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# Synecological analysis of endogaeic ground beetles in oilseed rape field in Croatia

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# WHY THIS TOPIC?

## Ground beetles (Coleoptera: Carabidae)

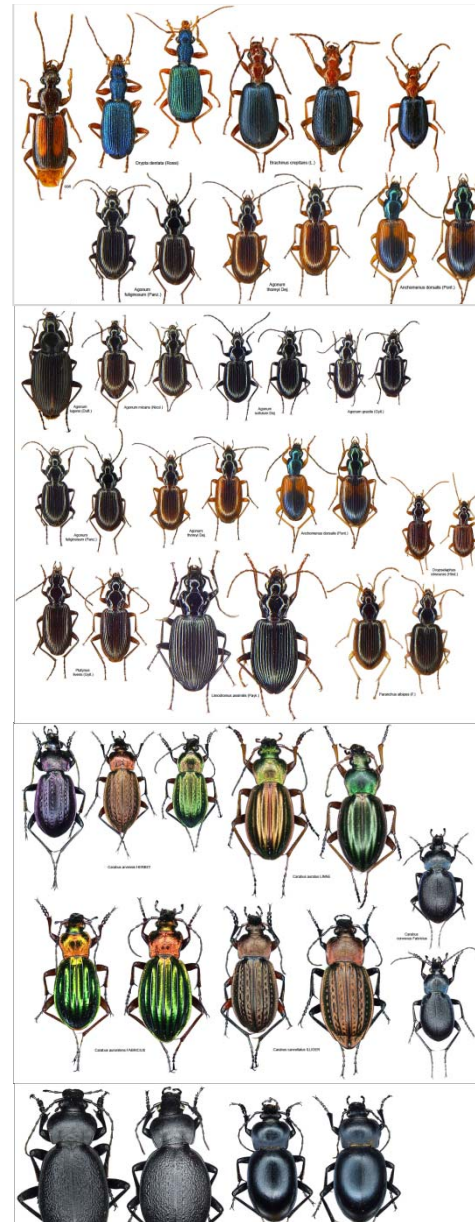
Largest family of aedeophagan beetles

~40.000 species in the world / 6.000 in the Europe

Abundant in arable habitats all over the world

Important role in natural pest control - predatory  
polyphagous nutrition

**BENEFICIAL INSECTS!**



# WHY THIS TOPIC?

## Ground beetles (Coleoptera: Carabidae)

Useful model organisms

Easy to collect

Well known ecology

Exhibit significant plasticity in terms of environmental factors

Efficiently reflect biotic and abiotic changes (agricultural management practices or changing environmental conditions)

Widely and successfully used for different kinds of indicator studies



## and beetles regarding the development and reproduction

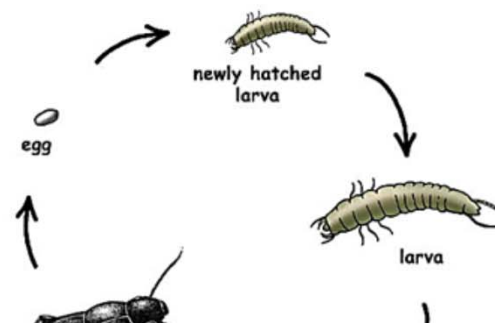
(1939, cit. Holland, 2002)

**autumn type** (species breed in the autumn and overwinter as larvae)

**spring type with autumn activity** (overwintering as adults, breed in the spring, a new generation active in the autumn before overwintering)

**spring type without autumn activity** (adults overwinter to breed in the spring and the new generation of adults is not active until the following year)

**autumn autumn species** is only partially correct. The larva  
rough three stages of development prior to their  
formation into pupae, and lives in a specially constructed  
cell in the soil.



## Ground beetles regarding the habitat

et al., 1999; Symondson et al., 2002 cit. Zaller, 2009; Zagmajster et al., 2008; and Edwards, 2011; Schwerk and Dymitryszyn, 2015.

