

TROPHIC CASCADES IN WOODY VEGETATION: INSIGHTS FROM A CASE STUDY IN PEAR ORCHARDS

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INTRODUCTION

The modern European landscape is heavily impacted by the extensive use of pesticides for crop protection (Bernhardt et al. 2017). One promising alternative to pesticide use is conservation biological control, which involves supporting natural predators occur to reduction of pest populations (Wyckhuys et al. 2013). However, relationships among generalist predators are complicated, especially between vertebrate and arthropod predators (Maas et al. 2016), and these complex interactions can significantly influence the effectiveness of pest control (Schmitz et al. 2010).

AIMS

Our aims were to assess the impact of arthropod predators enhancement and/or birds & bats exclusion on pear trees vitality, arthropod populations and overall impact of habitat manipulations on trophic cascades.

RESULTS

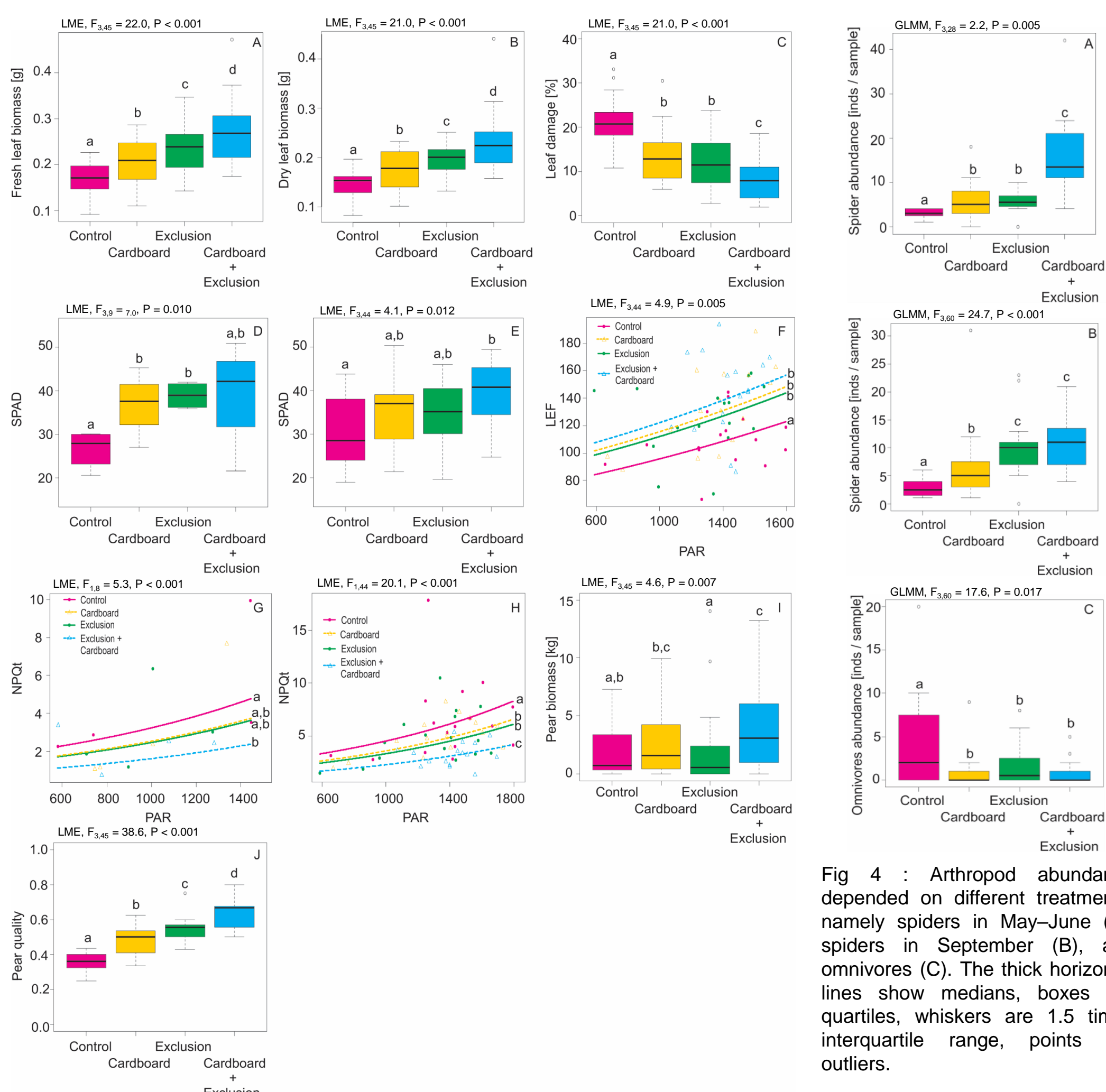


