Spatially explicit approaches for studying the influence of landscape on the spread of pests

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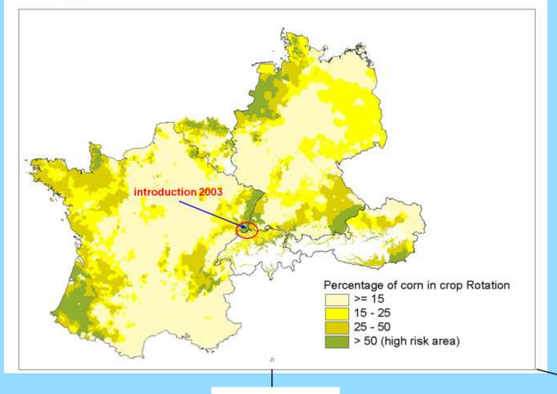
Importance of landscape features

- Fine scale landscape features in an ecosystem are important factors determining occurance, distribution and life-cycle of organisms.
- In the context of agricultural pests, spatial analysis of landscape features in the area of interest provides clues to the suitability of the landscape to the pest.
- Rate of potential spread or a risk index for a specific landscape could be derived.
- Landscape features that diminish pest's habitat suitability and contain further propagation and spread can be identified and encouraged.
- Applications for the Western corn rootworm and the spotted wing Drosophila are illustrated.

Western corn rootworm (Baufeld and Enzian 2005)

- Simulation starting point: Blotzheim (France), near the Swiss-German border
- Simulation period rate of spread: 10 years
- Software used: ArcGIS
- Parameters used:
  - concentration of corn (high-risk areas)
  - average natural spreading rate: 80km/year
  - spreading rate under containment: 20km/year
  - flying-over altitude threshold: 900m a.s.l.

Starting point for simulation was the introduction in 2003 in Alsace



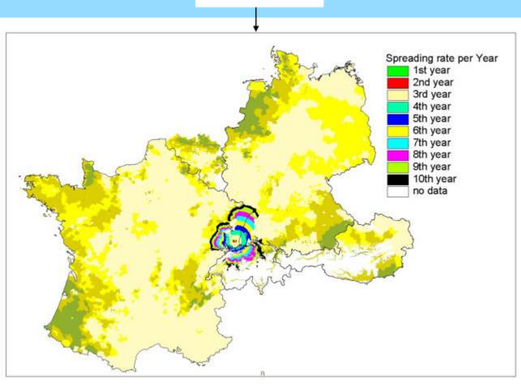
Method: basis for calculation of spreading scenarios

$AR = FD \cdot K$

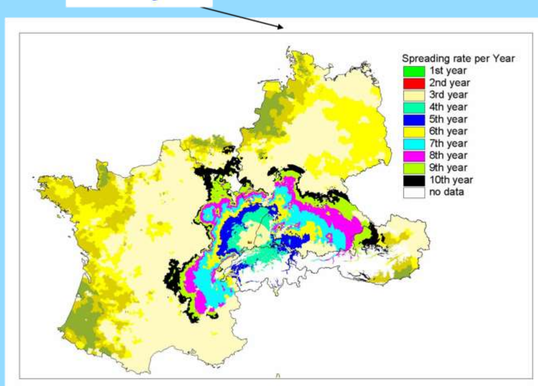
AR = spreading rate per year
FD = flying distance
version: 80 km per year (natural spread)
version: 20 km per year (containment)
K = factor for correction:
>= 50 % corn in crop rotation, than K = 1
< 50 % corn in crop rotation, than

$$K = \frac{\text{concentration of corn in \%} \cdot 2}{100}$$

containment



natural spread



year of spread	France infested corn area per year ha	Germany infested corn area per year ha	Switzerland infested corn area per year ha	total infested corn area per year ha
1.	184	0	0	184
2.	533	0	0	533
3.	5.592	2.410	2	8.004
4.	36.727	7.843	1.125	45.695
5.	30.992	8.131	2.728	41.851
6.	16.173	7.126	4.470	27.769
7.	13.418	7.898	6.952	28.268
8.	8.281	6.940	10.428	25.649
9.	22.497	3.150	5.802	31.449
10.	20.916	1.877	6.922	29.715
total sum	155.313	45. 375	38.429	239.117