### Belowground or epigeic ground beetles

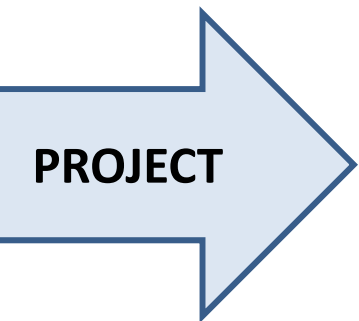
Potential as predator species  
control pest populations  
abundance and wide prey spectrum

Investigated by using pitfall traps in order to  
determine their distribution, composition and  
abundance in different vegetation types (forests,  
and different crops)

### Belowground or endogaeic ground beetles

- belowground predation - feeding on soil dwelling insects and other invertebrates such as snails, slugs and spiders
- large number of ground beetles spend their development in belowground habitats
- hasn't been much explored – few studies

\*It is considered that about 50% of the terrestrial fauna in endogaeic habitats are beetles!



## "Improving human capital by professional development through the research program in Plant Medicine," HR.3.2.01-0071



Europska unija

Ulaganje u  
budućnost



Projekt je sufinancirala Europska unija iz Europskog socijalnog fonda

Considering the lack of information on endogaeic ground beetles in Croatia, **The aim** of this research was to perform a synecological analysis of endogaeic ground beetle fauna collected during spring and autumn on an oilseed rape field, in order to gather new information about their composition, dominance, constancy and ecological significance indices.

# RIALS AND METHODS

Podravina County, Lukač, 45°50'24"N, 17°24'0"E



**Size of the field:** 34.76 ha

**Pre-crop:** winter wheat

**Common crop rotation cultivation practices :**  
four year rotation - oilseed rape, wheat, sugar beet, corn

**Common agro-technical measures:**  
The soils contain a great amount of fine sand and

# RIALS AND METHODS

## beetle trapping



- **Endogeic perforated probes**  
WB PROBE II<sup>®</sup> Trap, Trece inc.
- sampling was carried out with four perforated probes
- ( $\varnothing = 35$  mm, h = 440 mm, size of perforations: 4 mm x 2 mm)
- buried 44 cm into the ground
- top of the trap was in ground level
- Probes placed in squared manner: two traps at 20 m distance from the field edge and another two traps at 80 m distance from the edge of the field.



# RIALS AND METHODS

## beetle trapping

from 22nd to the 38th week of 2015

ing period was divided on spring and  
population sampling

g population was collected from  
**29th May till 29th July 2015**

nn population was collected from  
**5th August till 15th September 2015**

were inspected once a week.

nd beetles caught were preserved in 96%  
counted and identified.

tion was done by a taxonomy expert Mr  
Gijzen following the keys of Auber (1965),  
(1974) and Harde and Severa (1984).

ature verification was carried out according  
Tealianti (2012)

## 2015

### 1 January

	Mo	Tu	We	Th	Fr	Sa	Su
1				1	2	3	4
2	5	6	7	8	9	10	11
3	12	13	14	15	16	17	18
4	19	20	21	22	23	24	25
5	26	27	28	29	30	31	

### 2 February

	Mo	Tu	We	Th	Fr	Sa	Su
5							1
6	2	3	4	5	6	7	8
7	9	10	11	12	13	14	15
8	16	17	18	19	20	21	22
9	23	24	25	26	27	28	

### 3 March

	Mo	Tu	We	Th	Fr	Sa	Su
9							1
10	2	3	4	5	6	7	8
11	9	10	11	12	13	14	15
12	16	17	18	19	20	21	22
13	23	24	25	26	27	28	29
14	30	31					

### 4 April

	Mo	Tu	We	Th	Fr	Sa	Su
14			1	2	3	4	5
15	6	7	8	9	10	11	12
16	13	14	15	16	17	18	19
17	20	21	22	23	24	25	26
18	27	28	29	30			

