats subject to grazing intensity of various degrees. In all seasons of study barring spring, of the coleopterans *Aphodius* sp. represented the conspicuous population at both the extremely grazed and degraded as well as the grazed and recently protected pastureland sites while various species of *Aphodius* and related pastureland characteristic Geotrupideae are considered as important in decomposing dung in pasturelands. Different species of Aphodius are believed to be associated with the dung of different animals. In Australian pasturelands the problem of fouling due to sheep dung is also regarded to be due to non-existence of *Aphodius* spp. (Duffey *et al*., 1974).

The other dung inhabiting populations that were observed to harbor the sites like S-1, S-2 and S-N belonged to *Copris* sp. and *Geotrupes* sp. *Aphodius* spp. also seemed to exhibit their conspicuousness even at the high altitude nival / alpine zone site of S-N. The 9 araneid species in this assessment ranked at second level in their species number(20. 45%) in the over all hemiedaphic community. Although araneids are recognized as generalist predators of insects yet quantitative estimates related to their predatory value, especially in rangelands, are scarce (Watts *et al*., 1982). Araneids appeared to behave periodically both as epigeals / herbaceous and hemiedaphic. Visual field sightings showed *A. diadematus* , *A.*

quadratus, *P. mirabilis*, and *X. cristatus* to be using herb stratum as feeding and breeding layer right from late spring through summer to about mid autumn. From late autumn through winter upto about mid spring most of these resorted to hemiedaphic behavior. Populations of other araneids like *P. amentata* , *Herphyllus goansis*, *Salticus* sp., *Sparassus* sp. and *Pholcus* sp. tended to remain generally hemiedaphic but during warmer intervals of winter these were seen to be active epigeally. Duffey (1962) also appears to have distinguished almost from the same perspective, the four group associations (species living permanently on field layer plants, species using field layer plants for construction of egg-cocoons, species hunting on field layer plants and aeronautic species using field layer plants as platform wherefrom to become air borne) of araneids.

During spring, of all the existing populations, *Z. dextrosinister* was recorded in its peak density of 36. 84% in the grazed burnt and subsequently protected grassland site and in fact the species was a representation of an exclusive organism to this microhabitat and this seemed to be related to the higher calcium content (2. 12-6. 00%) of the soil (Bhat,1987). Investigators like Boycott (1934) and Duffey *et al*. (1974) also seem uphold the observations of higher numbers of terrestrial molluscs related to higher contents of calcium.

Of the species that comprised the hemiedaphic community at the grassland site subject to periodical cutting treatment the occurrence such elements as *Julus* sp., *Leptoiulus* sp., and *Scorpiops* sp. which fundamentally belong to forest hemiedaphoncould be presumed to be due to the fact that north part of the coincidentally happened to form forest edge and the occurrence of such species was not unexpected.

The mygalomorph *Lycosa* sp.was observed to exist as an exclusive element at the least interfered site S-5. During first summer the community at the post-fire sub-habitat (S-3) was seen to be formed of maximum number of species while minimum of species comprised that of the high altitude nival zone meadow site (S-N).

During both summers of study, of all the temperate sites (S-1 to S-5), the population of ubiquitous *Lasius* sp. (Hymenoptera-predator) was seen to exist in its highest density at the extremely grazed and degraded site, presumably because of availblity of more (prey) animal food at such a structurally more complex habitat. Besides, the occurrence of such hemaedaphic predatory species as *P. amentata*, *Anechurus* sp., *Archelithobius* sp., *Forficula* sp., *H. goansis*, *Pholcus* sp., *Salticus* sp., *Sparassus* sp., *X. cristatus*, *Arctosa* sp., *Scolopendra morsitans*, and *scutigera* sp. towards the microhabitats of S-1, S-2 and S-3 were probably also suggestive of this same nature of these interfered sites. Further, of the araneid fauna *P. amentata* appeared to show higher relative density towards these sub-habitats of S-1, S-2 and S-3.

