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Arthropod biodiversity monitoring using RBA techniques in viticulture

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Abstract: Wine producing areas often contain a rather high percentage of 'non-productive' interstitial space that could be managed in favour of biodiversity. Wine growers are often interested in biodiversity since they presume that conservation biological control can contribute to pest management. When farmscaping measures are taken the expected increase in biodiversity over time should be monitored. There are few clear practical indications available for farmers on how to manage the landscape of a farm in favour of biodiversity.

We tested the Rapid Biodiversity Assessment method (RBA) which consists of trapping arthropods (using a pitfall and an aerial interception trap) followed by the identification up to order level and then of 'morphospecies' (visually different individuals are presumed to be different species). The method is not 100% sound for a taxonomist but it allows quick and easy measurement of general biodiversity, which can be done by non-experienced volunteers, reducing costs and increasing efficiency. Morphospecies richness and overall abundance can easily be measured and compared among sites, habitats and years.

Key words: biodiversity, RBA, viticulture, arthropods, farm scale, habitats, landscape scale

Introduction

The influence of agricultural activities on biodiversity decline is a major concern of the international biodiversity year 2010. The IOBC rule (or equivalent rules) of '5% of the area managed as ecological compensation area' (ECA) (Malavolta & Boller 2009) is adopted in several countries but the efficiency of such schemes for biodiversity conservation has not been confirmed yet. Many wine growing areas over Europe are starting environmental management plans including 'landscape and biodiversity' projects but no clear indications on the efficiency of ECAs or their spatial arrangement at landscape scale on biodiversity are available (Boller et al 2004).

Pest insect abundance shows correlations with landscape composition for several viticulture pests (van Helden et al., 2006, 2008a,b). Wine grape growers are interested in adapting management techniques in favour of biodiversity both in vineyard plots and in the farm-landscape, often assuming that biodiversity will reduce pest insect pressure.

Classic biodiversity measurement is difficult, time and money consuming and taxonomy specialists are an endangered species (the 'taxonomy handicap', Silvain et al., 2009). Many studies therefore focus on 'indicator taxons' (carabid beetles, birds, etc.), or are using landscape parameters, but such variables are most often not validated as indicators for biodiversity.

The Rapid Biodiversity Assessment (RBA) system developed by Oliver and Beattie (1993) is used in our studies on biodiversity in vineyard landscapes at different spatial scales. This technique uses morpho-species or 'recognizable taxonomic units' rather than classical taxonomy, thus reducing the resources (time, expertise and money) needed for such studies (Krell 2004).

This technique focuses on arthropods, the most species rich taxonomic group. Insects are rather mobile and often have a relatively short duration of generations so should react quickly to changes in landscape composition or management practices and therefore be a good indicator for the effect of such changes. In order to get some idea of the richness of each habitat we earlier reported on arthropod richness monitoring in different habitats (vineyard, forest, meadow, hedgerows, cereals, flowers strips (Guenser et al., 2010). Comparing the arthropod abundance and species richness of different habitats in terms of biodiversity could allow us to find the most 'valuable' landscape elements.

In this paper we report on RBA monitoring inside vineyard plots only, at the landscape scale. Comparing such existing situations should help to identify an optimal spatial landscape arrangement for farmers to preserve and promote biodiversity that is compatible with viticulture.

Material and methods

Trapping network

Trapping sites (TS) consisting of a "combi"-trap (yellow 50cm diameter plastic funnel with two transparent 60 cm high panes) and a pitfall trap were installed in 31 different vineyard plots in the Limoux (France) production area. Traps were filled with water containing 5% of sodium chloride (NaCl) and a surfactant. Samples were collected once a week by sieving the trapping solution over a 2mm sieve, and stored in 70% ethanol. The sampling period was 10 weeks long during the summers of 2008 and 2009.

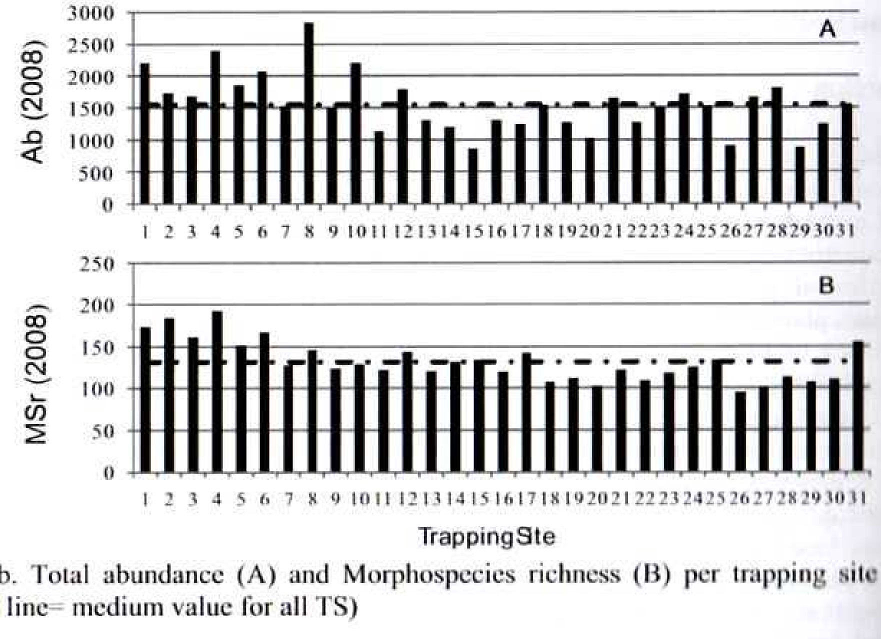

Fig 1a,b. Total abundance (A) and Morphospecies richness (B) per trapping site in 2008 (Dotted line= medium value for all TS)

Data analysis

Results are expressed as Morphospecies richness (MSr) and total abundance (Ab) summed per TS over a 1 year campaign. Since species richness of a sample depends on the sample size that can be influenced by differences in exposure at the TS (for example the amount of vegetation around the trap) we applied an ECOSIM correction to estimate the corrected MSr (cMSr) based on a fixed sample size (set at 100 individuals) for comparison among years and among sites in the same year (Gotelli and Entsminger, 2001).

