Diversity and richness of butterflies from government madhav science college campus, Ujjain, Madhya Pradesh, India

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Abstract
A total of 131 butterflies with 22 species belonging to five families were recorded during the period from 2014 and 2015 from Government Madhav Science College campus Ujjain. The maximum number of species were belong to family Nymphalidae with 10 species (Junonia lemonias, Junonia orithya, Junonia almana, Danaus chrysippus, Danaus genutia, Euploea core, Tirumala limniace, Melanitis leda, Ariadne merione, Phalantha phalantha) followed by Pieridae with 5 species (Belenois aurota, Eurema hecabe, Catopsilia pyranthe, Ixias marianne, Cepora nerissa), Lycaenidae with 4 species (Chilades parrhassius, Tarucus nara, Zizina otis, Arthopala bazalus), Papilionidae with 2 species (Papilio demoleus, Graphium agamemnon) and Hesperiidae with only one species (Hasora chromus).

Keywords: butterflies, diversity, Ujjain

Introduction
More than half of the world’s known animal are insects and the Lepidoptera are regarded as one of the important component of biodiversity [7] and are the second order among insects made up of approximately 1,50,000 species so far known to the literature. Approximately, 17200 species of butterfly found throughout the world, of which 1,501 species of butterfly are known from India [5]. Butterflies are lovely and graceful in sects provide economic and ecological benefits to the human society [2]. Butterflies play an immense role in pollination, brings variations through kinds of pollen dispersion from one place to another place [6]. Although India has a rich butterfly fauna, but due to various reasons such as habitat destruction, fire, use of pesticides and weedicides and illegal collection for trade, many species have become very and some are on the verge of extinction. Butterflies are potentially useful ecological indicator of urbanization because sensitive to changes in microclimate, temperature [9]. Increase urbanization one of the main cause of decrease in butterfly species richness, diversity and abundance [1, 3, 8].

Material and Methods
The present study was carried out for a period of two year from 2014 to 2015. The observations were made with digital camera (Nikon 7000). The sites were visited in morning hours to note maximum possible of butterflies and record its activities. The recorded species are identifies with the help of photographs by using standard books [10, 5] and [4]. The present work provided the update comprehensive checklist of butterflies in the study area with their abundance and diversity.

Statistical analysis
The following diversity indexes were used:

\[ H = \sum \frac{p_i}{n} \ln \left( \frac{p_i}{n} \right) \]

The Shannon index is an information statistic index, which means it assumes all species are represented in a sample and that they are randomly sampled. In the Shannon index, \( P \) is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), \( \ln \) is the natural log, \( \Sigma \) is the sum of the calculations, and \( s \) is the number of species.
Simpson index

\[ D = 1/\sum (P_i^2) \]

The Simpson index is a dominance index because it gives more weight to common or dominant species. In this case, a few rare species with only a few representatives will not affect the diversity. In the Simpson index, \( P_i \) is the proportion \((n/N)\) of individuals of one particular species found \((n)\) divided by the total number of individuals found \((N)\), \( \Sigma \) is still the sum of the calculations, and \( s \) is the number of species.

Measurement of species richness
Margalef’s index was used as a simple measure of species richness.

\[ M = \frac{(S - 1)}{\ln(N)} \]

\( S \) = total number of species
\( N \) = total number of individuals in the sample
\( \ln \) = natural logarithm

Measurement of evenness
For calculating the evenness of species, the Pielou’s Evenness index \((J)\) was used.

\[ J = \frac{H}{\ln(S)} \]

\( H \) = Shannon- Wiener diversity index
\( S \) = total number of species in the sample

### Table 1: Taxonomic composition and number of individuals of butterflies recorded from Govt. Madhav Science College Ujjain.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Family</th>
<th>Binomial name</th>
<th>No. of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nymphalidae</td>
<td>Junonia lemonias</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Nymphalidae</td>
<td>Junonia orithya</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Nymphalidae</td>
<td>Junonia almana</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Nymphalidae</td>
<td>Danaus chrysaugus</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Nymphalidae</td>
<td>Danaus genutia</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Nymphalidae</td>
<td>Euploea core</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Nymphalidae</td>
<td>Tirumala limnaiac</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Nymphalidae</td>
<td>Melanitis leda</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Nymphalidae</td>
<td>Ariadne merione</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Nymphalidae</td>
<td>Phalantha phalantha</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Pieridae</td>
<td>Belenois aurota</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>Pieridae</td>
<td>Eurema hecabe</td>
<td>65</td>
</tr>
<tr>
<td>13</td>
<td>Pieridae</td>
<td>Catopsilia pyranthe</td>
<td>19</td>
</tr>
<tr>
<td>14</td>
<td>Pieridae</td>
<td>Isias marriane</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Pieridae</td>
<td>Cepora nerissa</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Papilionidae</td>
<td>Papilio demoleus</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Papilionidae</td>
<td>Graphium agamemnon</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>Lycaenidae</td>
<td>Chilades parrhassius</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>Lycaenidae</td>
<td>Tarucus nara</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>Lycaenidae</td>
<td>Zicina otis</td>
<td>2</td>
</tr>
<tr>
<td>21</td>
<td>Lycaenidae</td>
<td>Arthropala bazalus</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>Heperidae</td>
<td>Hasora chromus</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 2: Calculation of Diversity in Government Madhav Science College Campus