### 5 May

	Mo	Tu	We	Th	Fr	Sa	Su
18					1	2	3
19	4	5	6	7	8	9	10
20	11	12	13	14	15	16	17
21	18	19	20	21	22	23	24
22	25	26	27	28	29	30	31

### 6 June

	Mo	Tu	We	Th	Fr	Sa	Su
23	1	2	3	4	5	6	7
24	8	9	10	11	12	13	14
25	15	16	17	18	19	20	21
26	22	23	24	25	26	27	28
27	29	30					

### 7 July

	Mo	Tu	We	Th	Fr	Sa	Su
27			1	2	3	4	5
28	6	7	8	9	10	11	12
29	13	14	15	16	17	18	19
30	20	21	22	23	24	25	26
31	27	28	29	30	31		

### 8 August

	Mo	Tu	We	Th	Fr	Sa	Su
31						1	2
32	3	4	5	6	7	8	9
33	10	11	12	13	14	15	16
34	17	18	19	20	21	22	23
35	24	25	26	27	28	29	30
36	31						

### 9 September

	Mo	Tu	We	Th	Fr	Sa	Su
36			1	2	3	4	5
37	6	7	8	9	10	11	12
38	13	14	15	16	17	18	19
39	20	21	22	23	24	25	26
40	27	28	29	30			

### 10 October

	Mo	Tu	We	Th	Fr	Sa	Su
40			1	2	3	4	

### 11 November

	Mo	Tu	We	Th	Fr	Sa	Su
44						1	

### 12 December

	Mo	Tu	We	Th	Fr	Sa	Su
49			1	2	3	4	5

# MATERIALS AND METHODS

## Analysis

**Dominance index (D)** represents the proportion in which the species participates to the productivity of the community.

$$D = \frac{nA}{N} \times 100$$

nA - number of individuals of species A

N - number of individuals of all recorded species

**Constancy index (C)** expresses the continuity of the species or population presence in a certain habitat.

$$C = \frac{nsA}{Ns} \times 100$$

nsA - number of samples that contained species A

Ns - the total number of samples



**Ecological significance index (W)** represents the relationship between the dominance index and the constancy index of the population (Varvala et al., 2001; Popescu and Zamfirescu, 2004)

$$W = (CA/100 \times DA/100)$$

where CA - constancy of species A

DA - dominance of species A



# RIALS AND METHODS

## analysis

**Species index (H)** characterize species diversity in each autumn community (Magurran, 1988)

$$H = - \sum_{i=1}^s (p_i \ln p_i)$$

proportion (n/N) of individuals of one particular species

number of found individuals

natural logarithm

for the calculations

number of species



**Sørensen's coefficient (QS)** outlines affinity of different populations belonging to a community through the species composition or the similarity of the habitats (Sørensen, 1948)

$$QS = (2C) / (S1 + S2)$$

C - number of species the two populations have in common

S1 - total number of species found in population 1 (spring population)

S2 - total number of species found in population 2 (autumn population)

