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Relationships between lycosid spiders and their prey in an agroecosystem. An outline of a project.

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THE FRAMEWORK OF THE PROJECT

Our project is part of the agroecosystem research network of Munich (Forschungsverbund Agrarökosysteme München = FAM). The objective of FAM is the monitoring, prognosis, and evaluation of alterations in agroecosystems and their environment which are caused by management practice. The field studies take place in a long-term experiment on a landscape scale. The experimental farm is situated in Scheyern about 40 kilometers north of Munich.

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SCIENTIFIC BACKGROUND OF THE PROJECT

In recent years the interest in polyphagous predacious arthropods occuring in farmland has increased (e.g. Nentwig, 1988; Thomas et al., 1991, 1992). Studies about the abundance and the diet of these polyphagous predators (for instance Coleoptera and Araneae) suggest that they can contribute substantially to the limitation of pest organisms in agroecosystems (e.g. Riechert, 1984; Nyffeler & Benz, 1987; Samu & Bíró, 1993). But direct evidence of the beneficial influence of polyphagous predators is scarce (e.g. Chiverton, 1986; Oraze & Grigarick, 1989; Riechert & Bishop, 1990; Dennis & Wratten, 1991). The exact influence of these polyphagous predators in ecological webs is an important but still rather unclear question. Also, there is a great lack of quantitative data of the contribution of predacious arthropods to nutrient turnover in agricultural systems (Verhoef & Brussaard, 1990; Zwart & Brussaard, 1991). Very few studies of below-ground food webs have taken into account the (epigeic) predators (Brussaard et al. 1988, Gunn & Cherrett, 1993). Especially the impact of these predators in detritus-based food webs and their possible effect on decomposition is still relatively unexplored and needs more attention (e.g. Kajak & Jakubczyk, 1976; Kajak et al., 1991).

OBJECTIVES OF THE PROJECT

1. Do polyphagous predacious arthropods have a substantial impact on prey populations?
2. Is this impact on prey populations dependent on predator species, prey species, prey size, season of the year and the habitat type?
3. Can these polyphagous predators exert an influence on the pattern of nutrient turnover (e.g. the decomposition rate)?

THE EXPERIMENTS

The experiments take place within enclosures. These enclosures have a diameter of 79 cm, thus covering an area of 0.5 square meters. The enclosures consist of a metal ring (10 cm deep in soil and 15 cm above ground) and are covered with a nylon net (mesh size 0.3 mm) (Fig. 1). The overall height of the enclosures is about 90 cm, which provides most of the present vegetation enough room to grow. Only maize plants will get to large and will therefore be cut down to suit to the height of the cages.

During the experiments the following abiotic data are taken continuously by a data logger: velocity, relative humidity and air temperature in three different heights above ground, and temperature at three different depths in the soil. Additionally, the daily minimum and maximum temperature is recorded inside and outside the enclosures to control for cage effects on temperature.

The experimental treatments are: enclosures with predators and enclosures without predators. For each treatment six replicates will be conducted. In the "without-predator treatment" all arthropod predators will be removed, whereas in the "predator treatment"

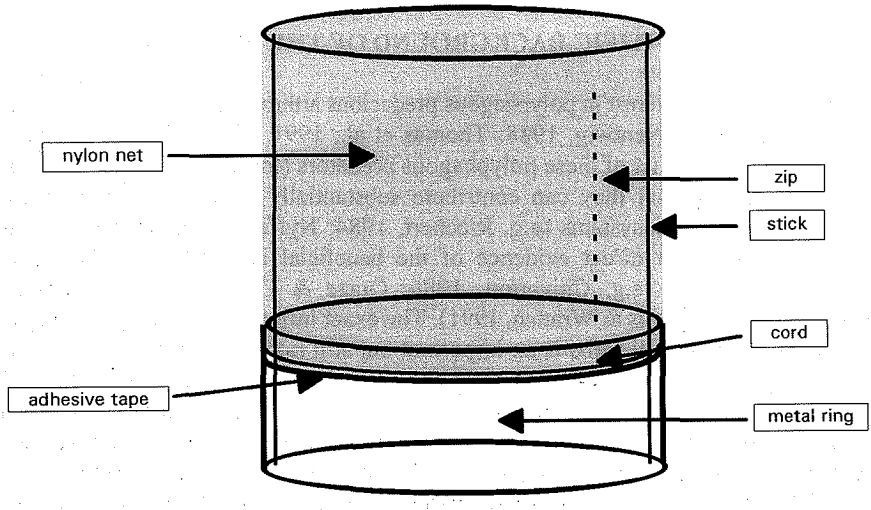

Fig. 1. Schematic drawing of an enclosure.

a defined number of selected species of Lycosidae and Carabidae will be put in (after the removal of all other predators before the start of the experiment). It is planned to run the predator enclosures for about three weeks at each trial. After this time period prey and predator densities within the enclosures will be determined. The differences in prey species and prey density between the "predator-treatment" and the "without-predator treatment" will show the influence of the investigated predator assemblage.

