Global Journal of Science Frontier Research
Environment & Earth Sciences
Volume 12 Issue 3 Version 1.0 Year 2012
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Microdistribution and Spatial Variation of Macroinvertabrate Populations in Sonamarg, Kashmir

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Abstract - Present investigation attempted to explore the occurrence, distribution and diversity of epigeal invertebrate fauna in the different micro-habitats of the Sonamarg (34°.40' 31"7 N latitude 74°71'29"E longitude) Kashmir. A checklist of epigeal invertebrate fauna was prepared and determines the effect of various micro habitats determined. Six sites were selected in the study area. A total of 34 species belonging to 11 different orders were reported. The maximum number of species belonged to order Coleoptera (10 species) followed by Araneida (5 species) and Hymenoptera (5 species), Hemiptera (3 species), Dermoptera, Diptera, Oligochaeta and Scolopendramorpha (2 species each), Dictyoptera, Juliformia and Orthoptera (1 specie each). Various relative parameters such as, density, relative-density, frequency, relative frequency, abundance, relative abundance and importance value index were computed. It was concluded that the maximum abundance and diversity pertained to the habitat rich in organic matter followed by the forest area. The epigeal fauna exhibited fairly good degree of variation both site as well as month wise.

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GJSFR-H Classification : *FOR Code: 270203, 060411p*

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Microdistribution and Spatial Variation of Macroinvertabrate Populations in Sonamarg, Kashmir

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Abstract - **Present investigation attempted to explore the occurrence, distribution and diversity of epigeal invertebrate fauna in the different micro-habitats of the Sonamarg (34°.40' 31"7 N latitude 74°71'29"E longitude) Kashmir. A checklist of epigeal invertebrate fauna was prepared and determines the effect of various micro habitats determined. Six sites were selected in the study area. A total of 34 species belonging to 11 different orders were reported. The maximum number of species belonged to order Coleoptera (10 species) followed by Araneida (5 species) and Hymenoptera (5 species), Hemiptera (3 species), Dermoptera, Diptera, Oligochaeta and Scolopendramorpha (2 species each), Dictyoptera, Juliformia and Orthoptera (1 specie each). Various relative parameters such as, density, relative-density, frequency, relative frequency, abundance, relative abundance and importance value index were computed. It was concluded that the maximum abundance and diversity pertained to the habitat rich in organic matter followed by the forest area. The epigeal fauna exhibited fairly good degree of variation both site as well as month wise.**

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I. Introduction

The valley of Kashmir offers an ideal environment due to its unique geographical position and 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. It has total area of 5350 square kms, lies at an average elevation of 1590 meters above sea level. The valley is surrounded by a chain of high mountains. On this account it is zoo geographically cut off from Jammu in South and Ladakh in North, which are two other administrative provinces of Jammu and Kashmir. The valley is known for its varied ecosystems of forests, rivers and lakes and is thus blessed with huge biodiversity reserves. Epigeal invertebrates are one of the important components of biodiversity. Epigeal invertebrates constitute an important group of soil fauna as they play vital role in (1) regulating the decomposition of organic matter, (2) aerating soils, (3) recycling nutrients, and (4) serving as prey or acting as predators, parasites or parasitoids in food chains (Ghosh,1994).

In J & K, Sonamarg is considered as a resort of tourist importance and also base camp for Amarnath yatris. The present investigation was taken up as a case study to assess the abundance and diversity of epigeal fauna and impact of various factors on epigeal Macroinvertabrate fauna in the area.

II. Study Area

Sonamarg is the last stoppage point of Kashmir valley before the Zoji -La pass into Ladakh. It is situated at an altitude of 2740 m above sea level in the state of Jammu and Kashmir. Its distance from summer capital (Srinagar) is about 80 kms. It has lush green landscapes, through which meanders river Sindh.

Site 1 (Coniferous Forest)

Topographically the site is very steepy (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

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tress- passing and other anthropogenic activities. The area is covered with small and large boulders. On right side of study site there lays 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 mean average 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 lash 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 lash 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.

III. Material and Methods

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 anaesthetized 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. Then the invertebrates were got identified by experts and using literature (Jain and Bhargava 2007, Prakash 2008).

