Epigeal Macroinvertebrate diversity in different microhabitats of the Sonamarg hill resort (Kashmir, India)
Syed Sana Mehraj, Bhat. G.A
Department of Environmental Science, University of Kashmir, Srinagar 190006, j & k, India
balkhisana@gmail.com
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ABSTRACT

Present study was an attempt to assess and evaluate the distribution, diversity and occurrence of epigeal invertebrate fauna in the different microhabitats of Sonamarg (34.33°N 75.33°E), Kashmir, India. Six different sites were selected for the study named as site 1, site 2, site 3, site 4, site 5 and site 6. Standard protocol was used to collect epigeal invertebrate fauna and total of 34 species belonging to 11 different orders were reported during the study. The maximum diversity pertained to order Coleoptera (10 species) followed by Araneida (5 species) and Hymenoptera (5 species), Hemiptera (3 species), Dermaptera, Diptera, Oligochaeta and Scolopendromorpha (2 species each), Dictyoptera, Juliformia and Orthoptera (1 species each). The evaluation of various relative parameters such as density, relative density, frequency, relative frequency, abundance, relative abundance and importance value index were also calculated. From the study it was concluded that the maximum abundance and diversity pertains to the habitat rich in organic matter followed by the forest area. The epigeal fauna exhibited fairly good degree of variation at different sites.

Keywords: Diversity – Species – Invertebrate – Habitat - Geographical.

1. Introduction

Faunal diversity is a subset of biodiversity which specifically refers to the variety and variability among the animal community. Epigeal, epigean, epigeic and epigeous are biological terms describing an organisms activity above the soil surface, invertebrate fauna is an important component of faunal diversity. India occupies 2% of global space and harbors 7% of global faunal diversity (Gupta, 1978). The valley of Kashmir offers an ideal environment due to its unique geographical position and temperate climate. Jammu and Kashmir State is situated in the subtropical north temperate region of Asia in the north western Himalayas between 32.17°-36.58° north latitude and 73.26°-80.50° east longitude. If Srinagar to Leh is the heading point to Kashmir then Sonamarg is the last stoppage point of Kashmir valley before the Zoji-La pass into Ladakh. Sonamarg is a place where “Meadows” reflect in golden color which holds our eyes and heart for a while. Sonamarg is situated at an altitude of 2740 m above sea level in the state of Jammu and Kashmir. Six different sites were selected for the study of epigeal invertebrate fauna of Sonamarg area. These six sites were named as Site 1 (Coniferous Forest), Site 2 (Intermediate site between Coniferous forest and Meadow land), Site 3 (Meadow land), Site 4 (Sindh Riparian Corridor), Site 5 (Baltal Riparian Zone), and Site 6 (Riparian Zone of Thajwas Stream). Study sites were selected to represent a variety/range of habitat types related to altitude and anthropogenic activities. The samples were collected randomly from an area of 100m square at each site.

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1.1 Study Sites

Site 1 (Coniferous Forest)

Topographically the site is very steep (70° slope). It was difficult to track this area. Few grasses and herbs with dense Pinus, Abies and Deodar trees occupy this area. The soil surface remains densely covered with Pinus needles. One is able to view a large area of Sonamarg and river Sind from this vantage point. It lies at geographical co-ordinates of 34° 17’ 58.53”N 75° 17’ 27.15”E. The mean average soil and air temperature was 10.6° C and 13.1° C respectively. It lies at an altitude of 2,759 m (9,055 ft) above sea level. The site was inhabited by a fairly good number of Beetles and Spiders.

Site 2 (Intermediate site between Coniferous forest and Meadow land)

Few shrubs and grasses occupied this area. From top it is covered by dense forests sub alpine forests. The area is occupied by some hotels and army bunkers. It lies at geographical co-ordinate of 34° 18’ 02.85”N 75° 17’ 30.99”E. The mean average soil and air temperature was recorded as 8.7° C and 10.3° C respectively. It lies at an altitude of 2,689 m (8,823 ft) above sea level.

Site 3 (Meadow land)

The site does not contain any vegetation but a few patches of grasses, which shows previously vegetation was present; the degradation is as a result of tress- passing and other anthropogenic activities. The area is covered with small and large boulders. On right side of study site there lies a transport yard and tourist reception bungalow and on left are some hotels etc. It lies at geographical co-ordinate of 34° 18’ 05.39’’N 75° 17’ 35.39’’E. The average mean soil and air temperature was recorded as 8.7° C and 11.1° C respectively. It lies at an altitude of 2,676 m (8,780 ft) above sea level.

