Simple spatial distribution models for vector density in a field
Bloodsucking creatures from dusk to dawn

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Simple spatial distribution models for vector density in a field
Bloodsucking creatures from dusk to dawn

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Introduction

Bluetongue virus in Northern Europe

• Infects ruminants
• Vector-borne
• Females of:

  *Culicoides obsoletus* group

  *Culicoides pulicaris* group
Objectives

• Model vector dispersal → spread of virus

• First step: Where are the vectors?
  → (Spatial) factors for vector density?

• Spatial prediction model

• Linear Mixed Model

• Density measure: Light trap
Study design

- 50 light traps – 50 m grid
- Dist. to Breeding sites
- Temperature
- Wind speed
Study design

- Smell of host animals

- Windbreaks

- Interactions:
  
  Host animals * Windbreaks
  Wind speed * Windbreaks, Temperature^2

\[
\text{wind speed} \times \text{wind effect} = \frac{1}{1 + \text{dist. sheep}^2}
\]

\[
\text{wind effect} = \frac{1}{1 + \text{dist. windbreak}}
\]
# Dataset

Analysis of 8 days: 5180 female vectors

<table>
<thead>
<tr>
<th>Day</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. obsoletus</em></td>
<td>316</td>
<td>259</td>
<td>612</td>
<td>2</td>
<td>93</td>
<td>95</td>
<td>29</td>
<td>253</td>
<td>1659</td>
</tr>
<tr>
<td><em>C. pulicaris</em></td>
<td>1524</td>
<td>335</td>
<td>952</td>
<td>4</td>
<td>190</td>
<td>223</td>
<td>33</td>
<td>260</td>
<td>3521</td>
</tr>
</tbody>
</table>

![Graph showing data analysis](image)

- 40 vectors
- 0 vectors
Dataset

- Temperature: 12 – 20°C
- Wind speeds: 0.2 – 3.3 m/s

Procedures

- Normalize data
- Random effect → Mixed Effects Model
- Observations not independent...
Data analysis

Spatial correlation

- *All information on the surroundings for a trap is contained within the neighbors*

- \( X \perp Y \mid \text{Neighbors} \)

- \( \text{Corr}(X, \text{Neighbor}) = \rho \)
Final model

- *C. pulicaris estimates*

  Wind speed: -0.56  
  Windbreaks: 2.34  
  Wind speed : Windbreaks : -1.19

  (adjusted for spatial correlation)

- *Spatial correlation coefficient, $\rho = 0.26$***

  $N.S.$
Final model

- *C. obsoletus estimates*

  Wind speed: -0.59 
  
  (adjusted for spatial correlation)

- *Spatial correlation coefficient, $\rho = 0.33$***

  $N.S.$

  $N.S.$

  $N.S.$
Conclusions

- Temperature not significant
- Breeding sites not significant
- Host animals not significant
- Windbreaks significant for *C. pulicaris*
- Wind speed significant
What’s next?

• More covariates
  Precipitation?

• More days

• Broader scale
Thank you for your attention
Comments are welcome

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