Projekt Hof Ritzerau

Biodiversity change on arable fields during conversion from conventional to organic farming

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Introduction

The aim of the presented investigation is to analyse the changes of the beetle community, corresponding to the conversion from conventional to organic farming. This is part of a long-term monitoring project to the effect of organic farming to biodiversity. Ground-beetles (Carabidae) and rove-beetles (Staphylinidae) have been selected to represent insects and their species richness.

The main questions are:

- How is the spatial distribution of species on the farmland?
- Do species benefit from the conversion to organic farming?
- Do species that benefit from organic farming invade from outside the existing farming system?

Methods

168 pitfall traps, filled with Ethandiol (mono-ethylene-glycol) have been established in the investigated area. Sampling period started May 3, 2001 and finished April 20, 2004, interrupted by harvest and soil cultivation only. 140 pitfall traps have been installed on the arable fields, 28 in the hedgerows, close to ponds and in abandoned strips or grassland.

The area of Hof Ritzerau had been in intensively used since the last decades. In 2001 the fields were managed conventionally, 2002 the conversion to organic farming started on a few selected fields, the remaining fields followed successively till spring 2004.

Results

In total, 125 species (105,042 Individuals) of carabids and 262 species (108,207 Individuals) of staphylinids have been determined during three years (Tab.1).

Tab.1: Numbers of species and individuals of ground- and rove-beetles at Hof Ritzerau between 03.05.2001 and 20.04.2004; Sampling period was between May to May next year.

	Carabidae		Staphylinidae	
Year	Species	Individuals	Species	Individuals
2001	108	30,169	192	34,864
2002	101	49,237	182	37,734
2003	98	25,636	150	35,609

Changes in the community

Ground-beetles: Generally, a significant decrease of diversity indices (Shannon-Weaver) was found with increasing distance from field-edges (Fig.1).

Rove-beetles: Diversity indices were significantly higher in class '0-15 meters' in 2003 only, but species richness was significantly higher in all years.

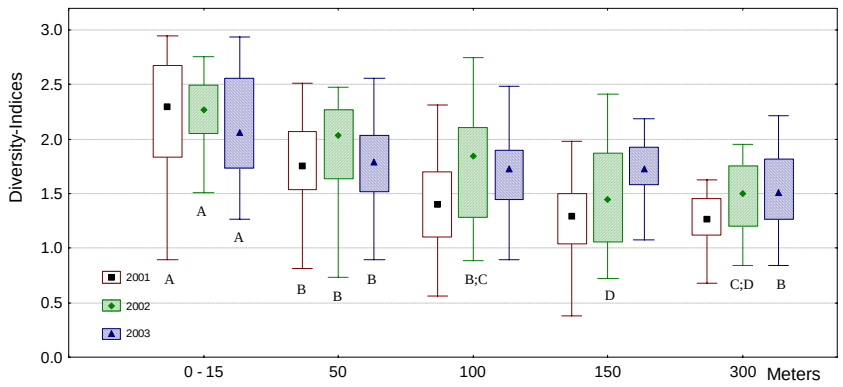

Fig.1: Diversity-indices of ground-beetles assemblages on arable fields in relation to the distance from semi-natural habitats. Different letters mark significant differences using one-way ANOVA (Statistica, StatSoft 1996).

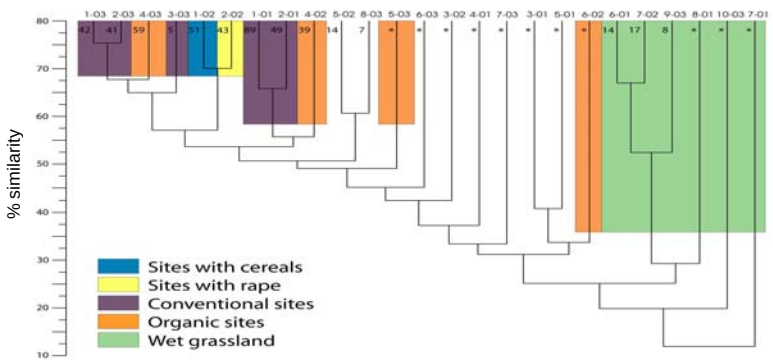

*Fig.2: Assemblages of rove-beetles 2001-2003, weighted by highest similarity (Renkonen-Indices). Numbers give sum of sampling sites, * : less than five sites.*

Assemblages of rove-beetles and ground-beetles on conventionally and organically farmed fields showed only small differences. In rove-beetles, however, 59 respectively 39 sites on organically farmed sites formed clusters with higher similarity. This may indicate, that organic farming already influences the composition of rove-beetle community (Fig.2).

Changes for single species

In total, 14 species of ground-beetles showed different abundances in relation to the two farming systems. (Tab.2). Nine species reacted negatively, five positively on organic farming. The negatively reacting species are all frequent in agricultural land in Middle Europe.