Results and discussion

Over 450 morphospecies (γ diversity) were observed on this area in both 2008 and 2009. Large differences in abundance and richness were observed among trapping sites (Figure 1a & b) The MSr (sum of each year) varied from 86 to 383 morphospecies and Ab from 523 to 2836 per TS. Overall the abundance of arthropods was clearly higher in 2009 (39,000 individuals) then in 2008 (25,000). Morphospecies richness cannot simply be compared among years due to differences in observers and differences abundance among years, but corrected MSr showed excellent correlations between years (Figure 2).

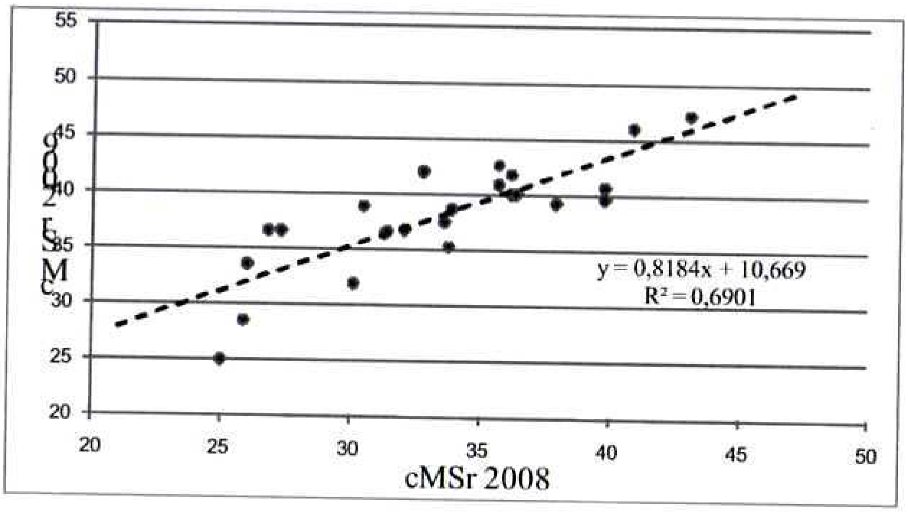

Figure 2. Comparison of (sample size corrected) morpho-species richness in the Limoux area in 2008 and 2009

In the area of Limoux different landscape (and climatic) areas are identified in the same appellation (production area). Figure 3 confirms that traps in similar landscape areas (markers) show comparable values, different from other areas. This confirms that the method is sufficiently sensitive for biodiversity assessment at this scale. More detailed analysis of arthropod communities and comparison with landscape characteristics (Van Helden et al., 2006, 2008a,b) are underway. This method should be useful to measure the effect of changing landscape composition and changing farmers' management on overall species biodiversity.

Acknowledgements

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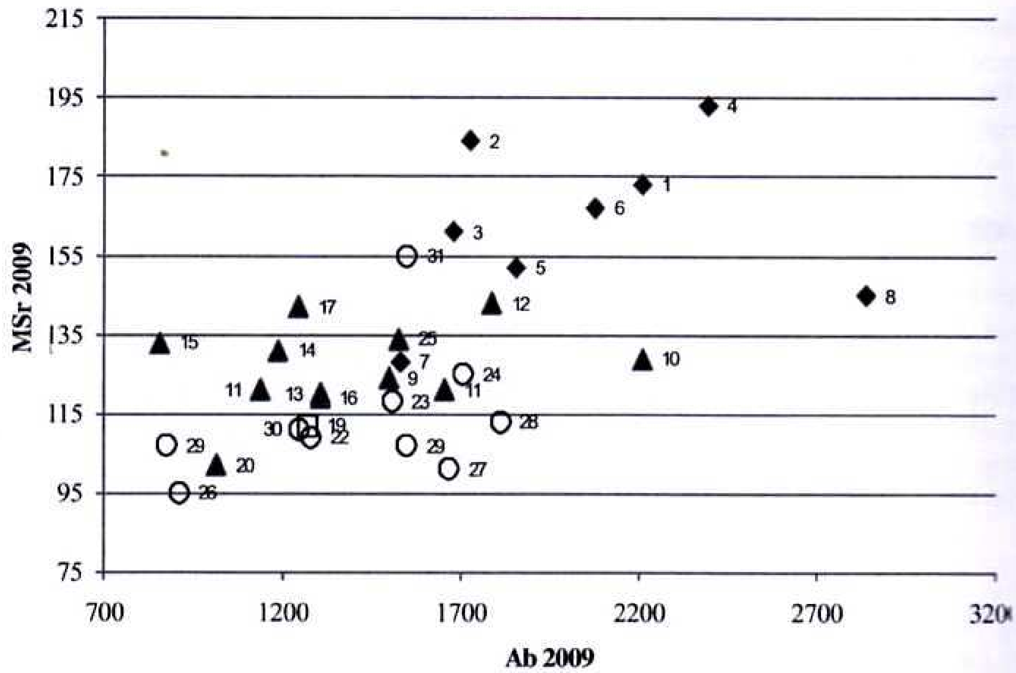

Figure 3. Morphospecies richness (MSr) and Abundance among trapping sites in Limoux 2009. Different markers identify different landscape units.

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