Climatic Risk Atlas of European Butterflies

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Climatic Risk Atlas of European Butterflies

Result of ALARM & MACIS EU-funded projects
Methods

• Use distribution maps of butterflies at 50x50km grid from Mapping European Butterflies project (Kudrna, 2001)

• Fit climate models to current distributions using 22 variables (temp, soil moisture, humidity etc)

• Use models to predict future ranges (climate space) under three scenarios:-
  • SEDG (B1): moderate change; 2.4°C by 2080
  • BAMBU (A2): intermediate change; 3.1°C by 2080
  • GRAS (A1FI): maximum change; 4.1°C by 2080

• Assume either no or full dispersal ability of the butterfly
Dusky Large Blue

*Maculinea nausithous*

Habitats Directive species

Threatened in Europe
2000

- Current and modelled distribution
SEDG 2080
Full = - 22 %
No = - 73 %

KEY
- Range maintained
- Range lost (if no dispersal)
- Range gained (if full dispersal)
BAMBU 2080
Full = - 47 %
No = - 86 %

KEY
- Range maintained
- Range lost (if no dispersal)
- Range gained (if full dispersal)
GRAS 2080
Full = - 64 %
No = - 96 %

KEY

- Orange: Range maintained
- Grey: Range lost (if no dispersal)
- Brown: Range gained (if full dispersal)
Northern Clouded Yellow

*Colias hecla*
GRAS 2080 - 98% (FULL or NO)
Orange-tip
Anthocaris cardimines
GRAS 2080
Full = - 37%
No = - 53%
Eastern Festoon
Zerynthia cerisyi
<table>
<thead>
<tr>
<th></th>
<th>Full dispersal</th>
<th>No dispersal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2050</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEDG</td>
<td>1685 (291.02%)</td>
<td>-11 (-1.9%)</td>
</tr>
<tr>
<td>BAMBHU</td>
<td>2079 (359.07%)</td>
<td>-10 (-1.73%)</td>
</tr>
<tr>
<td>GRAS</td>
<td>2080 (359.24%)</td>
<td>-23 (-3.97%)</td>
</tr>
<tr>
<td><strong>2080</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEDG</td>
<td>2970 (512.95%)</td>
<td>-35 (-6.04%)</td>
</tr>
<tr>
<td>BAMBHU</td>
<td>3022 (521.93%)</td>
<td>-73 (-12.61%)</td>
</tr>
<tr>
<td>GRAS</td>
<td>4073 (703.45%)</td>
<td>-71 (-12.26%)</td>
</tr>
</tbody>
</table>

Changes in climatic niche distribution
(in 10’x10’ grid cells; present niche space: 579 cells)
Results: No. Sp. at risk  
(assuming no dispersal by 2080)

<table>
<thead>
<tr>
<th>% sp. losing</th>
<th>SEDG</th>
<th>GRAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 95% range</td>
<td>3%</td>
<td>24%</td>
</tr>
<tr>
<td>&gt; 50% range</td>
<td>48%</td>
<td>78%</td>
</tr>
<tr>
<td>&lt; 50% range (low risk)</td>
<td>43%</td>
<td>6%</td>
</tr>
</tbody>
</table>

- Climate change poses a considerable additional risk to European butterflies.
- The risk varies considerably under the three scenarios.
Results: time lag effects
(assuming no dispersal)

<table>
<thead>
<tr>
<th>% sp. losing &gt; 50% range</th>
<th>SEDG</th>
<th>GRAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2050</td>
<td>28%</td>
<td>40%</td>
</tr>
<tr>
<td>2080</td>
<td>57%</td>
<td>96%</td>
</tr>
</tbody>
</table>

- There is considerable time lag to worst effects: assuming no dispersal
Results: time lag of increasing sp.
(assuming full dispersal)

<table>
<thead>
<tr>
<th>% sp. Increasing range</th>
<th>SEDG</th>
<th>GRAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2050</td>
<td>33%</td>
<td>23%</td>
</tr>
<tr>
<td>2080</td>
<td>30%</td>
<td>18%</td>
</tr>
</tbody>
</table>

- Until 2050 there may be better conditions for mobile warmth-loving species to disperse
- This effect reduces by 2080
Country analysis

Gras 2080 full dispersal

Change (%)
Caveats

- More factors impact future species distributions than “simply” climate alone
  - e.g. food-plant, habitat, land use, dispersal
- 293 of the c 450 European species were modelled.
- 149 species could not be modelled – too rare
- AUC used to assess goodness of fit of models
Conservation recommendations

Although some aspects of climate change may seem unstoppable, there are still some ways to mitigate some of the negative impacts.

1) Maintain large populations in diverse habitats

2) Encourage mobility across the landscape by restoring habitats

3) Reduce emissions of greenhouse gasses

4) Allow maximum time for species adaptation

5) Conduct further research on climate change and its impacts on biodiversity
Policy recommendations

We have the chance to mitigate some of the worst effects of climate change if we act now.

Specifically, we need:

• A big shift in the spending of Common Agricultural Policy (CAP) funds to help conserve biodiversity.

• More funding of schemes that deliver environmental outcomes (e.g. better agri-environment schemes; High Nature Value (HNV) farming).

• Full implementation of the EU Habitats and Species Directives.

• Creation of habitat networks that support biodiversity and help mitigate adverse effect of climate change.

• International action to reduce greenhouse gas emission significantly
To decline (further)

UK results

+ Others ??
UK results

Already arrived

To arrive soon?

100+ Others will gain climate space but probably will not cross channel
Main conclusions

- Climate change will have a profound and largely adverse impact on butterflies
- Many species are at risk of extinction unless they move
- Many species are not able to move, so face extinction or extreme threat
- We have some time if we act soon
- Our current conservation action at a landscape scale, and to create habitat mosaics, is a no risk policy for current and future scenarios

[Website URL]