The evaluation of various relative parameters and indices in respect of invertebrate fauna was performed as follows (Smith, 1998):

1) Density (D) $= \frac{\text{Number of individuals of a single Specie}}{\text{Number of Quadrant}} x \text{ Area of Quadrant}$

2) Relative density (RD) $= \frac{\text{Density value of single specie}}{\text{Density value of all species}} x100$

3) Frequency% (F) $= \frac{\text{Number of quadrants in which species occur}}{\text{Total number of quadrants}} x100$

4) Relative frequency (RF) $= \frac{\text{Frequency value of single species}}{\text{Frequency value of all species}} x100$

5) Abundance (A) $= \frac{\text{Total number of individual species}}{\text{Number of quadrat in which species occur}} x100$

6) Relative abundance (RA) $= \frac{\text{Abundance of single species}}{\text{Abundance value of all species}} x100$

7) Importance value index (IVI) $=$ Relative density $+$ Relative frequency $+$ Relative abundance

IV. Results and Discussion

Epigeal invertebrate fauna of the study area was found to be represented by 11 Orders namely: Araneida, Coleoptera, Dermoptera, Dictyoptera, Diptera, Hemiptera, Hymenoptera, Juliformia, Oligochaeta, Orthoptera and Scolopendramorpha.

The systematic screening for the total collection of the organisms revealed 34 species within 11 orders. The maximum diversity pertained to order Coleoptera (11), followed by Araneida (5) and Hymenoptera (5). Among all the species only *Lasius niger* was found at all the six sites. The highest diversity of epigeal invertebrates fauna was found at Coniferous Forest site (1) followed by Site 4 (Sindh Riparian Corridor) in the month of August during first sampling and in the month of September the highest epigeal invertebrate fauna was collected from Site 5 (Baltal Riparian Zone) followed by forest site and Riparian Zone of Thajwas Stream (1and 6).While during the third sampling in the month of October the maximum diversity was found at the site (1 and 5) followed by site (6) .While as during last and fourth sampling each site was fully covered with snow, about ½,1 and 2 inch snow was recorded at site(3), (2) and (1) respectively while as road to site (6)Thajwas and site (5) Baltal was totally blocked, only one specie was found at site(4) i,e river site.

Xysticus critatus were specifically restricted to Baltal site, *Tipula* sp. were restricted to Thajwas site, *Vespa* sp. was restricted to forest site and *Pyrrhocoriss* sp. were restricted to river site. Thus study has concluded that the area is diverse in epigeal invertebrate fauna.

a) Relative density

For the month of July during first sampling the highest relative density was calculated for *Lasius niger* (59.70) while the lowest relative density of 2.56 was for *Lamycetes sp.*, as *Lasius niger* are colonial insects they were found in abundance, it may also be attributed to availability of food. For the month of September the highest relative density value of 60.46 was obtained for *Lasius niger* and 0.55 for *Calosoma orientalis*. During third sampling in the month of October, the highest value was recorded for *Harpalus* (53.84) and lowest of 1. 49 for the araneid *Xysticus critatus*.

During last and fourth sampling in the month of December the entire study area of Sonamarg was covered with snow .Only one specie was found at site 4 (Sindh Riparian Corridor) i,e *Phyrrhocoris sp.*

b) Relative frequency

As far as relative frequency values are concerned for the month of July during first sampling the highest relative frequency value was calculated for *Lasius niger* and *Formica rufa* (23.52) and lowest of 4.34 for *Formica rufa, Pholcus* sp., *Arctosa* sp., *Scolopendra* sp., *Hylobius* sp. and *Galeruca tanaceti*. For the month of September the highest relative frequency was recorded for *Lasius niger, Formica rufa* and *Pholcus* (26.66) and lowest of 4 for *Leva* sp..During third sampling the highest value was calculated for *Harpalus* sp.(40) and lowest of 3.57 for *Xysticus critatus* and *Leva* sp. During last and fourth sampling in the month of December each site was covered with snow .Only one specie was found at site 4 (Sindh Riparian Corridor) i,e *Phyrrhocoris sp.*

c) Relative abundance

Relative abundance values are also calculated and the highest relative abundance value was calculated for *Lasius niger*(35.52) and lowest for *Leva* sp. and *Bembidion*(2.32) for the month of July. For the month of September the highest relative abundance was calculated for *Lasius niger*(53.45) and lowest of 4.413 for *Lumbricus* sp..For the month of October during third sampling the highest relative abundance value was calculated for *Harpalus* (30.43) and lowest for *Lumbricus* (0.14).During last sampling only one species was found.

d) Importance value index

Importance value index is considered as an important ecological parameter. The highest IVI value for the month of July is calculated for *Lasius niger* (101.044) and lowest of 11.2 for *Leva* sp..For the month of September the highest IVI value calculated for *Lasius niger* (140.5) and lowest for *Leva* sp. (10.895), during third sampling in the month of October the highest IVI value was calculated for *Harpalus* sp.(124.27) and lowest for *Xysticus critatus* and *Leva* sp. of 10.1.

