

The role of permanent grasslands on ant community structure: Ants (Hymenoptera: Formicidae) as ecological indicators in the agro-ecosystems of the Taro River Regional Park (Italy)¹

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Abstract

Environmental stress, also associated with human land-use, induces a response in ecological indicators that can be measured and used to develop an effective land management policy. There are various reasons to usually exclude terrestrial invertebrates from land monitoring and assessment programmes. Ants are an exception and they are routinely used for biological monitoring in many Australian ecosystems. However, the value of ants as ecological indicators has been comparatively poorly studied in the Palaearctic region. This research is one of the first attempts to verify whether ants are eligible to become efficient ecological indicators in typical Mediterranean agro-ecosystems. The area of investigation has been selected in the Fluvial Regional Park of Taro River (Parma, Northern Italy). Since the reserve is located in the region that produces Parmigiano-Reggiano cheese, park management guidelines tend to match principles of environmental protection with human demands. In this framework, the fluvial park has developed a project for the preservation of Permanent Grasslands that are considered a valid alternative to monocultures for the production of cow fodder. In this work, sampling with pitfall traps was used to compare the presence and distribution of ant-fauna between Permanent Grasslands and Lucerne Monocultures. The results showed that the degree of invasiveness of agricultural practice has a meaningful impact on ant species composition: the reduction of environmental stress and disturbance produces variations in the ant community structure promoting especially *Lasius niger* (LINNAEUS, 1758). On the contrary, on such sites *Messor* cf. *structor* (LATREILLE, 1798) is present to a lesser extent. This research suggests that the study of ant communities is a promising method to evaluate the influence of different land management policies also in the agro-ecosystems of the Taro River Regional Park.

Key words: Ecological indicators, ant community structure, permanent grasslands, agro-ecosystems, environmental stress.

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Introduction

Bioindicators can be classified into three different categories reflecting their main applications: (I) environmental indicators readily reflect the abiotic or biotic state of an environment, (II) ecological indicators represent the impact of environmental change on a habitat, community or ecosystem, whereas (III) biodiversity indicators are indicative of the diversity within an area (for a review see MCGEOCH 1998). In particular, ecological indicators can assess a general ecological change following environmental stresses associated with human land-use, such as habitat alteration, fragmentation or climate change. For this reason, there is an increasing demand of such indicators especially in land management where the principles of the sustainable development are spreading (ANDERSEN 1999). Moreover, ecological indicators can be useful in monitoring longer term changes on biota because their responses to environmental stress, such as changes in abundance, richness, composition or spatial distribution, can be studied at several temporal levels (MCGEOCH 1998).

Invertebrates have many characteristics that make them good indicators of ecological conditions. First of all, they fit the criteria of wide distribution, and high abundance and

species richness. Secondly, they have a relevant functional role in ecosystems. Thirdly, they have a measurable sensitivity to environmental changes and fourthly they are easily sampled (GREENSLADE & GREENSLADE 1984, BROWN 1997, MCGEOCH 1998). Invertebrates were first used as indicators of water quality and now they are commonly studied in order to assess the conditions of freshwater and marine ecosystems (HELLAWELL 1986, ROSENBERG & RESH 1993). Several terrestrial invertebrates have been proposed as ecological indicators such as butterflies, cicadas, springtails, flies, grasshoppers, spiders and beetles (cf. ANDERSEN 1999). However, terrestrial invertebrates are usually excluded from land monitoring and assessment programmes because in many cases they are too diverse, the status of taxonomic studies is relatively poor and their ecological importance in ecosystem functioning is not well understood (AGOSTI & al. 2000).

Exceptions to this, among others, are ants that are routinely used for biological monitoring in many Australian ecosystems (ANDERSEN & MAJER 2004). The Australian experience and other examples in different continents show that ants can be very useful as bioindicators (MAJER 1992,

¹ This research is dedicated to the memory of Dr. Stefan Schödl.

MAJER & DE KOCK 1992, GOMEZ & al. 2003, VAN HAMBURG & al. 2004). Unlike several terrestrial invertebrates, ants have particular attributes that make them good candidates for monitoring environmental quality. First of all, they are well known from a systematic point of view at least at genus level (BOLTON 1994, 1995). In addition, they are highly diverse and dominant (relative abundance, biomass) in many habitats, their ecological role in ecosystems is well known, as is their sensitivity to environmental changes (ANDERSEN 1997, 2000, ANDERSEN & MAJER 2004). Moreover, they have stationary nesting habits that allow them to be resampled over time (AGOSTI & al. 2000). Finally, their sampling is generally easy and low-cost in terms of time and resource consumption (AGOSTI & al. 2000, ANDERSEN & al. 2002).

