Macrophysiological traits of tropical butterflies

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Colour variety

• Functions of colour:
  • Camouflage, the warning signal
    (Bond & Kamil, 2002; Ruxton et al., 2004)
  • Physiological mechanism
Thermal melanism hypothesis (TMH)

• Under low temperature condition, dark ectotherms are at an advantage (Gate, 1980)

(Zeuss et al., 2014)
2 Gloger’s rule

- Individuals in warm and humid areas are more heavily pigmented than in cool dry areas (Gloger, 1883)
- UV protection

(Bastide et al., 2014)
3. Melanism-desiccation hypothesis (MDH)

- Individual with darker body color have higher desiccation resistance (Kalmus, 1941)
- Same biochemical process between darkening and hardening

(Parkish et al., 2010)
1. **TMH**
   - Lightness vs. Temperature / Solar radiation

2. **UV protection**
   - Lightness vs. UV / Solar radiation

3. **MDH**
   - Lightness vs. Precipitation

<table>
<thead>
<tr>
<th>Species</th>
<th>Butterfly, Moth, Lizard</th>
<th>Drosophila</th>
<th>Drosophila</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td>Europe, China</td>
<td>Africa</td>
<td>Indian</td>
</tr>
<tr>
<td>Level</td>
<td>Assemblage</td>
<td>Intraspecies</td>
<td>Intraspecies</td>
</tr>
</tbody>
</table>
Gap

• Different environment condition

• Multiple factors work together

Temperature  Precipitation  Radiation

Ambient temperature
Correlations between lightness and environmental factors

Lightness index

Environment factors

Assemblage
Species
Assemblage level analysis

WorldClim version 2.0
- Radiation

Taiwan Climate data
- Temperature
- Precipitation

Assemblage lightness
Butterfly survey 1993-2014

1 x 1 km
Species level analysis

Logistic Additive Model

Temperature/ Solar Radiation/ Precipitation

Butterfly survey 1993-2014
## Model averaging - Assemblage level

<table>
<thead>
<tr>
<th>Environment factor</th>
<th>Model rank</th>
<th>Model average</th>
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<tbody>
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<td>2</td>
</tr>
<tr>
<td>Radiation</td>
<td>•</td>
<td>***</td>
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<tr>
<td>Temperature</td>
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<tr>
<td>Precipitation</td>
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<td>Precipitation X Radiation</td>
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<tr>
<td>R²</td>
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<td>0.057</td>
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N=384
## Model averaging – Species level

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<th>RVI</th>
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<td>Estimate</td>
<td>Adjusted SE</td>
<td>P-value</td>
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<tr>
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Discussion and Conclusion

• Solar radiation plays an important role in both assemblage and species models
  • UV protection
  • Higher heating and cooling rate
Acknowledgements