Spatially explicit simulations reveal

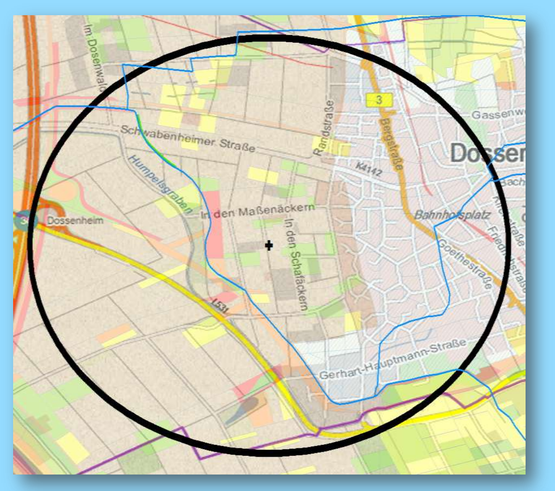
- infested corn areas under different management scenarios

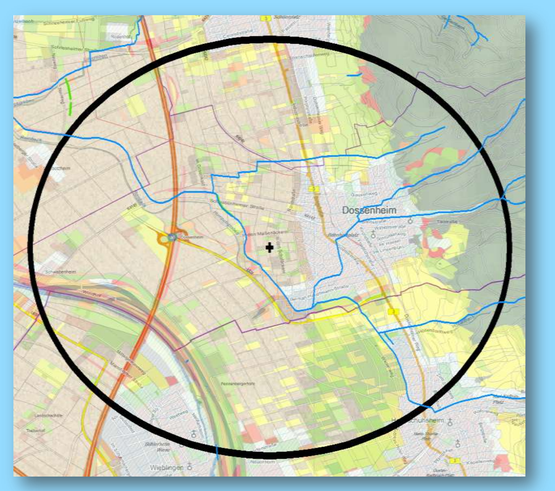
- yearly rate of spread and periods of high risk

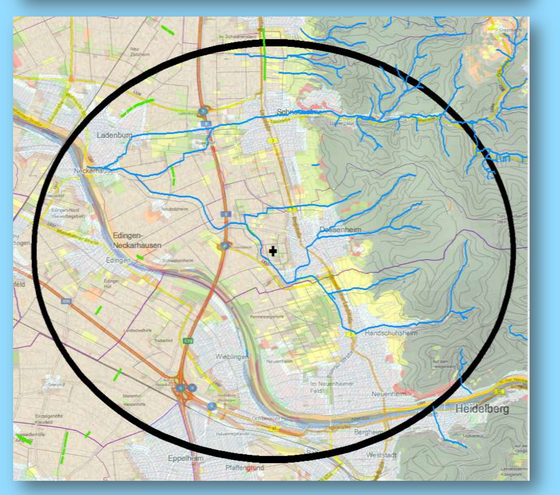
Baufeld, P.; Enzian, S. (2005): Western corn rootworm (*Diabrotica virgifera virgifera*), its potential spread and economic and ecological consequences in Germany.. Plant protection and plant health in Europe: Introduction and spread of invasive species (BCPC symposium proceedings 81), Alton, Hampshire, 149-154.

Spotted wing Drosophila

- Traps in various locations record number of captures of males and females at regular intervals
- In buffer zones of 50m, 100m, 250m, 500m, 1km, 2.5km and 5km around the traps, various landscape features are noted, along with their percentage density.
- Spatial correlation of each landscape feature with the observed occurance of Drosophila.







	Agriculture	Gardens	Woods	Water bodies	Pasture
1km	51.4	0.1	1.7	0.2	4.3
2.5km	36.4	3.1	2.4	0.1	4.5
5km	28.1	1.3	1.9	0.1	3.4

Trap location and landscape features in the buffer zones of radii 1km, 2.5km and 5km around it. The table shows percentage of landuse types in the buffer zones.

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Landuse types get a risk value using which high risk areas can be identified for monitoring.