The value of ants as ecological indicators is clearly recognized in Australia. On the other hand, in the northern hemisphere, the most widely used invertebrate indicators are beetles, mainly of the family Carabidae (STORK 1990, NIEMELÄ & al. 2000, EYRE & LUFF 2002). The potential of ants has been poorly studied in the Palaearctic region, even though studies have demonstrated that variations in ant community structure can represent the ecological impact of different land management practices (GOMEZ & al. 2003, OTTONETTI & al. 2004, DAHMS & al. 2005). This research is one of the first attempts to verify whether ants are eligible to become efficient ecological indicators in Italian agro-ecosystems. In particular, the study sites were selected in the Regional Park of Taro River (Parma, Italy).

The agricultural exploitation of the environment, as with monocultures, often induces a general reduction of biodiversity. However, monocultures are frequently preferred over other management practices because they are relatively easy to manage and quickly produce positive economic results. On the contrary, sustainable land management practices tend to reduce the loss of biodiversity because they help to maintain the productivity and the potential of the agro-ecosystem. For this reason, a suitable level of biodiversity can assure resource conservation and, as a consequence, human exploitation over time (cf. PAOLETTI 1999). In the Italian Regional Park of the Taro River (Parma), Permanent Grasslands are now tested as a valid alternative to Lucerne Monocultures for the production of fodder for dairy cows. They are good carbon sinks and favour a higher level of plant biodiversity as compared to Lucerne Monocultures, but no data concerning the animal biodiversity is known (VIAROLI & GARDI 2004). This research is a preliminary study to verify if ant communities are influenced by the two different agricultural practices and, subsequently, if there is evidence for their applicability as bioindicators in this context.

Material and methods

Research area: The sites for investigation were selected in the Fluvial Regional Park of Taro River (Parma, Northern Italy). This area covers about 3000 ha and runs along the side of the Taro river for 20 km. Because of its high environmental value, this fluvial park was selected for a recovery project by the European Community (Project LIFE 98 NAT/IT/5138). However, the reserve is located in the production area of Parmigiano-Reggiano cheese where dairy cow farming is one of the main economic activities. A total of 62 farms own fields located within the park

boundaries and about 50 % of the reserve is utilised for the cultivation of fodder for dairy cows.

Park management guidelines are aimed at keeping a sustainable land management in which environmental integrity is maintained whilst meeting the demands of land-use activities. For this reason, the fluvial park has developed a project for the preservation of Permanent Grasslands that are considered to be a valid alternative to monocultures for the production of cattle fodder. A Permanent Grassland is a cultivation of more than one kind of plant and it can be from ten to hundreds of years old. The first plant colonization can be spontaneous or artificial, but the culture can only be maintained with periodic irrigation, mowing and facultative manuring. Permanent Grasslands are not artificially sowed after first plant colonization because natural mechanisms ensure the propagation of species. Due to their internal equilibrium, Permanent Grasslands are not ploughed because they are rarely overcome by external factors.

In this work, we present the first sampling results of a research in progress. The aim was to compare the presence and distribution of ant-faunas between Permanent Grasslands and Lucerne Monocultures that are two of the most common practices utilized in the Taro River Park to produce fodder for dairy cows.

Sampling and sorting: Sampling was conducted in July 2005. The weather conditions were: total precipitation 45.0 mm (3 rainy days over 2.0 mm and 1 rainy day over 20.0 mm), mean temperature 25.1 °C (max: 36.6 °C, min: 15.7 °C, with 17 days over 32 °C) (Source: www.meteoparma.com). A total of 10 fields were sampled: 5 Permanent Grasslands, all at least one hundred years old (named: PG1, PG2, PG3, PG4, PG5) and 5 monocultures cultivated with lucerne (*Medicago sativa*) (named: LM1, LM2, LM3, LM4, LM5). All Permanent Grasslands were classified in the same phytosociological association: Poo sylvicolae-Lolietum multiflori. This association is a subgroup of Arrhenatheretalia order (Molinio-Arrhenatheretea class) that includes fodder grasslands rich in nutrients, of anthropogenic origin, with periodic mowing and irrigation (VIAROLI & GARDI 2004).

Sampling in each field was conducted using 10 pitfall traps with 10 m spacing along a linear transect. Pitfall traps (ø: 6 cm) were inserted in the ground three days before opening. At day one, they were opened and partially filled with propylene glycol as a killing agent / preservative. At day three, all traps in the same transect were collected and labelled. All trapped invertebrates were sorted and identified to phylum level, and then insects were identified to at least family level. All ants were sorted to species, identified and enumerated. Ant species identification was achieved in collaboration with Dr. Fabrizio Rigato (Natural History Museum of Milan, Italy). This protocol was inspired by the Ants of the Leaf Litter Protocol (ALL) as described in AGOSTI & ALONSO (2000) and modified for the specific context of the Taro River Park. All specimens are housed in the Laboratory of Myrmecology, Department of Evolutionary and Functional Biology, University of Parma, Italy.