**Evenness (E<sub>H</sub>)** assumes a value between 0 and 1 representing complete evenness

$$E_H = H / H_{max} = H / \ln S$$

non-index

maximum diversity possible

# TS

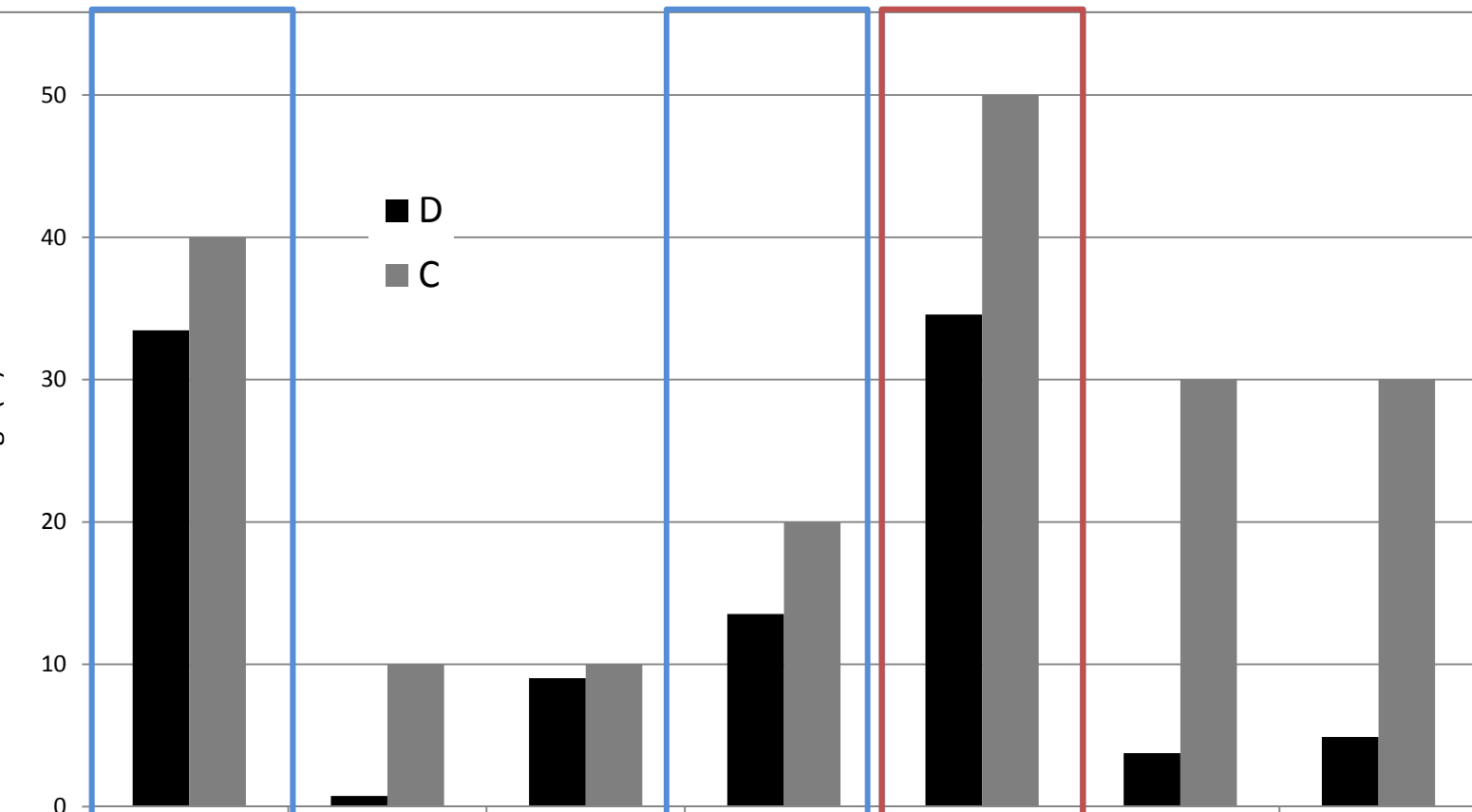
487 individuals of 8 species, belonging to 6 genera, were collected in endogaeic traps on oilseed rape field in Lukač, 2015

Species	Spring			Autumn		Total
	May	June	July	Aug.	Sept.	
<i>Anchomenus (Anchomenus) dorsalis</i> (Pontoppidan, 1763)	19	12	58	4	1	94
<i>Asaphidion (Asaphidion) curtum</i> (Linnaeus, 1761)	0	0	2			2
<i>Brachinus (Brachinus) crepitans</i> (Linnaeus, 1758)	0	24	0			24
<i>Brachynolomus (Brachynolomus) explodens</i> (Duftschmid, 1812)	0	36	0			36
<i>Brachinus (Brachinus) psophia</i> (Audinet-Serville, 1821)	7	39	46	147	67	306
<i>Clivina (Clivina) fossor fossor</i> (Linnaeus, 1758)	4	0	6			10
<i>Stenolophus (Stenolophus) teutonius</i> (Schrank, 1781)	2	11	0			13
<i>Trechus (Trechus) quadristriatus</i> (Schrank, 1781)				2	0	2
	32	122	112	153	68	<b>487</b>

