Predicting spatial and temporal habitat use of rodents in a highly intensive agricultural area in NE Germany

Christina Fischer
Landscape Ecology, Department of Ecology and Ecosystem Management, Technische Universität München, Germany
The state of agriculture

- growth in food production

(Godfray et al., 2010. *Science*)
The state of agriculture

- growth in food production
  (Godfray et al., 2010. Science)

- agricultural intensification
  - reduced landscape diversity
  - increasing use of pesticides and fertilizers
    (Robinson and Sutherland, 2002. J. Appl. Ecol.)
  - greenhouse gas emissions (mechanization)
    (Power, 2010. Philos. Trans. R. Soc. B)
The state of agriculture

- growth in food production
  (Godfray et al., 2010. *Science*)
- agricultural intensification
  - reduced landscape diversity
  - increasing use of pesticides and fertilizers
    (Robinson and Sutherland, 2002. *J. Appl. Ecol.*)
  - greenhouse gas emissions (mechanization)
- decrease of farmland biodiversity
  (Geiger et al., 2010. *Basic Appl. Ecol.*)
The state of agriculture

- growth in food production
  (Godfray et al., 2010. Science)

- agricultural intensification
  - reduced landscape diversity
  - increasing use of pesticides and fertilizers
    (Robinson and Sutherland, 2002. J. Appl. Ecol.)
  - greenhouse gas emissions (mechanization)
    (Power, 2010. Philos. Trans. R. Soc. B)

- decrease of farmland biodiversity
  (Geiger et al., 2010. Basic Appl. Ecol.)

Trade-off between:
- increase global food demand
- environmentally sustainable agriculture
Rodents in agricultural areas

- the state rodents in agricultural landscapes

- ecological functions of rodents

- contribution to soil aeration

- important links in food webs

- pests of various kinds of crops
  (Brown et al., 2007. *Agric. Ecosyst. Environ.*)

- disease transmission
  (Pfeffer et al., 2010. *Rundsch. Fleischhyg. Lebensmittelüberw.*)
Study area

- area of 290 km²
- different landscape complexity
Rodent trapping

- 20 Ugglan live traps
- 2 trap nights (+ 2 pre-baiting days)
Study system

- (micro-) habitat conditions: 6 habitats, vegetation cover

- cereal
- forest
- field margin
- kettle hole
- grassland
- oilseed rape
Study system

- (micro-) habitat conditions: 6 habitats, vegetation cover
- landscape patterns: % arable land, perimeter-area-ratio
Study system

- (micro-) habitat conditions: 6 habitats, vegetation cover
- landscape patterns: % arable land, perimeter-area-ratio
- temporal variation: before and after crop harvest

before crop harvest (June)  
after crop harvest (August)
## Overview

<table>
<thead>
<tr>
<th></th>
<th>Cereal</th>
<th>Oilseed rape</th>
<th>Grassland</th>
<th>Forest</th>
<th>Field margin</th>
<th>Kettle hole</th>
<th>Σ</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A. agrarius</em></td>
<td>35</td>
<td>15</td>
<td>22</td>
<td>1</td>
<td>67</td>
<td>48</td>
<td>188</td>
</tr>
<tr>
<td><em>A. flavicollis</em></td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td><em>A. sylvaticus</em></td>
<td>8</td>
<td>7</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>18</td>
</tr>
<tr>
<td><em>M. minutus</em></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td><em>M. agrestis</em></td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td><em>M. arvalis</em></td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>-</td>
<td>10</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td><em>M. glareolus</em></td>
<td>19</td>
<td>14</td>
<td>18</td>
<td>44</td>
<td>48</td>
<td>33</td>
<td>176</td>
</tr>
<tr>
<td>Σ</td>
<td>75</td>
<td>45</td>
<td>47</td>
<td>46</td>
<td>131</td>
<td>112</td>
<td>455</td>
</tr>
</tbody>
</table>

C. Fischer: Predicting habitat use of rodents  

Results
Landscape complexity

- species accumulation in simple landscapes
- high predation pressure in complex landscapes (Butet and Leroux, 2001. Biol. Conserv.)
(Micro-)habitat parameters

- low abundances in grassland (c.f. Arlettaz et al., 2010. *J. Ornithol.)*

⇒ sink habitats for rodents

after crop harvest predation pressure increases (Huitu et al., 2004. *Ecography*)

⇒ refuges with high cover
(Micro-)habitat * temporal variation

- **A. agrarius**: habitat is (partly) removed after crop harvest
  ⇒ protection through cover
- **M. glareolus**: habitat is not removed after harvest
Small rodents habitat use is determined by:

- (micro-) habitat parameters
- species specific habitat preferences
- protection against predation through vegetation cover

⇒ landscape factors played a minor role

**conservation of small rodents by**
- semi-natural habitats in highly intensive agricultural areas
- vegetation cover (shelter) especially after crop harvest

**suppression of small rodents by**
- grasslands (sink habitats) and low vegetation cover
Perspectives

- long-term studies to reduce effects of population cycles
- large-scale (e.g. Europe-wide) monitoring of population cycles (esp. Eastern Europe)

(http://www.ecocycles-europe.org, downloaded: 13-02-12)

- comparisons between highly intensive agricultural landscapes and extensive landscapes
- predator-prey interactions
  ⇨ predictions of pest outbreaks
Thank you for your attention!
Results

- abundance/ species richness ~ landscape + (micro-)habitat + temporal variation

<table>
<thead>
<tr>
<th></th>
<th>Abundance</th>
<th>Species richness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>% arable</td>
<td>0.01</td>
<td>(-0.005, 0.015)</td>
</tr>
<tr>
<td>Perimeter-area-ratio</td>
<td>-0.70</td>
<td>(-4.702, 3.301)</td>
</tr>
<tr>
<td>% vegetation cover</td>
<td>0.01</td>
<td>(-0.008, 0.021)</td>
</tr>
<tr>
<td>Run</td>
<td>0.40</td>
<td>(-0.570, 1.369)</td>
</tr>
<tr>
<td>Perimeter-area-ratio * run</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% vegetation cover * run</td>
<td>0.01</td>
<td>(0.000, 0.023)</td>
</tr>
</tbody>
</table>
Results

- abundance/ species richness ~ landscape + (micro-)habitat + temporal variation

<table>
<thead>
<tr>
<th></th>
<th>A. agrarius</th>
<th>M. glareolus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>% arable</td>
<td>0.00</td>
<td>(-0.002, 0.001)</td>
</tr>
<tr>
<td>Perimeter-area-ratio</td>
<td>0.12</td>
<td>(-1.016, 1.229)</td>
</tr>
<tr>
<td>% vegetation cover</td>
<td>0.00</td>
<td>(-0.005, 0.002)</td>
</tr>
<tr>
<td>Run</td>
<td>-0.17</td>
<td>(-0.408, 0.070)</td>
</tr>
<tr>
<td>Perimeter-area-ratio * run</td>
<td>-1.70</td>
<td>(-3.121, -0.274)</td>
</tr>
<tr>
<td>% vegetation cover * run</td>
<td>0.01</td>
<td>(0.010, 0.0189)</td>
</tr>
</tbody>
</table>