Statistical analyses: For each sampled taxon, two parameters were measured: (I) the number of sampled individuals, as an abundance index, and (II) the number of traps where the taxon was sampled, as a measurement of its fre-

Tab. 1: List of ant-species sampled in Permanent Grasslands (PG) and Lucerne Monocultures (LM) in summer 2005.

Species	PG	LM
1. <i>Aphaenogaster subterranea</i> (LATREILLE, 1798)	–	×
2. <i>Formica cunicularia</i> LATREILLE, 1798	×	×
3. <i>Formica fusca</i> LINNAEUS, 1758	–	×
4. <i>Lasius emarginatus</i> (OLIVIER, 1792)	×	–
5. <i>Lasius niger</i> (LINNAEUS, 1758)	×	×
6. <i>Lasius paralienus</i> SEIFERT, 1992	×	–
7. <i>Messor cf. structor</i> (LATREILLE, 1798)	×	×
8. <i>Monomorium monomorium</i> BOLTON, 1987	–	×
9. <i>Myrmica specioides</i> BONDROIT, 1918	×	–
10. <i>Plagiolepis pygmaea</i> (LATREILLE, 1798)	×	×
11. <i>Solenopsis fugax</i> (LATREILLE, 1798)	×	×
12. <i>Strongylognathus testaceus</i> (SCHENCK, 1852)	×	–
13. <i>Tapinoma ambiguum</i> EMERY, 1925	×	×
14. <i>Tetramorium cf. caespitum</i> (LINNAEUS, 1758)	×	×
Total	11	10

quency of occurrence. Especially for ants, the number of traps was used in order to avoid the problem of capturing large numbers of individuals inside few traps due to placement near nest entrances or foraging trails. Nevertheless, the number of sampled individuals was also analysed because it was considered potentially useful to identify ant species with a meaningful ecological impact in the above-ground part of the agro-ecosystem (SCHLICK-STEINER & al. 2006).

The number of individuals was first used to calculate a list of diversity indexes: Species Richness (S), Simpson Index and its reciprocal (D and 1 / D), Berger-Parker Index and its reciprocal (d and 1 / d), Shannon Index (H') and Alpha Index (α). Since they demonstrate different sensitivities to sample size, species richness and evenness, each index was used to search for differences between Permanent Grasslands and Lucerne Monocultures applying Mann-Whitney U-Tests. Rank-Abundance Plots were also drawn (MAGURRAN 1988, LONGINO 2000).

The number of individuals or the number of traps of each ant species were used to obtain two contingency tables. Only the seven species recorded in both field types were considered (cf. A, B in Tab. 3). χ^2 -tests were used to

search for differences between Permanent Grasslands and Lucerne Monocultures.

Results

All sampled animals were arthropods. In particular, insects (Insecta) and spiders (Arachnida) were the most abundant taxa contributing 2310 and 1289 individuals respectively. Two other taxa were sampled to a minor extent: Myriapoda (11 individuals) and Isopoda (4 individuals). Considering the number of traps, insects and spiders were the most widespread taxa in all the sampled fields (Insecta: found in 100 % of traps; Arachnida: 94 %; Isopoda: 10 % and Myriapoda: 4 %). Of the insects, ants (Hymenoptera, Formicidae) and ground beetles (Coleoptera, Carabidae) were the most abundant, contributing 1062 and 548 individuals respectively, and the most widespread (Formicidae: found in 95 % of traps and Carabidae: 78 %) (Fig. 1).

A total of 14 ant species was recorded, with 11 species in Permanent Grasslands and 10 species in Lucerne Monocultures (Tab. 1). Four species were found only in Permanent Grasslands: *Myrmica specioides*, *Strongylognathus testaceus*, *Lasius emarginatus* and *Lasius paralienus* and another three species were recorded only in Lucerne Monocultures: *Aphaenogaster subterranea*, *Monomorium monomorium*, and *Formica fusca*.

No differences were found in ant abundance between the vegetation types in any diversity index (Tab. 2). Similarly, Rank-Abundance Plots found no difference between the vegetation types, as both curves were similar in total length and slope (Fig. 2).