Fig. 3: Tree vitality parameters depended on different treatment, namely fresh leaf biomass (A), dry leaf biomass (B), leaf damage (C), special products analysis division (SPAD) in June (D), SPAD in September (E), the relationship between photosynthetically active radiation (PAR) and linear electron transport (LEF) in September (F), the relationship between PAR and the modified parameter of the non-photochemical quenching (NPQ) in June (G), the relationship between PAR and NPQ in September (H), the effect of treatment on the biomass of 10 pear fruits (I), and the quality of pear fruits (J). In panels [A–E, I, J], the thick horizontal lines show medians, boxes are quartiles, whiskers are 1.5 times interquartile range, points are outliers. In panels [F–H], the lines show the estimated relationships and the points are individual measurements. In all panels, different superscripts sign statistical difference ($P < 0.050$).

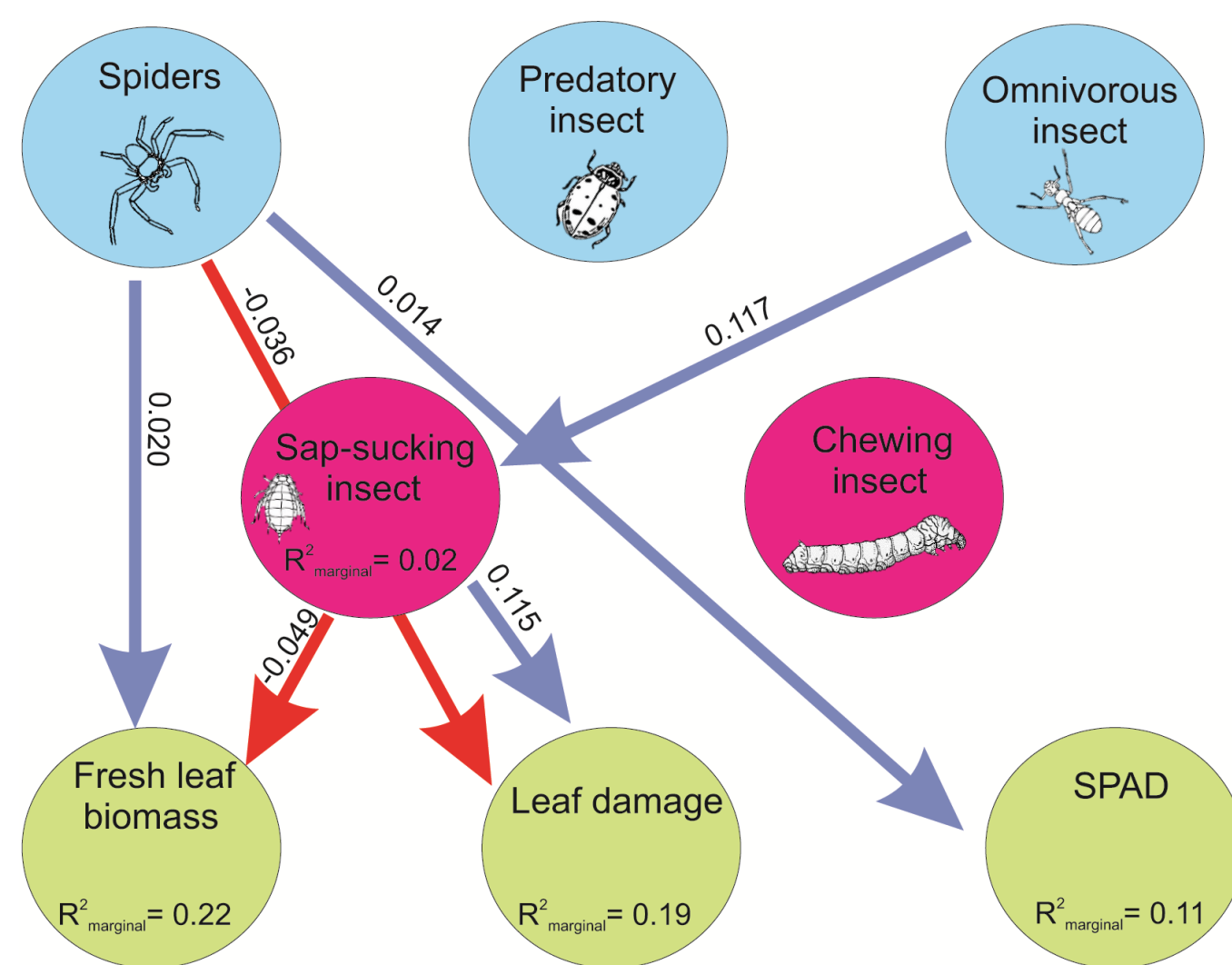


Fig. 5: SEM of relationships among predators, herbivores and vitality parameters. Arrows point from explanatory to response variable. The blue arrows indicate significantly positive relationship while red arrows indicate negative relationship. The estimated slope parameters are shown next to the arrows. Marginal R^2 s for the endogenous variables are displayed.