Site 4 (Sindh Riparian Corridor)

The site lies close to the Main market of Sonamarg near Mark 135 on the bank of the river Sind, The area was found to be dominated by small grasses. It lies at the geographical co-ordinate of 34° 18’ 14.30”N 75° 17’ 33.26”E. The average mean soil and air temperature was recorded as 14° C and 16° C during study period respectively. It lies at an altitude of 2,660 m (8,728 ft) above sea level.

Site 5 (Baltal Riparian Zone)

The site, representing an area abandoned by the river or forming a wide bank of the river, possessed a ground cover of dwarf herbs and grasses with some scattered shrubs. Baltal is 15 kms away from the main Sonamarg market, because of interference of yatris the area is apparently adversely affected in its floral and faunal diversity and at the site on one side river Sind flows and on another side there are some constructions in the form of shops and rooms etc. On the site a variety of Spiders and Lizards were seen moving here and there. It lies at geographical co-ordinate of 34° 17’ 22.71”N 75° 19’ 31.36”E. The mean average soil
and air temperature were determined as 6°C and 7°C respectively. It lies at an altitude of 2,718.6m (8,919.3 ft) above sea level.

**Site 6 (Riparian Zone of Thajwas Stream)**

The area is surrounded by lush green forest from one side and Thajwas glacier on the other side. Sind river meanders through the area and cold breeze always remain dominant in the area. It is 3 kms away from main Sonamarg market. The study site remains covered by lush green grasses and dominates in ants. It lies at geographical co-ordinate of 34° 18′ 13.13″N 75° 17′ 24.22″E. The average mean temperature of soil and air was 16°C and 14.1°C respectively. It lies at an altitude of 2,654.1m (8,708 ft) above sea level.

![Figure 1: Satellite images of study sites](image)

**2. Material and methods**

The study area was surveyed and samples were collected. All the samples were collected for 7 minutes per quadrat at each site i.e. 28 minutes at each site by following the standard methodology:

For the collection of epigeal invertebrate fauna a quadrant of 25 x 25 cm was delineated at each site and epigeal invertebrate organisms were handpicked by using forceps and a soft brush. The exercise at each site was conducted using four different quadrants of the same size after spending an interval of 28 minutes, (7 x 4) at each study site. It was made sure that no invertebrate escaped out, the collected invertebrate were killed by exposing them to Formaldehyde fumes in a killing bottle containing cotton balls at the bottom saturated with 40% formaldehyde and covered with filter paper, then these were preserved in plastic specimen tubes containing 80% ethyl alcohol solution. The specimens that required dry preservation were dry preserved. Than the invertebrates were identified by experts and using literature. Surface soil temperature (°C) at 10-15 cm depth of the surface was recorded by using a mercury thermometer. The mean atmospheric temperature was also recorded at 30 cm above ground surface with mercury thermometer under shade [7 and 10]. The evaluation of various relative parameters and indices in respect of invertebrate fauna was also performed as [13] Density (D), Relative density (RD), Frequency% (F), Relative frequency (RF), Abundance (A), Relative abundance (RA) and Importance value index (IVI).
1.2 Calculations

The evaluation of various relative parameters and indices in respect of invertebrate fauna was performed as follows:

1) Density (D) = \frac{\text{Number of individuals of a single species}}{\text{Number of Quadrant}} \times \text{Area of Quadrant}

2) Relative density (RD) = \frac{\text{Density value of single species}}{\text{Density value of all species}} \times 100

3) Frequency% (F) = \frac{\text{Number of quadrants in which species occur}}{\text{Total number of quadrants}} \times 100

4) Relative frequency (RF) = \frac{\text{Frequency value of single species}}{\text{Frequency value of all species}} \times 100

5) Abundance (A) = \frac{\text{Total number of individual species}}{\text{Number of quadrat in which species occur}} \times 100

6) Relative abundance (RA) = \frac{\text{Abundance of single species}}{\text{Abundance value of all species}} \times 100

7) Importance value index (IVI) = \text{Relative density} + \text{Relative frequency} + \text{Relative abundance}

3. Result and conclusion

The systematic screening for the total collection of the organisms revealed 34 species within 11 orders. The maximum diversity pertained to order Coleoptera (10), followed by Araneida (5) and Hymenoptera (5). The study reveals that *Xysticus* sp. were specifically restricted to Baltal site, *Tipula* sp. were restricted to Thajwas site, *Vespa* sp. was restricted to forest site, and *Pyrrhocoris* sp. were restricted to river site. Thus study has concluded that the area is diverse in epigeal invertebrate fauna, while detailed results are represented in the form of bar charts given below:

![Figure 2: Variations in density, frequency and abundance of epigeal invertebrate organisms at site 1.](image-url)
Epigeal Macroinvertebrate diversity in different microhabitats of the Sonamarg hill resort (Kashmir, India)

Figure 3: Variations in density, frequency and abundance of epigeal invertebrate organisms at site 2.