The number of individuals was then referred to ant species in order to obtain a contingency table (7 species \times 2 agricultural practices; Tab. 3A). The corresponding χ^2 -test is statistically significant ($\chi^2_{(6)}$: 667.28, $p < 0.001$; Fig. 3A) showing that Permanent Grasslands and Lucerne Monocultures were different. This difference was mainly due to the influence of data related to *Lasius niger* ($\chi^2_{(1)}$: 327.92, $p < 0.001$), *Messor cf. structor* ($\chi^2_{(1)}$: 241.76, $p < 0.001$), and *Solenopsis fugax* ($\chi^2_{(1)}$: 77.06, $p < 0.001$). *Lasius niger* (PG: 240 vs. LM: 13 individuals) and *S. fugax* (PG: 64 vs. LM: 7 individuals) were more abundant in Permanent Grasslands than in Lucerne Monocultures, whereas *M. cf. structor* was more present in Lucerne Monocultures than in Permanent Grasslands (PG: 23 vs. LM: 461 individuals). Other species that displayed statistically significant differences in their distribution were: *Formica cunicularia* ($\chi^2_{(1)}$: 8.13, $0.01 > p > 0.001$, PG: 28 vs. LM: 19 individuals) which was more abundant in Permanent Grasslands, as well as *Tetramorium cf. caespitum* ($\chi^2_{(1)}$: 7.36, $0.01 > p > 0.001$, PG: 42 vs. LM: 106 individuals) and *Plagiolepis pygmaea* ($\chi^2_{(1)}$: 4.97, $0.05 > p > 0.02$, PG: 7 vs. LM: 27 individuals) which were more common in Lucerne Monocultures.

Concerning the number of traps, a second 7 \times 2 contingency table was obtained (7 species \times 2 agricultural practices; Tab. 3B). The corresponding χ^2 -test is statistically significant ($\chi^2_{(6)}$: 55.67, $p < 0.001$; Fig. 3B) showing that Permanent Grasslands and Lucerne Monocultures are also different according to this parameter. This difference was mainly due to the influence of data related to *L. niger* ($\chi^2_{(1)}$: 20.43, $p < 0.001$) and *M. cf. structor* ($\chi^2_{(1)}$: 12.75, $p < 0.001$). *Lasius niger* was more frequent in Permanent Grasslands than in Lucerne Monocultures (PG: 36

