Spatial models for the distribution of Culicoides on a local scale

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Spatial models for the distribution of *Culicoides* on a local scale

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Introduction

Bluetongue virus in Northern Europe

• Infects ruminants

• Vector-borne

  *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

• Density measure: Light trap
Study design

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

- Scent of host animals
  
  ![Scent of host animals](image)

- Windbreaks
  
  ![Windbreaks](image)

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

Wind effects:

- Full effect
- Half effect
- No effect
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>C. obsoletus</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>C. pulicaris</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>
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*

• $X \mid X Y \mid \text{Neighbors}$

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

- *C. pulicaris estimates*

\[
\begin{align*}
\text{Wind speed:} & \quad -0.56 \\
\text{Windbreaks:} & \quad 2.34 \\
\text{Wind speed : Windbreaks :} & \quad -1.19
\end{align*}
\]

(adjusted for spatial correlation)

- *Spatial correlation coefficient, } \rho = 0.26***
Final model

- *C. obsoletus estimates*

  Wind speed: -0.59

  (adjusted for spatial correlation)

- *Spatial correlation coefficient, ρ = 0.33***

  N.S.
Conclusions

• Temperature not significant

• Breeding sites not significant

• Host animals not significant

• Windbreaks significant for *C. pulicaris*

• Wind speed significant
Current research

- Optimized autocorrelation

- More covariates:
  - Precipitation
  - Turbulence
  - Moisture

- More catch days
Thank you for your attention

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