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Effect of management strategies on rove and ground beetles in a hilly area in Northern Italy

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Abstract: Results of research on two important Coleoptera family, Staphylinidae (rove beetle) and Carabidae (ground beetle), in a park landscape near Brescia (Northern Italy, Lombardy) are given. This study investigated the impact of management strategies applied in woods and meadows in this area on the two Coleoptera families. Noteworthy is the capture of the rove beetle *Atheta pseudoelongatula* Bernhauer, 1907, an alien species never detected in Italy before.

Key words: Carabidae, Staphylinidae, biodiversity conservation, pitfall trap, habitat management, bioindicators, *Atheta pseudoelongatula,* exotic species

Introduction

In Northern Italy, which is the centre of Italian industry is also characterized by intensive agriculture and semi-natural areas (like urban or periurban forestry and greenings) which are the primary sources of biodiversity. However their proximity to crowded and industrialized cities makes them vulnerable. Management solutions can mitigate the pressures on biodiversity. In the case of a periurban forest, sylviculture is oriented towards landscape management, conservation and development of biodiversity, and usability.

There is a long history associated with using Coleoptera as bioindicators of management strategies and of variations in the vegetation structure within woodlands (Paoletti & Bressan 1996, Ruzicka & Bohac 1994). Ground beetles are one of the best-known taxa in entomology and there are hundreds of scientific publications (Kotze et al. 2011). Rove beetles can also be considered biological indicators of the environmental status, particularly of the human influence on ecosystems because of their immense diversity, not only in species, but also in potential habitats and feeding habits (Buse & Good 1993, Bohac 1999, Lupi et al. 2006).

The present research was developed in a hilly area in the province of Brescia (Northern Italy) which surrounds the city and its hinterlands. The aim was to improve the knowledge of taxocenosis of rove and ground beetles in this area since there is very limited information available (Ruffo & Stoch 2005) and to acquire information on the impact of the management strategies applied in the hilly area on their abundance and composition.

Material and methods

Study areas

The current research was conducted inside a park area which is an area of connection and integration between urban and natural areas. It comprises different semi-natural habitats very rich in flora, but in the last decade there has been a progressive destruction of meadows and

natural woodlands, due also to the establishment of invasive plant species such as *Robinia pseudoacacia* L., *Rubus* sp. and *Sambucus nigra* L.

In this study meadows and woods were considered, choosing sites from 350m to 750m above mean sea level. Regarding woods, different sylvicultural management strategies were explored: mature (mixed broadleaved and chestnut woods) and juvenile (new chestnut planting) forests and a newly deforested area.

Methods

Pitfall traps were placed from April to August 2010 and inspected fortnightly. Two sets of 5 traps were positioned in each habitat. Rove and ground beetles have been separated and classified to species level. Additional information on rove beetles was acquired with two inspections with a car-mounted net and with direct collection on the ground.

The biodiversity indices [Margalef species richness (d), Shannon diversity (H_0), Evenness (J'), Simpson's species diversity (D) and Sørensen similarity index] have been used to evaluate the importance of wood and meadow to serve as potential site for biodiversity conservation.

The dominance rate (Tischler 1949) was then applied and the species detected were classified in relation to their percentage against the entire range as subrecedent (less than 1.0%), rare recedent (1.0%-2.0%); fairly numerous subdominant (2.1%-5.0%), numerous dominant (5.1%-10.0%), very numerous eudominant (over 10.0%).

Results and discussion

A total of 30 ground beetle species and 98 rove beetle species were collected. Table 1 shows the species distribution in the different habitats.

Table1. Ground and rove beetle found in the different habitats.

	Number of species detected	
	Ground beetles	Rove beetles
dry meadow$_1$	7	15
dry meadow$_2$	6	11
mixed broadleaved wood $_1$	14	21
mixed broadleaved wood $_2$	9	27
chestnut wood	11	30
new chestnut planting	8	10
newly deforested area	13	23

Among ground beetles the detection of *Abax (Abax) fiorii* Jacobson, 1907 is significant because it is commonly localized in a small area in the west of Garda lake (Northern Italy). Among rove beetles we have to mention *Atheta pseudoelongatula* Bernhauer, 1907, a Japanese species recently introduced into Europe and new to Italy, collected by car net on Monte Maddalena. *Ocypus rhaeticus* (Eppelsheim, 1873) and *Tasgius tricinctus* (Aragona, 1803) are remarkable for their unusual geographical location.