Tab.2: Carabid species with different abundances between organic or conventional farming at Hof Ritzerau in 2003. Test: Mann-Whitney-U-Test $p \leq 0.005$, n_{2003} organic: 55, n_{2003} conventional: 85; [1] species with lower abundance in organic farming in 2002; [2] species with higher abundance in conventionally cultivated rape.

Carabidae species	Rank total		U	p-level	Median		Average [Ind./100 d/trap]	
	org.	conv.			org.	conv.	org.	conv.
A. dorsalis[1]	3124.5	6745.5	1584.5	0.0013	4.63	**8.89**	6.73	**12.48**
Tr. quadristriatus[1]	2385.0	7485.0	845.0	0.0000	0.94	**4.89**	1.77	**6.51**
B. tetracolum	4516.0	5354.0	1699.0	0.0064	**4.44**	2.43	**5.61**	3.70
A. mülleri	3216.5	6653.5	1676.5	0.0048	1.94	**3.32**	2.86	**4.77**
A. similata[1,2]	3296.0	6574.0	1756.5	0.0131	0.00	**0.00**	0.54	**3.08**
C. granulatus	2876.5	6993.5	1336.5	0.0000	0.00	**1.46**	0.97	**2.47**
P. cupreus	4668.0	5202.0	1547.0	0.0007	**1.16**	0.00	**1.66**	0.75
N. brevicollis[1]	2824.0	7046.0	1284.0	0.0000	0.00	**0.47**	0.12	**1.06**
H. affinis	4506.0	5364.0	1709.0	0.0073	**0.46**	0.00	**0.85**	0.49
P. assimilis[1]	2847.0	7023.0	1307.0	0.0000	0.00	**0.00**	0.06	**0.97**
Not. biguttatus	2883.5	6986.5	1343.5	0.0000	0.00	**0.38**	0.12	**0.88**
B. quadrimaculatum	4986.5	4883.5	1228.5	0.0000	**0.46**	0.00	**1.22**	0.08
L. pilicornis[1]	3239.5	6630.5	1699.5	0.0065	0.00	**0.00**	0.16	**0.64**
O. rufibarbis	4384.5	5485.5	1830.5	0.0305	**0.00**	0.00	**0.59**	0.09

In total, 30 carabid species and 61 staphylinid species have been recorded as endangered according to the 'Rote-Liste-Schleswig-Holstein'. In particular the ground-beetle *Calosoma auropunctatum* (RL1), a steppe-dwelling carabid immigrating from eastern Europe (Fig.3).

C. auropunctatum became increase in abundance during the three sampling years (Fig.4), Finally in 2003, the species occurred most frequently on the organic field in the North.

As a predator of caterpillars, the species was presumably attracted by a high density of whites (Pieridae) and their larvae, which benefited from rape growing between the cultivated clay.

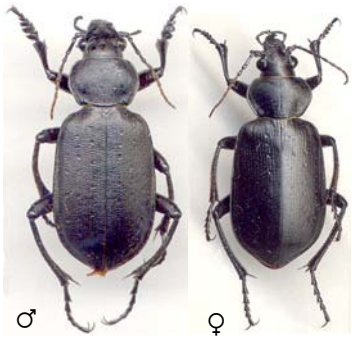

Fig.3: Calosoma auropunctatum, body size: 18-30mm.

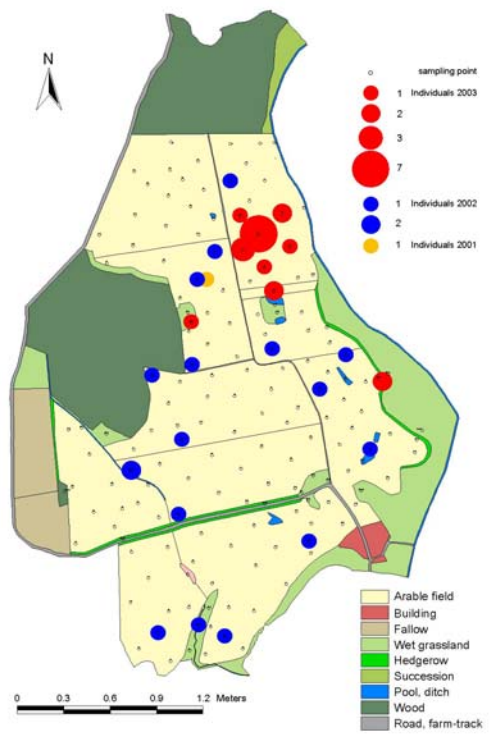

Fig.4: Distribution of Calosoma auropunctatum, on the area of Hof Ritzerau; Numbers of individuals from 2001 to 2003.

Conclusions

No 'dramatic' changes were expected for the beetle community within the first two years of conversion from conventional to organic farming. Climate and soil conditions were supposed to play a higher role than management change in the first years. In particular, the arable fields at Hof Ritzerau were intensively used for several decades with high input of pesticides. Additionally, the land consolidation was performed very early in the beginning of the 20th century.

Nevertheless several highly endangered species were recorded, that survived the intensive farming period in semi-natural habitats, e.g. hedgerows or pond margins. It can be supposed that they will be supported by organic farming.

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