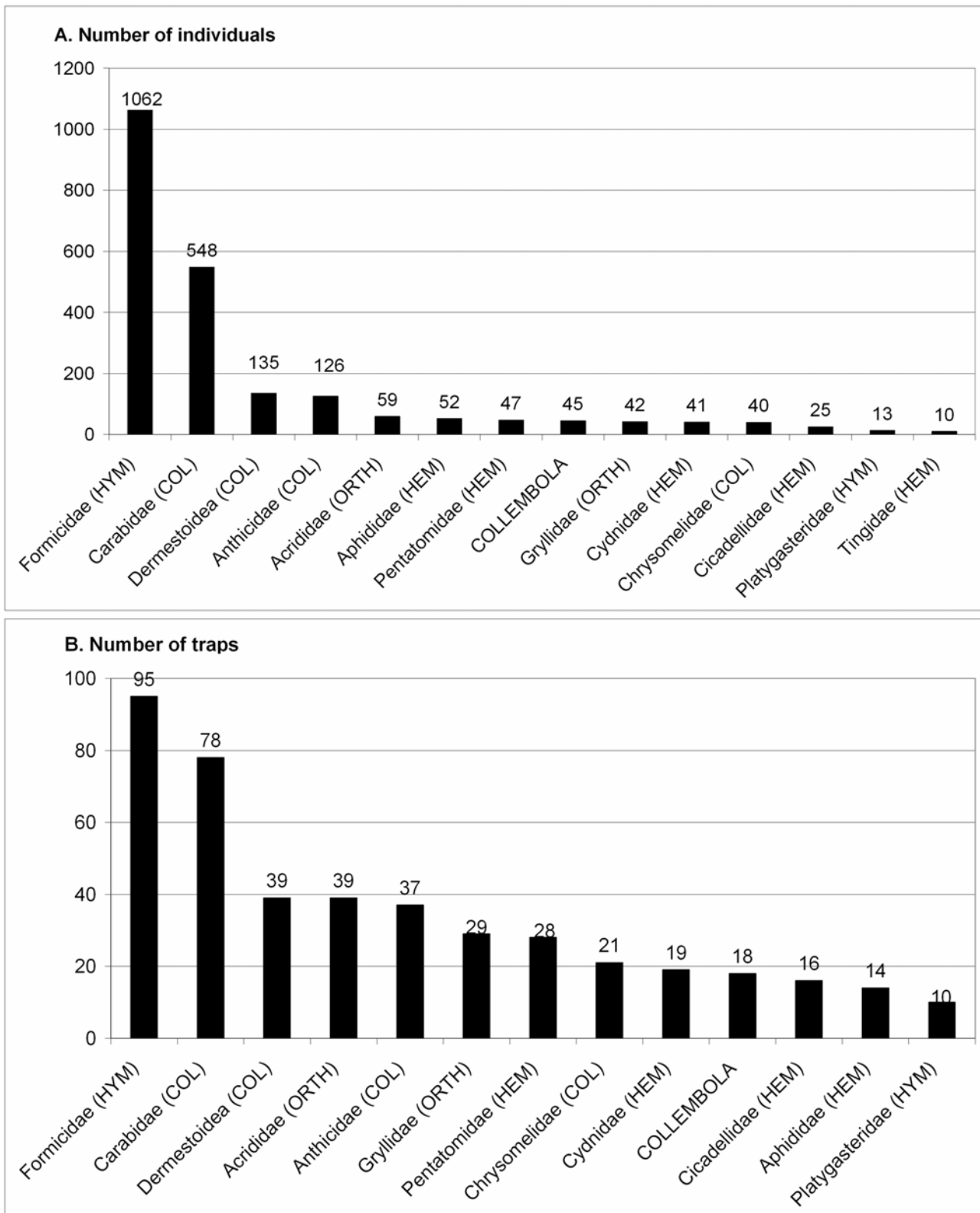


Fig. 1: Insects sampled in summer 2005. For each family, the corresponding systematic order is shown in capital letters (HYM: Hymenoptera; COL: Coleoptera; ORTH: Orthoptera; HEM: Hemiptera). (A) Total number of individuals sampled. Families with less than 10 individuals were omitted. (B) Total number of traps where each family was sampled. Families found in less than 10 traps were omitted.

Tab. 2: List of Diversity Indexes calculated to search for differences between Permanent Grasslands (PG) and Lucerne Monocultures (LM). For each index the value of U (Mann-Whitney Test) and the corresponding probability (p) are shown. None of them is statistically significant. S.E. – standard error.

	Number of individuals (N)	Species Richness (S)	Simpson Index (D)	1 / D	Berger-Par-ker Index (d)	1 / d	Shannon Index (H')	Alpha Index (α)
Permanent Grasslands (PG)								
PG 1	119	6	0.67	1.49	0.82	1.23	0.75	1.32
PG 2	43	5	0.37	2.68	0.56	1.79	1.17	1.47
PG 3	129	7	0.38	2.62	0.58	1.72	1.28	1.57
PG 4	50	9	0.19	5.21	0.38	2.63	1.85	3.19
PG 5	76	6	0.40	2.52	0.51	1.95	1.10	1.55
<i>Mean (S.E.)</i>	<i>83.40 (17.54)</i>	<i>6.60 (0.68)</i>	<i>0.40 (0.08)</i>	<i>2.91 (0.62)</i>	<i>0.57 (0.07)</i>	<i>1.86 (0.23)</i>	<i>1.23 (0.18)</i>	<i>1.82 (0.35)</i>
Lucerne Monocultures (LM)								
LM 1	25	7	0.28	3.61	0.48	2.08	1.49	2.78
LM 2	202	4	0.77	1.30	0.87	1.15	0.46	0.81
LM 3	42	7	0.21	4.73	0.33	3.00	1.64	2.40
LM 4	339	6	0.66	1.51	0.80	1.25	0.68	1.02
LM 5	37	4	0.27	3.68	0.35	2.85	1.29	1.14
<i>Mean (S.E.)</i>	<i>129.00 (61.76)</i>	<i>5.60 (0.68)</i>	<i>0.44 (0.11)</i>	<i>2.97 (0.67)</i>	<i>0.57 (0.11)</i>	<i>2.07 (0.39)</i>	<i>1.11 (0.23)</i>	<i>1.63 (0.40)</i>
U Mann-Whitney	10.00	9.00	12.00	12.00	10.00	10.00	12.00	8.00
p	0.602	0.452	0.917	0.917	0.602	0.602	0.917	0.347