# Dominance (D) and constancy (C) of endogaecic ground beetle spring population in oilseed rape field (Lukač, 2015)

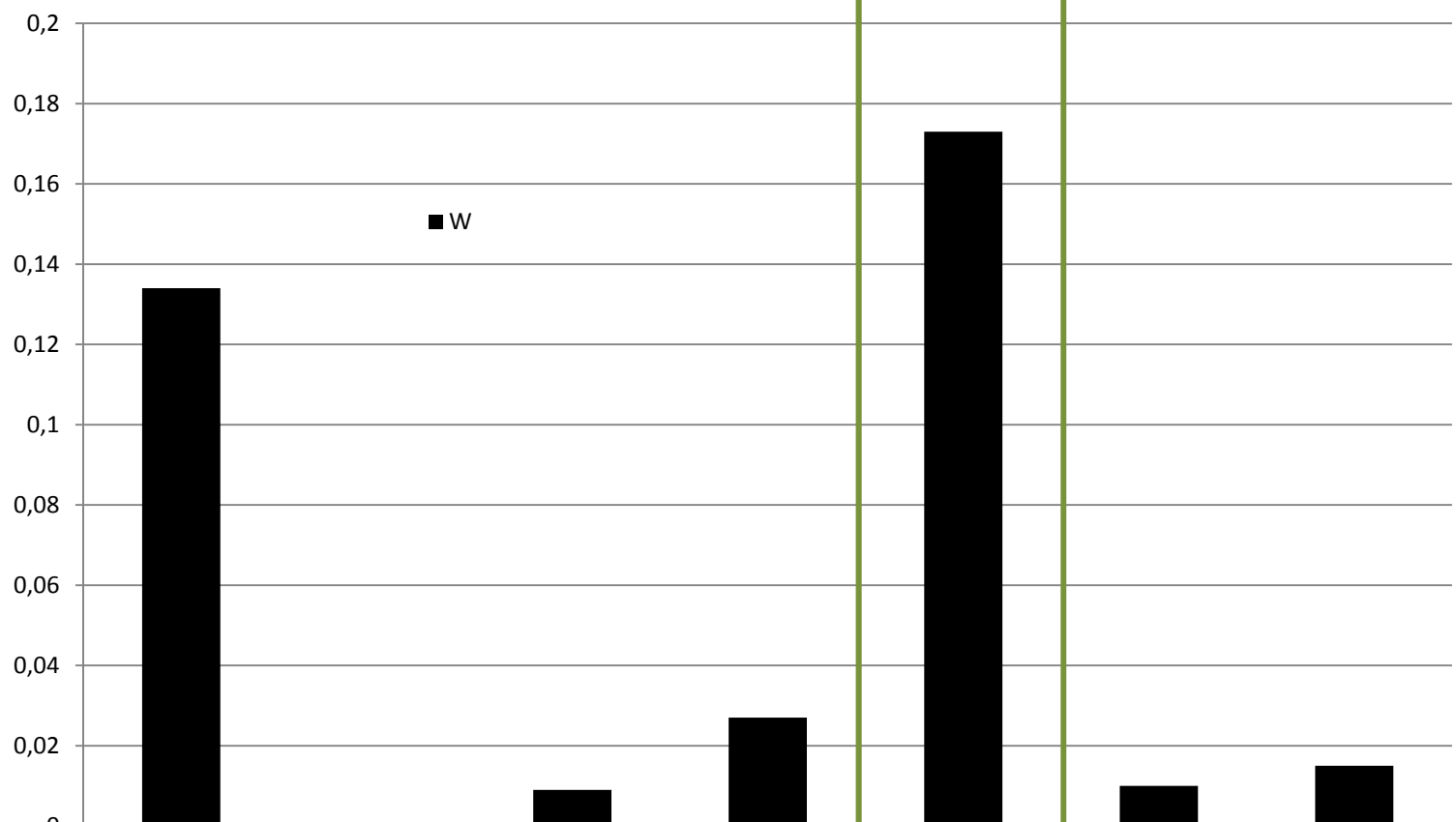
Eudominant species (D5) with >10.1% dominance index