Biodiversity indexes gave different information according to the taxa considered and to the management strategies adopted (Table 2). The highest values of Margalef and Shannon indexes applied to ground beetles were found in newly deforested area where species belonging to both a woody and a meadow habitat can live, lowest values were recorded in dry meadow$_1$ where few species can adapt. The Simpson's index was low in nearly all areas due to the irregular distribution in the species abundance. For rove beetles, major values in Margalef and Shannon indexes were found in the mixed broadleaved woods. The newly deforested area showed the lowest biodiversity level for the Margalef indexes, and among the lowest values for the other indexes.

Table 2. Biodiversity indexes applied to ground and rove beetles in the different habitats (mean values ± standard error).

	Ground beetles				Rove beetles			
	d*	H_0*	J'*	D*	d*	H_0*	J'*	D*
dry meadow$_1$	0.75±0.37	0.74±0.38	0.53±0.27	0.55±0.27	1.12±0.19	1.07±0.26	0.67±0.08	0.41±0.13
dry meadow$_2$	1.42±0.51	1.10±0.46	0.94±0.03	0.22±0.11	2.46±0.61	1.84±0.19	0.89±0.04	0.15±0.01
mixed broadleaved wood $_1$	1.70±0.12	0.89±0.09	0.39±0.03	0.64±0.05	3.19±0.04	1.65±0.12	0.6±0.03	0.35±0.05
mixed broadleaved wood $_2$	1.39±0.09	1.27±0.08	0.64±0.07	0.37±0.03	4.36±0.78	2.23±0.28	0.73±0.04	0.19±0.06
chestnut wood	1.91±0.14	1.36±0.07	0.68±0.15	0.39±0.14	2.04±0.42	0.49±0.11	0.19±0.03	0.83±0.03
new chestnut planting	1.68±0.00	1.30±0.04	0.80±0.11	0.29±0.07	1.28±0.51	0.98±0.01	0.58±0.13	0.52±0.05
newly deforested area	2.01±0.66	1.48±0.47	0.76±0.13	0.31±0.16	0.19±0.17	1.18±0.11	0.52±0.07	0.45±0.09

*Margalef species richness (d), Shannon diversity (H_0), Evenness (J'), Simpson's species diversity (D).

Table 3. Sørensen similarity index for ground beetle (g, in bold) and rove beetle (r, in italics) communities in the different habitats.

		dry meadow$_1$	dry meadow$_2$	mixed broadleaved wood $_1$	mixed broadleaved wood $_2$	chestnut wood	new chestnut planting	newly deforested area
			g	**g**	**g**	**g**	**g**	**g**
dry meadow$_1$		-	**0.60**	**0.65**	**0.83**	**0.57**	**0.83**	**0.75**
dry meadow$_2$	*R*	*0.35*	-	**0.79**	**0.71**	**0.75**	**0.71**	**0.89**
mixed broadleaved wood $_1$	*R*	*0.15*	*0.20*	-	**0.43**	**0.22**	**0.33**	**0.60**
mixed broadleaved wood $_2$	*R*	*0.24*	*0.31*	*0.63*	-	**0.44**	**0.38**	**0.80**
chestnut wood	*R*	*0.19*	*0.37*	*0.49*	*0.51*	-	**0.33**	**0.55**
new chestnut planting	*R*	*0.40*	*0.30*	*0.41*	*0.38*	*0.47*	-	**0.70**
newly deforested area	*R*	*0.30*	*0.40*	*0.53*	*0.38*	*0.57*	*0.44*	-

Ground beetle communities of the woody areas showed a rather high similarity independently of the management adopted. Also in dry meadows, and in newly deforested area, the index indicated a similarity of species composition (Table 3). The dominance rate showed that *Abax (Abax) parallelepipedus lombardus* Fiori, 1896 (Coleoptera: Carabidae) and *Atheta trinotata* species-group (Coleoptera: Staphylinidae) were eudominant or dominant in all the habitats considered. The abundance and distribution of recedent or subrecedent species differed in function of the habitat considered. Rove beetle communities differed more between the various habitats, and the highest similarity was recorded between the two broadleaved woods.

Most of the species detected are very common in Italy for these environments. This allowed us to relate the community composition to local urban disturbances and their ability to move from one area to another. This was evident with carabids which were more likely to colonize newly deforested area. On the other hand, rove beetle diversity was higher in more stable habitats like mature forests.

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