Additionally "open controls" will be taken, i.e. the natural densities of predators and prey will be determined at the start and the end of the experiments. This is done for two reasons: first, to see whether we have studied the naturally occuring predator assemblage in terms of species and density, and secondly, to check for possible cage effects of our manipulative treatments on population densities of the enclosed animals.

The experiments will be run three times a year: in spring, in summer and in autumn. This is done to see whether the influence of the predators does change during the course of the season.

Species composition and population densities of predators differ between different habitats. To see whether this has an effect on the influence of the predators the experiments will be conducted in three habitat types: a fallow, a meadow and a field (maize in 1994, winter wheat in 1995). These three habitat types represent the major land use practises at our study site.

In the year 1995 enclosures with manipulated predator densities are planned to study the influence of these predators on the decomposition rate. For that purpose litter bags will be put within the enclosures which will be placed in the fields for several months.

REFERENCES

BRUSSAARD L., VAN VEEN J. A., KOOISTRA M. J. & LEBBINK, G. 1988: The Dutch programme on soil ecology of arable farming systems. I. Objectives, approach and some preliminary results. *Ecol. Bull.* **39**: 35–40.

CHIVERTON P. A. 1986: Predator density manipulation and its effect on populations of Rhopalosiphum padi (Hom.: Aphididae) in spring barley. *Ann. appl. Biol.* **109**: 49–60.

DENNIS P. & WRATTEN S. D. 1991: Field manipulation of populations of individual staphylinid species in cereals and their impact on aphid populations. *Ecol. Entomol.* **16**: 17–24.

GUNN A. & CHERRETT J. M. 1993: The exploitation of food resources by soil meso- and macro invertebrates. *Pedobiologia* **37**: 303–320.

KAJAK A. & JAKUBCZYK H. 1976: The effect of intensive fertilization on the structure and productivity of meadow ecosystems. 18. Trophic relationships of epigeic predators. *Polish Ecological Studies* **2**: 219–229.

KAJAK A., CHMIELEWSKI K., KACZMAREK M. & REMBIALKOWSKA E. 1991: Experimental studies on the effect of epigeic predators on matter decomposition processes in managed peat grasslands. *Pol. Ecol. Studies* **17**: 289–310.

NENTWIG W. 1988: Augmentation of beneficial arthropods by strip-management. 1. Succession of predacious arthropods and long-term change in the ratio of phytophagous and predacious arthropods in a meadow. *Oecologia* **76**: 597–606.

NYFFELER M. & BENZ G. 1987: Spiders in natural pest control: A review. *J. Appl. Ent.* **103**: 321–339.

ORAZE M. J. & GRIGARICK A. A. 1989: Biological control of aster leafhopper (Homoptera: Cicadellidae) and midges (Diptera: Chironomidae) by Pardosa ramulosa (Araneae: Lycosidae) in California rice fields. *J. Econom. Entomol.* **82**: 745-749.

RIECHERT S. E. & BISHOP L. 1990: Prey control by an assemblage of generalist predators: spiders in garden test systems. *Ecology* **71**: 1441–1450.

RIECHERT S. E. 1984: Spiders as biological control agents. *Ann. Rev. Entomol.* **29**: 299–320.

SAMU F. & BÍRÓ Z. 1993: Functional response, multiple feeding and wasteful killing in a wolf spider (Araneae: Lycosidae). *Eur. J. Entomol.* **90**: 471–476.

THOMAS M. B., WRATTEN S. D. & SOTHERTON N. W. 1991: Creation of "island" habitats in farmland to manipulate populations of beneficial arthropods: predator densities and emigration. *J. Appl. Ecol.* **28**: 906–917.

THOMAS M. B., WRATTEN S. D. & SOTHERTON N. W. 1992: Creation of "island" habitats in farmland to manipulate populations of beneficial arthropods: successional changes in predatory community structure. *J. Appl. Ecol.* **29**: 524-531.

VERHOEF H. A. & BRUSSAARD L. 1990: Decomposition and nitrogen mineralization in natural and agro-ecosystems: the contribution of soil animals. *Biogeochemistry* **11**: 175–211.

ZWART K. B. & BRUSSAARD L. 1991: Soil fauna and cereal crops. In Firbank L.G. et al. (eds.): *The Ecology of Temeperate Cereal Fields.* Oxford Blackwell Scientific Publications, Oxford, pp. 139-168.