



## Landscape and local effects on multiparasitoid coexistence

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**Abstract.** 1. When resources are spatially fragmented, strength of competition between species is diminished by alternative patterns of resource use and parasitoids of the same host species become potential competitors. The coexistence of competing species in spatially fragmented habitats may be achieved, however, due to niche partitioning and alternative responses to patch characteristics. To evaluate responses to resource patterns facilitating coexistence, we examined the resource use patterns of four parasitoid species (*Orthopelma mediator*, *Pteromalus bedeguaris*, *Torymus bedeguaris* and *Glyphomerus stigma*) of the gall inducer *Diplolepis rosae* at both landscape and local scales.

2. Parasitoid species of rose gall communities behave differently at landscape and local scales. Parasitism rates and parasitoid incidence showed correlations with local characteristics in some cases, with landscape characteristics in others and, in some other cases with both.

3. Species responses to the examined characteristics depend rather on life history traits of parasitoids than on their frequency within the community. The examined parasitoids responded differently to landscape and local characteristics, while their phenology corresponded with their responses. Species emerging earlier in spring (*O. mediator* and *P. bedeguaris*) responded only to local variations, while later emerging species (*T. bedeguaris* and *G. stigma*) were sensitive to landscape characteristics as well.

4. Differences between species-specific and overall responses highlight the importance of species characteristics when considering multiparasitoid communities, and support both fine and coarse partitioning between different species coexisting in the community.

**Key words.** Coexistence, land use, landscape fragmentation, parasitism rate, parasitoid incidence, tritrophic system.

### Introduction

Fragmentation of natural environments mostly occurs as a consequence of human activities such as agriculture and urbanisation. Several authors concluded that the decrease in insect species richness may be the result of fragmentation,

diminished habitat area, and connectivity (Debinski & Holt, 2000; Fahrig, 2003; Schnitzler *et al.*, 2011); thus, biological diversity and ecosystem functions may be altered by the structural composition of landscapes which consist of habitat patches of different quality (Kruess & Tschardtke, 1994, 2000; Thies & Tschardtke, 1999). With regard to communities of herbivores and their parasitoids, many studies have pointed out that species richness and community biomass or inter-specific interactions are affected by the changes in habitats in fragmented landscapes (Didham *et al.*, 1996; Tschardtke *et al.*, 2002). Furthermore, landscape effects may change with spatial

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