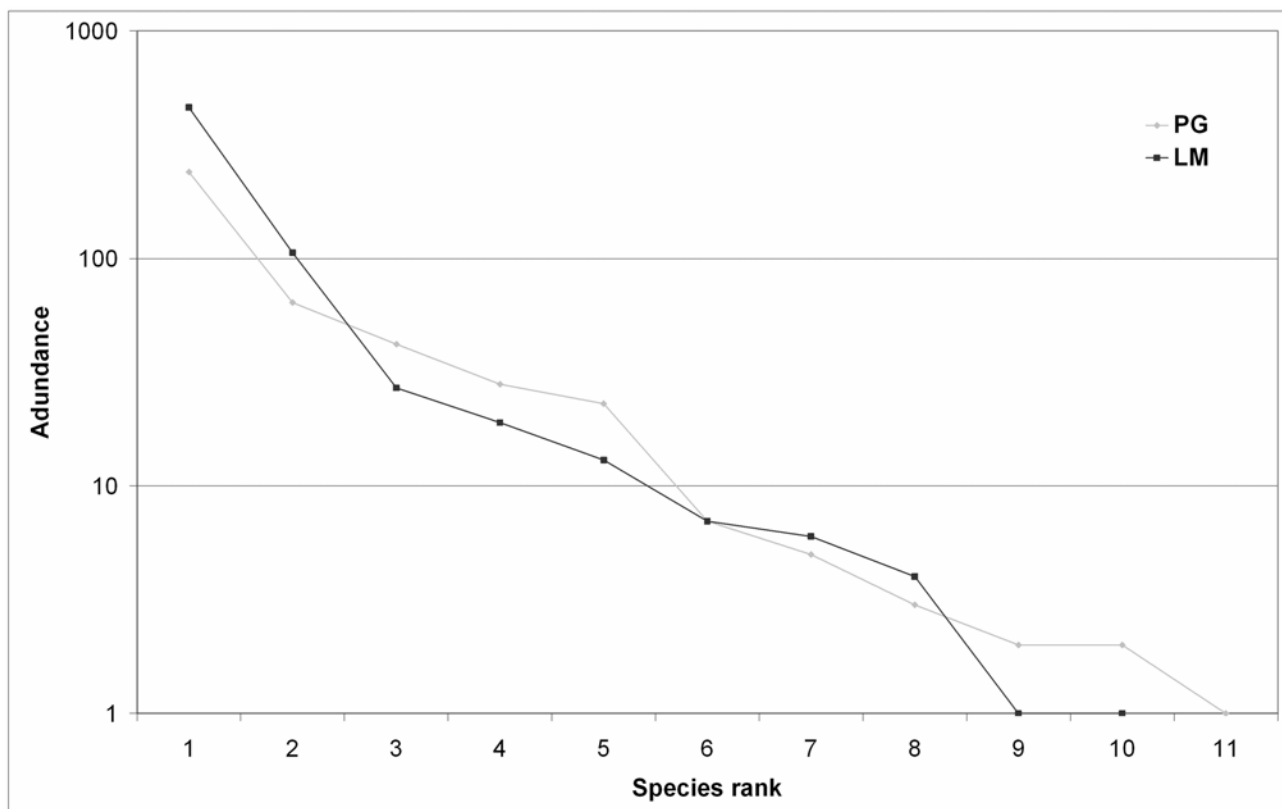


Fig. 2: Rank-Abundance Plot of sampled ant-species divided for Permanent Grasslands (PG) and Lucerne Monocultures (LM). Abundance (number of individuals) is expressed on a log scale.