Figure 4: Variations in density, frequency and abundance of epigeal invertebrate organisms at site 3.

Figure 5: Variations in density, frequency and abundance of epigeal invertebrate organisms at site 4.
Epigeal Macroinvertebrate diversity in different microhabitats of the Sonamarg hill resort (Kashmir, India)

Figure 6: Variation in density, frequency and abundance of epigeal invertebrate organisms at site 5.

Figure 7: Variation in density, frequency and abundance of epigeal invertebrate organisms at site 6.

Photo gallery of identified epigeal species

Salticus sp.
Figure 8:

Arctosa sp.
Figure 9:

Xysticus crinitatus
Figure 10:

Pholcus sp.
Figure 11:

Pardosa sp.
Figure 12:

Anechura sp.
Figure 13:
Epigeal Macroinvertebrate diversity in different microhabitats of the Sonamarg hill resort (Kashmir, India)

Hind end of *Anechura* sp.  
Figure 14:

*Forficula* sp.  
Figure 15:

Hind end of *Forficula* sp.  
Figure 16:

*Blatta orientalis*  
Figure 17:

*Carabus nemoralis*  
Figure 18:

*Atheta* sp.  
Figure 19:

*Calosoma orientalis*  
Figure 20:

*Bembidion* sp.  
Figure 21:

Hind end of *Bembidion*sp  
Figure 22:

*Cicindella* sp.  
Figure 23:

Unidentified beetle larva  
Figure 24:

*Galeruca tanaceti*  
Figure 25:

*Hylobius abietus*  
Figure 26

*Harpalus* sp.  
Figure 27

*Meleo* sp.  
Figure 28
Epigeal Macroinvertebrate diversity in different microhabitats of the Sonamarg hill resort (Kashmir, India)

Lumbricus sp
Figure 29

Eutypheus sp.
Figure 30

Scolopendra sp.
Figure 31

Lamycetes sp
Figure 32

Julus sp.
Figure 33

Pyrrophocsis sp.
Figure 34

Rhinocoris sp.
Figure 35

Anthocoris nemorum
Figure 36

Lasius flavus
Figure 37

Lasius niger
Figure 38

Myrimica rubra
Figure 39

Formica rufa
Figure 40

Leva sp.
Figure 41

Vespa vulgaris
Figure 42

Tipula oteracea
Figure 43
Source: Photographs has been taken by author herself.

The Epigeal invertebrate fauna collected from Sonamarg area along six study sites belonged to 11 orders including: Araneida, Coleoptera, Dermoptera, Diptera, Dictyoptera, Juliformia, Hemiptera, Hymenoptera, Orthoptera, Oligochaeta and Scolopendramorpha.

Although the general pattern of invertebrate fauna seemed to change with the change in habitat (Pearee, 2004) and that too with temperature. As maximum population of insects is found at 25°C (Beeson, 1994). Temperature is considered as most important factor responsible for their reproduction, growth and development as invertebrates are pikilothermic they slightly change their body temperature with external variable of temperature. Slight variation in temperature declines insect population (Evans, 1994). Temperature and moisture are two important soil conditions which affects invertebrate fauna the most (Ali, 2012). Numerically the epigeal fauna doubled between April and November with highest in August and September (Lussenhop, 1973). Vegetation cover remarkably affects micro arthropod population density (Riana, 1979; Singh, 1970; Sutton, 1989). As the study sites varied in altitude, though not significantly, there was a difference in the species composition and thus community organization in the terrestrial insect fauna along the elevation gradients of even few meters (Riana, 1979). Among all the six sites the highest diversity was found at site 5 (Baltal riparian zone). It might be because the site was covered with cattle dung when compared to other study sites. Site 1 (Coniferous forest area) also exhibited a fairly good diversity of Epigeal invertebrate fauna as maximum diversity of epigeal invertebrates should be in forest (Ali, 2012; Riana, 1979). Presence of excessive number of cattle, sheep, horses, buffalo and goat at site 5, add organic matter in the form of dung, urine and animal carcasses which invite many epigeals at sites subject to such activities. At site 1, normally there should not have been grazers and browsers which were found beyond the carrying capacity of the area which added to the presence of epigeal fauna (Adela, 2004). Total of 34 species comprising 11 orders were recorded from Sonamarg during the study period. A good variation in epigeal fauna was seen in different habitats. The variations, according to the observations made were due to the cumulative effects of various factors such as; Increase in temperature, Deforestation of the area, Overgrazing of area, anthropogenic stresses as the study area is a famous tourist destination.

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References