Constant species (C3) with index  $50\% \leq c < 75\%$

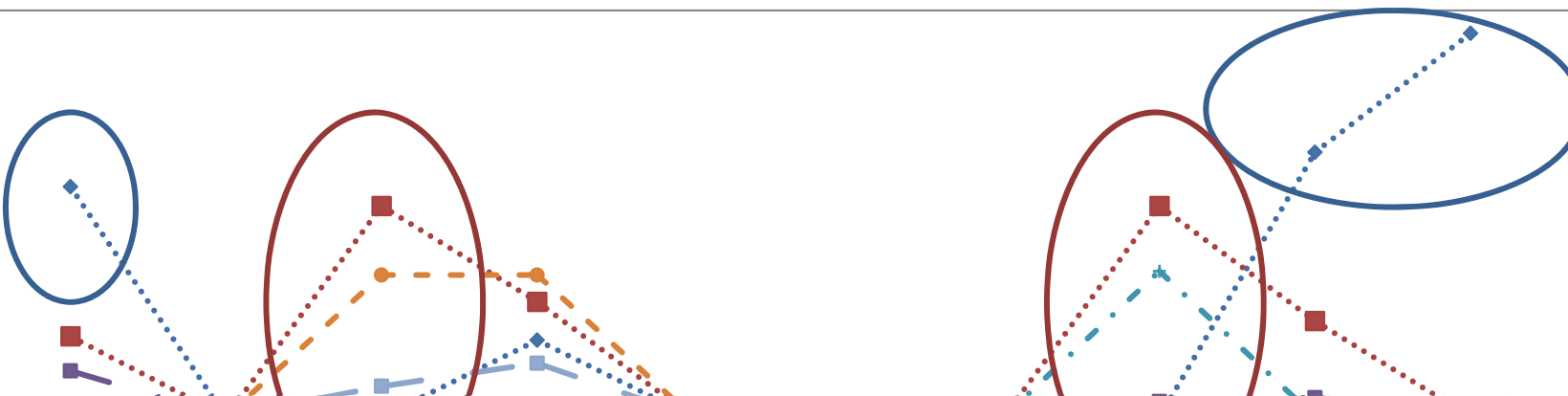


**Ecological significance (W)** of endogaecic ground beetle spring populations in oilseed rape field (Lukač, 2015)

Highest ecological significance index (W)



Basic ground beetle temporal dominance indices for **spring population** in Lukač, 2015



According to **Sørensen's coefficient** the analysis of spring and autumn population similarity outlined overlapping of populations by 0.4.

Shannon's index confirmed more diverse spring population ( $H = 1.898$ ;  $E_H = 0.913$ ) in relation to autumn population ( $H = 0.161$ ;  $E_H = 0.077$ ).

2015

## CONCLUSIONS

In many researches very often **small species are not present** at all or are present at lower abundance.

The absence of smaller species of ground beetles in pitfall traps, such as those found in our study, is **interpreted by their ability to avoid traps, perceive the edge or their capacity to escape from the pitfall trap.**

Since **endogeic ground beetles represent significant portion** of all ground beetle assemblages in agricultural landscapes it is very useful to gather more knowledge on those species.

Therefore results presented in this study serve as **valuable contribution** to the knowledge of endogaecic **ground beetle fauna in oilseed rape fields**