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## Insect Communities of *Phragmites* Habitats Used for Sewage Purification: Effects of Age and Area of Habitats on Species Richness and Herbivore-parasitoid Interactions

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With 4 Figures

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### Abstract

In 1994, 28 sewage purification plants based on common reed *Phragmites australis* were analyzed, to study fragmentation effects on diversity and on food web structure of insect communities. Purification plants differed in age (2 to 11 years) and area (10 to 2,500 m<sup>2</sup>). Both age and area were significantly correlated with species richness of herbivores. Populations of the two most abundant herbivores, the gall makers *Lipara pullitarsis* (Diptera, Chloropidae) and *Giraudiella inclusa* (Diptera, Cecidomyiidae), increased significantly with age and size of the *Phragmites* habitats, i.e. the purification plants. Incidence curves showed that only habitats older than 6 years and larger than 100 m<sup>2</sup> have a 50% probability of finding these two most abundant gall makers, and can correspondingly be considered to contribute to insect species conservation. Natural enemies were even more susceptible to habitat fragmentation than their phytophagous hosts or prey, thereby hampering possible biocontrol. Percent parasitism of both the *Lipara* and *Giraudiella* gall makers significantly increased with habitat age.

### Introduction

Habitat fragmentation is one of the major threats to biological diversity in the agricultural landscape. Populations of organisms specialised to certain aspects of their habitat become increasingly smaller and more isolated from each other, so exchange between adjacent populations becomes a rare event. Both decreased size and increased isolation make populations susceptible to stochastic forces of extinction, due to demographic, genetic or environmental reasons (BEGON et al. 1995). Reduced species numbers in fragmented habitats may be due to effects of (i) reduced area per se, shown by HAVE (1993) with respect to ciliate communities, or (ii) reduced habitat heterogeneity (ROSENZWEIG 1995). Besides fragmentation, age of habitats greatly influences

species diversity, since permanent anthropogenic influences in the agricultural landscape favour young and greatly disturbed, at the expense of old and little disturbed, habitats.

Communities of common reed *Phragmites australis* also suffer from reductions in area, enhanced by die-back and decline of reed stands observed during recent centuries in Central Europe (OSTENDORP 1989). Sewage purification plants based on *Phragmites australis* may be a compensation for reed losses. However, these purification plants are predominantly young and small, and such fragmentation effects may worsen their suitability as compensation areas for the natural reed stands that have disappeared.

*Phragmites australis* harbours more than 100 monophagous stem-boring insect species which are well-known and, thereby, provide a basis for study of fragmentation effects on food web structure (TSCHARNTKE 1992 b, 1993). Our study focus on two gall makers and their parasitoids. The gall-inducing chloropid fly *Lipara pullitarsis* (Diptera, Chloropidae) is one of four *Lipara* species in central Europe inducing a cigar-like gall at the top of reed shoots (CHVALA et al. 1974; DE BRUIN 1994; TSCHARNTKE 1994). Larvae overwinter within leaves above stout internodes and adults hatch in May. *Stenomalina liparae* (Hymenoptera, Pteromalidae) oviposits in *Lipara* larvae and kills the host before adults hatch in spring; this chalcid wasp is mainly known from *L. lucens* (CHVALA et al. 1974), but, in this study, it was the only parasitoid we reared from *L. pullitarsis*. The "ricegrain" gall midge *Giraudiella inclusa* (Diptera, Cecidomyiidae) induces ricegrain-like galls protruding inwards from the internode wall and being crowded within the basal half of the internode (TSCHARNTKE 1988). Fourteen parasitoids are known to attack *Giraudiella* galls (TSCHARNTKE 1992 a).