A total of 34 species comprising 11 orders (Araneida, Coleoptera, Dermoptera, Diptera, Dictyoptera, Juliformia, Hemiptera, Hymenoptera, Orthoptera, Oligochaeta and Scolopendramorpha) were recorded from Sonamarg during the study period , i.e.: from July – December 2009. The maximum diversity pertained to order Coleoptera (10), followed by Araneida (5) and Hymenoptera (5) .Among all the species only *Lasius niger* was found at all the six sites. The highest diversity of epigeal invertebrates fauna was found at Coniferous Forest site followed by site 4 i.e Sindh Riparian Corridor in the month of August during first sampling and in the month of September the highest epigeal invertebrate fauna was collected from site (5) followed by site (1 and 6).While during the third sampling in the month of October the maximum diversity was found at the site (1 and 5) followed by site (6) .While as during last and fourth sampling each site was fully covered with snow, about ½,1 and 2 inch snow was recorded at site(3),(2) and (1) respectively while as road to site (6)Thajwas and site (5) Baltal was totally blocked, only one specie was found at site(4) i.e.; river site. The study also 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 *Pyrrhocoriss sp.* were restricted to river site. Thus study has concluded that the area is diverse in epigeal invertebrate fauna.

The epigeal fauna exhibited variation of a fairly good degree both site wise as well as month wise. The variations, according to the observations made were due to the cumulative effects of various factors . Temperature and moisture are two important soil conditions which affects invertebrate fauna the most (Evans and Guild, 1994). According to Singh and Mukherji (1970) vegetation cover remarkably affects micro arthropod population density. pH of a soil also effects invertebrate fauna. Seasonal variations are also responsible for diversity of fauna Sheals (1957).

As the study sites varied in altitude, though not significantly, there was a difference in the species composition and thus community organization (Sutton, 1989; Casson & Hodkinson, 1991; Campton et al., 2000). 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 (Raina, 1979).

Presence of excessive number of cattle, sheep, horses, buffalo and goat in the area of Sonamarg add organic matter in the form of dung, urine and animal carcasses which invite many epigeals at sites subject to such activities. Normally there should not have been grazers and browzers beyond the carrying capacity of the area.

Occurrence of fairly higher number of dipterans and their predators like araneids in the area and at various sites also indicates occurrence of more than the tolerable number of live stock in the area. Although the general pattern of invertebrate fauna seemed to change with the change in temperature. As maximum population of insects is at 25° C (Gupta and Mukherji, 1978).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 (Gupta and Mukherji, 1978). As the maximum abundance was found in the month of September, it may be attributed to the temperature, as at range of 18 -29 °C there is rise in population and above 29 °C population abruptly declines (Gupta and Mukherji, 1978).While as maximum diversity of the species was found in the month of July. Temperature and moisture are two important soil conditions which affects invertebrate fauna the most (Evans and Guild, 1994). Numerically the epigeal fauna doubled between April and November with highest in August and September (Lussehop, 1973). According to Singh and Mukherji (1970) vegetation cover remarkably affects micro arthropod population density.

There are other factors responsible for change in abundance of epigeal invertebrate fauna during different months and at different sites in the same month such as moisture, (Stevens, 2004), pH of a soil also plays an important role in the population density of Epigeal fauna (Fischet and Fuhrer, 2004) and pollution concentration (Tak and Bhat , 2009).

V. Conclusions

A total of 34 species comprising 11 orders were recorded from Sonamarg during the study period , i.e.; from July – December 2009. The epigeal fauna exhibited variation of a fairly good degree both site wise as well as month wise. The variations, according to the observations made were due to the cumulative effects of various factors such as ; Increase in temperature, in the month of September the number of individuals was recorded as highest while as in the month of July the diversity of species was highest. The , Deforestation of the area, Overgrazing of area, anthropogenic stresses particularly in the months of July as the study area is a famous tourist destination besides being the main station and base camp for the pilgrims of Amarnath Yatris , Construction in the form of makeshift shops and other structures made on both temporary and permanent basis in the area also make a significant contribution to the variations in the environmental variables which may be responsible for erratic and not normal population features of the epigeal fauna.

Presence of excessive number of cattle, sheep, horses, buffalo and goat in the area of Sonamarg add organic matter in the form of dung, urine and animal carcasses which invite many epigeals at sites subject to such activities. Normally there should not have been grazers and browzers beyond the carrying capacity of the area.

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VI. Acknowledgement

The authors are highly thankful to Head, P. G. Department of Environmental Science, University of Kashmir, Srinagar for providing the laboratory facilities for the work undertaken.

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