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of individuals (n)</th>
<th>n/N</th>
<th>Pi</th>
<th>Pi^2</th>
<th>In pi</th>
<th>pi Inpi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon pansy</td>
<td>3</td>
<td>3/131</td>
<td>0.022</td>
<td>0.00048</td>
<td>-3.816</td>
<td>-0.083</td>
</tr>
<tr>
<td>Blue pansy</td>
<td>4</td>
<td>4/131</td>
<td>0.030</td>
<td>0.0009</td>
<td>-3.506</td>
<td>-0.105</td>
</tr>
<tr>
<td>Peacock pansy</td>
<td>2</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
<tr>
<td>Plain tiger</td>
<td>3</td>
<td>3/131</td>
<td>0.022</td>
<td>0.00048</td>
<td>-3.816</td>
<td>-0.083</td>
</tr>
<tr>
<td>Striped tiger</td>
<td>4</td>
<td>4/131</td>
<td>0.030</td>
<td>0.0009</td>
<td>-3.506</td>
<td>-0.105</td>
</tr>
<tr>
<td>Common crow</td>
<td>6</td>
<td>6/131</td>
<td>0.045</td>
<td>0.00202</td>
<td>-3.101</td>
<td>-0.139</td>
</tr>
<tr>
<td>Blue tiger</td>
<td>4</td>
<td>4/131</td>
<td>0.030</td>
<td>0.0009</td>
<td>-3.506</td>
<td>-0.105</td>
</tr>
<tr>
<td>Common evening brown</td>
<td>2</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
<tr>
<td>Common castor</td>
<td>2</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
<tr>
<td>Common leopard</td>
<td>2</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
<tr>
<td>Indian pioneer</td>
<td>2</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
<tr>
<td>Common grass yellow</td>
<td>65</td>
<td>65/131</td>
<td>0.496</td>
<td>0.24601</td>
<td>-0.701</td>
<td>-0.347</td>
</tr>
<tr>
<td>Mottled emigrant</td>
<td>19</td>
<td>19/131</td>
<td>0.145</td>
<td>0.02102</td>
<td>-1.931</td>
<td>-0.279</td>
</tr>
<tr>
<td>White orange tip</td>
<td>1</td>
<td>1/131</td>
<td>0.007</td>
<td>0.00004</td>
<td>-4.961</td>
<td>-0.034</td>
</tr>
<tr>
<td>Common gull</td>
<td>1</td>
<td>1/131</td>
<td>0.007</td>
<td>0.00004</td>
<td>-4.961</td>
<td>-0.034</td>
</tr>
<tr>
<td>Lime butterfly</td>
<td>1</td>
<td>1/131</td>
<td>0.007</td>
<td>0.00004</td>
<td>-4.961</td>
<td>-0.034</td>
</tr>
<tr>
<td>Tailed jay</td>
<td>1</td>
<td>1/131</td>
<td>0.007</td>
<td>0.00004</td>
<td>-4.961</td>
<td>-0.034</td>
</tr>
<tr>
<td>Small cupid</td>
<td>1</td>
<td>1/131</td>
<td>0.007</td>
<td>0.00004</td>
<td>-4.961</td>
<td>-0.034</td>
</tr>
<tr>
<td>Striped pierrot</td>
<td>3</td>
<td>3/131</td>
<td>0.022</td>
<td>0.00048</td>
<td>-3.816</td>
<td>-0.083</td>
</tr>
<tr>
<td>Lesser grass blue</td>
<td>2</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
<tr>
<td>Powdered oakblue</td>
<td>1</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
<tr>
<td>Common banded awl</td>
<td>2</td>
<td>2/131</td>
<td>0.015</td>
<td>0.00022</td>
<td>-4.199</td>
<td>-0.062</td>
</tr>
</tbody>
</table>

**Shannon index (H)**

\[
H = \left(-0.083+0.105+0.062+0.083+0.105+0.139+0.105+0.062+0.062+0.062+0.062+0.062+0.062+0.062+0.062+0.062+0.062+0.062+0.062+0.062+0.062\right)
= 1.995
\]

**Simpson index (D)**

\[
D = \frac{1}{(0.00048+0.0009+0.00022+0.00048+0.0009+0.00202+0.0009+0.00022+0.00022+0.00022+0.00022+0.24601+0.0210+0.00004+0.00004+0.00004+0.00004+0.00004+0.00004+0.00004)}
= 1/0.27515 = 3.63
\]

**Measurement of species richness**

Margalef’s index = \((22-1)/\ln131 = 21/4.87\)
Margalef’s index = 4.312

**Measurement of evenness**

\[
J = \frac{1.995}{\ln22} = 0.645
\]

**Fig 1:** Photographs of butterflies recorded from Govt. Madhav Science College Ujjain

**Fig 2:** Photographs of butterflies recorded from Govt. Madhav Science College Ujjain

**Fig 3:** Photographs of butterflies recorded from Govt. Madhav Science College Ujjain
Conclusion
The present study concludes Family- Nymphalidae carries the maximum number of species than other families. This study would be useful to conserve wide range of indigenous butterfly species in an area.

Acknowledgement
The authors are grateful to Principal Dr. Usha Shrivastava and all staff of the department of Zoology, Govt. Madhav Science P.G. College Ujjain for their constant encouragement and for providing the necessary facilities.

References