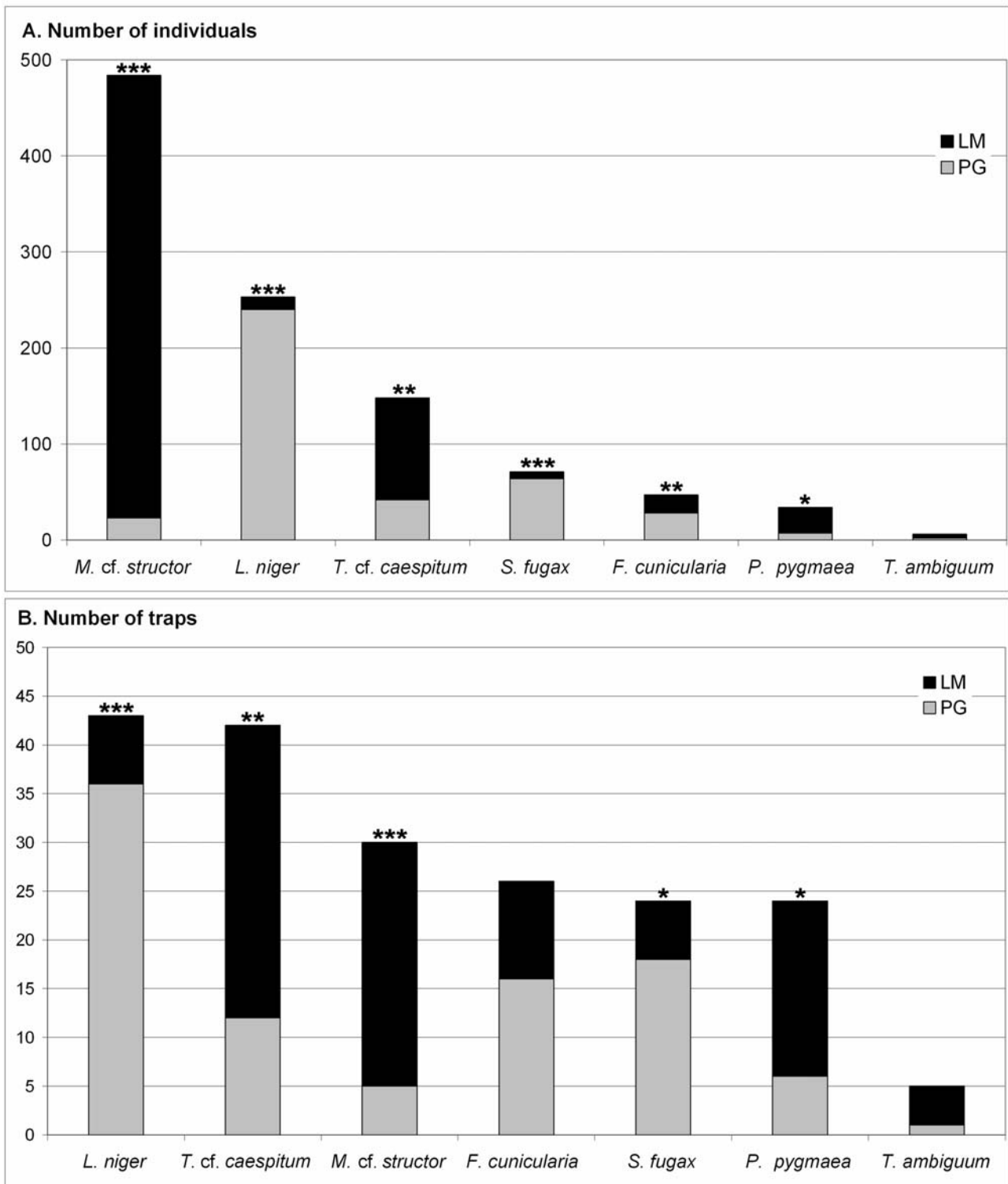


Fig. 3: Data of ant-species present both in Permanent Grasslands (PG) and Lucerne Monocultures (LM). (A) Total number of individuals sampled. Species that were statistically different (PG vs. LM; χ^2 -test) are marked with asterisks (*** $p < 0.001$; ** $0.01 > p > 0.001$; * $0.05 > p > 0.02$). (B) Total number of traps where each species was sampled. Species that were statistically different (PG vs. LM; χ^2 -test) are marked with asterisks (*** $p < 0.001$; ** $0.01 > p > 0.001$; * $0.02 > p > 0.01$).

vs. LM: 7 traps), whereas *M. cf. structor* had an opposite trend (PG: 5 vs. LM: 25 traps). Other species that displayed statistically significant differences in their frequencies of occurrence were: *T. cf. caespitum* ($\chi^2(1)$: 7.19, $0.01 > p > 0.001$, PG: 12 vs. LM: 30 traps) and *P. pygmaea* ($\chi^2(1)$:

5.65, $0.02 > p > 0.01$, PG: 6 vs. LM: 18 traps) which were more common in Lucerne Monocultures, as well as *S. fugax* ($\chi^2(1)$: 6.36, $0.02 > p > 0.01$, PG: 18 vs. LM: 6 traps) which was more common in Permanent Grasslands.

Tab. 3: Contingency tables of number of individuals (A) and number of traps (B) referred to ant-fauna. The values are divided according to ant species (columns) and agriculture practices (rows). Only the seven species recorded in both field types were considered.

A. Number of individuals								
	<i>Formica cunicularia</i>	<i>Lasius niger</i>	<i>Messor cf. structor</i>	<i>Plagiolepis pygmaea</i>	<i>Solenopsis fugax</i>	<i>Tapinoma ambiguum</i>	<i>Tetramorium cf. caespitum</i>	Total
PG	28	240	23	7	64	2	42	406
LM	19	13	461	27	7	4	106	637
Total	47	253	484	34	71	6	148	1043

B. Number of traps								
	<i>Formica cunicularia</i>	<i>Lasius niger</i>	<i>Messor cf. structor</i>	<i>Plagiolepis pygmaea</i>	<i>Solenopsis fugax</i>	<i>Tapinoma ambiguum</i>	<i>Tetramorium cf. caespitum</i>	Total
PG	16	36	5	6	18	1	12	94
LM	10	7	25	18	6	4	30	100
Total	26	43	30	24	24	5	42	194

Discussion

A rapid preliminary assessment with pitfall traps was used in order to verify if ants were one of the most abundant groups and consequently a promising taxon to investigate changes in biodiversity (PAOLETTI 1999). The cumulative sampling data showed that insects and spiders were the most represented invertebrates. Among insects, ants (Hymenoptera, Formicidae) and ground beetles (Coleoptera, Carabidae) were the most abundant and widespread.