Population of *Aphodius* sp. existed in its highest density of 20% at at the nival zone meadow microhabitat S-N. *Cicindella* sp. (Coleoptera-predator), ?*Limax* sp. (Mollusca), and *Eutyphoeus* sp. (Oligochaeta) appeared to constitute a community of exclusives at the same high altitude nival zone site S-N. During autumn also Lasius sp. was found to exist as an opportunist population at all the five temperate sites with highest relative density at sub-habitat S-3 and was altogether absent from the site S-N. Decline in number of species from summer to autumn at post - fire site could be attributable to the post fire protection and change in the nature and height (microclimate) of vegetation. At the control or least interfered site S-5 also the number of species encountered was generally lower. Increase in the relative density of *P. amentata* on the cut grassland site (S-4) and least interfered site (S-5) might be due to recruitment of newly produced summer individuals and also because of decrease in the number of other species, perhaps a general phenomenon related to their annual succession.

Winter activity of hemiedaphic invertebrates, particularly of araneids has been documented by many authors like Holmquist (1926), Bertram (1935), Chapman (1954), Mani (1962), Breymer (1966), Huhta (1971), Hagvar (1973) and Aitchison (1978, 79). At all temperate microclimatic sites *P. amentata* population was found to exist as an opportunist or ubiquitous population even during winter. Sites S-4 and S-5 went to the extent of providing shelter to araneid fauna only with its macroinvertebrate hemiedaphon of *H. goansis* and *p. amentata* at the highest located and least interfered of temperate sites. Besides *p. amentata* , the cut grassland site (S-4) was observed to harbor an araneid community of *X. cristatus*, *Lycosa* sp. and *P. mirabilis*, while the extremely grazed and degraded site (S-1) was inhabited by *H. goansis*, *P. mirabilis* and *Salticus* sp.

The dung inhabiting Aphodius sp. was seen to be surviving at both the subhabitats of S-1 and S-2. While Holmquist (1926) and Renken (1956) have recorded winter mobility of hymenopterans (Formicidae), *Lasius* sp was noticed as winter active at the sites like S-1, S-2 and S-3 on open patches of ground surrounded by snow.

Various kinds of agricultural practices are known to affect earthworm populations directly and indirectly and often a particular practice has more than one effect. The practices either affect them by way of their food supply or through variations in physico-chemical nature of soil and often it becomes very difficult to pin point the exact factor responsible for

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increase or decrease in the populations of these geophages. With the favorable background of macroclimate (weather, soil, climate) food is regarded as the most important limiting factor for an earthworm population (Lofs-Holmin, 1983 and Edwards and Lofty, 1975 a, b). From the simple data related to Annelida (Megadrilli) and recorded inTable 2., *Allolobophora* sp. was noticed only at the extremely grazed and degraded site (S-1) in spring which was in receipt of much of urine and dung from sheep and cattle. Lofs-Holmin (1979), in his pot method for field experiments with earthworms, also recorded significantly high number of adult worms of *Allolobophora calliginosa* and *A. chlorotica* in pots buried in the plots pre-treated with farm yard manure (FYM) than in pots treated in various other ways. *Lumbricus terrestris* was noticed at sites S-1 and S-3 in first spring; at S-2 in first summer and at S-1 in second spring and summer.

Eutyphoeus sp. , *Cicindella* sp. and ?*Limax* sp. was seen to constitute a community of exclusives at the nival/alpine zone meadow site (S-N). Although ?*Limax* sp. was completely wanting from the temperate grasslands yet in our field trips from visual sightings it was found to be a cosmopolitan hemiedaphic population on the forest floor and thus exhibited an alpine -temperate or nival-temperate distribution. Throughout the study period also *Arctosa* sp. was found to occur at the grazed and subsequently protected site S-2 with both maximum and minimum density during second spring and autumn of the study period.

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