In order to verify if ant communities are sensitive to the two different agricultural practices, data related to this taxon was analysed at species level. A total of 14 ant species were recorded: 11 on Permanent Grasslands and 10 on Lucerne Monocultures. Although comparisons are difficult because of differences in geographical site conditions, study designs and management policies, the total number of species in each of the two experimental conditions is tendentially low when compared with other Mediterranean Grasslands (GOMEZ & al. 2003, REYES-LOPEZ & al. 2003, DAHMS & al. 2005). A first explanation could relate to sampling effort. For this reason this pilot study will be enriched by other samplings that are planned in order to also verify the effectiveness of different sampling efforts.

A second hypothesis could be that a low number of species in both Permanent Grasslands and Lucerne Monocultures indicates a high level of stress and disturbance. Accordingly, both agro-ecosystems are too highly disturbed for a species rich ant community to become established and it is consequently difficult to detect differences.

However, ant species richness could be a relatively uninformative measure of ant community response. In support of this view, the analyses of Diversity Indexes and Rank-Abundance Plots show no differences between Permanent Grasslands and Lucerne Monocultures. Both approaches are based on species number and species abundance but they ignore the differences in the global composition of species that could be more useful in this context (HOFFMANN & ANDERSEN 2003, ANDERSEN & MAJER 2004).

More data is planned to be recorded, but differences in species composition are already discernible at the present stage. Permanent Grasslands seem to be characterized by the presence of *L. niger*, whereas Lucerne Monocultures seem to be a preferred habitat of *M. cf. structor*. This preliminary data from Taro River Park suggests that the degree of invasiveness of agricultural practice could have a meaningful impact on ant species composition. When compared with Lucerne Monocultures, Permanent Grasslands promote a substantial habitat modification associated with an evident plant diversification. This variation can affect species composition of ant communities, but more data needs to be collected to reach a more reliable interpretation. Moreover, additional data could allow the analysis of ant functional groups that could provide more general conclusions since this approach is based on ecological and behavioural features of the particular ant species (ANDERSEN 1997, AGOSTI & al. 2000, BROWN 2000, GOMEZ & al. 2003, ANDERSEN & MAJER 2004).

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Zusammenfassung

Umweltbelastungen, auch im Zusammenhang mit menschlicher Landnutzung, schlagen sich in messbaren Reaktionen ökologischer Indikatoren nieder, die bei der Entwicklung nachhaltiger Landwirtschaftsstrategien einbezogen werden können. Aus einer Reihe von Gründen werden terrestrische Invertebraten häufig nicht in Monitoring-Programme einbezogen. Ameisen stellen eine Ausnahme dar und werden etwa in Australien routinemäßig bei biologischem Monitoring eingesetzt. In der Paläarktischen Region aber ist der Wert von Ameisen als ökologische Indikatoren vergleichsweise wenig untersucht. Diese Studie ist einer der ersten Versuche zu evaluieren, ob Ameisen sinnvoller Weise als ökologische Indikatoren typischer mediterraner Agro-Ökosysteme einsetzbar sind. Das Untersuchungsgebiet liegt im Landschaftspark des Flusses Taro (Parma, Norditalien). Da der Park in der Region liegt, die

Parmesan produziert, sind die Bewirtschaftungsrichtlinien des Parks darauf ausgerichtet, Prinzipien des Naturschutzes mit den Bedürfnissen des Menschen zu vereinbaren. Unter dieser Voraussetzung hat der Flusslandschaftspark ein Projekt zum Erhalt von Dauergrünland als effektive Alternative zu Monokulturen für die Produktion von Rinderrfutter gestartet. In vorliegender Arbeit wurde anhand von Barberfallenfängen die Zusammensetzung der Ameisenfaunen von Dauergrünland und Luzerne-Monokulturen verglichen. Die Ergebnisse zeigen, dass der Grad der Umweltverträglichkeit von Bewirtschaftungsformen einen deutlichen Einfluss auf die Arteninventare der Ameisengemeinschaft hat: Die Verringerung von Umweltbelastungen bewirkt Veränderungen in der Gemeinschaftsstruktur, wobei vor allem *Lasius niger* gefördert wird. *Messor* cf. *structor* hingegen ist auf solchen Flächen seltener. Die Arbeit legt nahe, dass auch in den Agro-Ökosystemen des Landschaftsparks des Flusses Taro die Untersuchung von Ameisengemeinschaften eine Erfolg versprechende Methode zur Beurteilung verschiedener Bewirtschaftungsformen ist.

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