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METHODS

The study was conducted in four organic pear orchards, located in the South Moravian and Zlín regions. In each orchard, 16 trees were selected and divided into four groups with: a) natural control without any manipulation, b) installation of cardboard bands (Fig. 2A), c) exclusion of birds and bats (Fig. 2B), d) combination of exclusion and cardboard bands (Fig. 2C). During the growing season 2022 we measured vitality parameters (a) SPAD (relative chlorophyll content) and chlorophyll fluorescence parameters, b) leaf biomass and damage, and c) fruit weight and surface lesion) and sampled arthropods.

Fig. 1: Diagram showing effect of treatments according our hypothesis and expected results

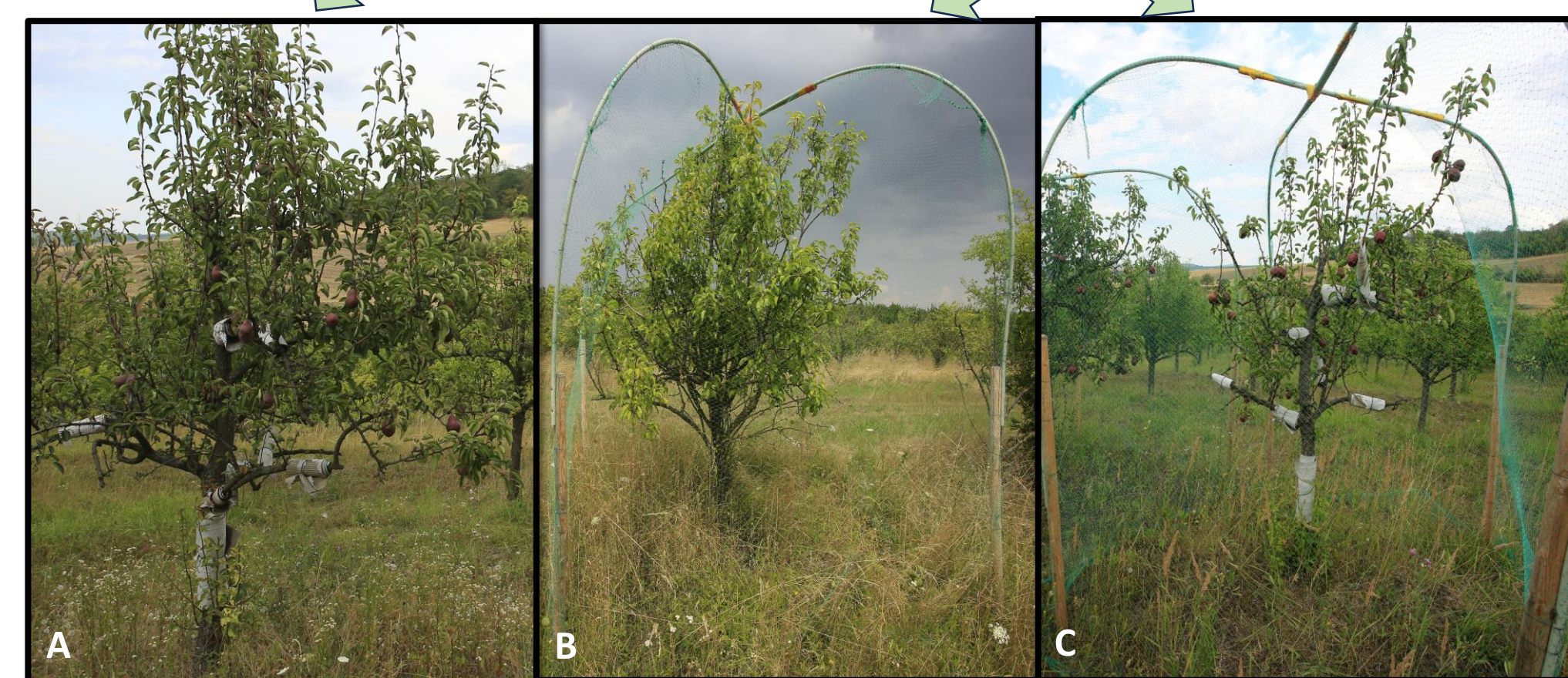
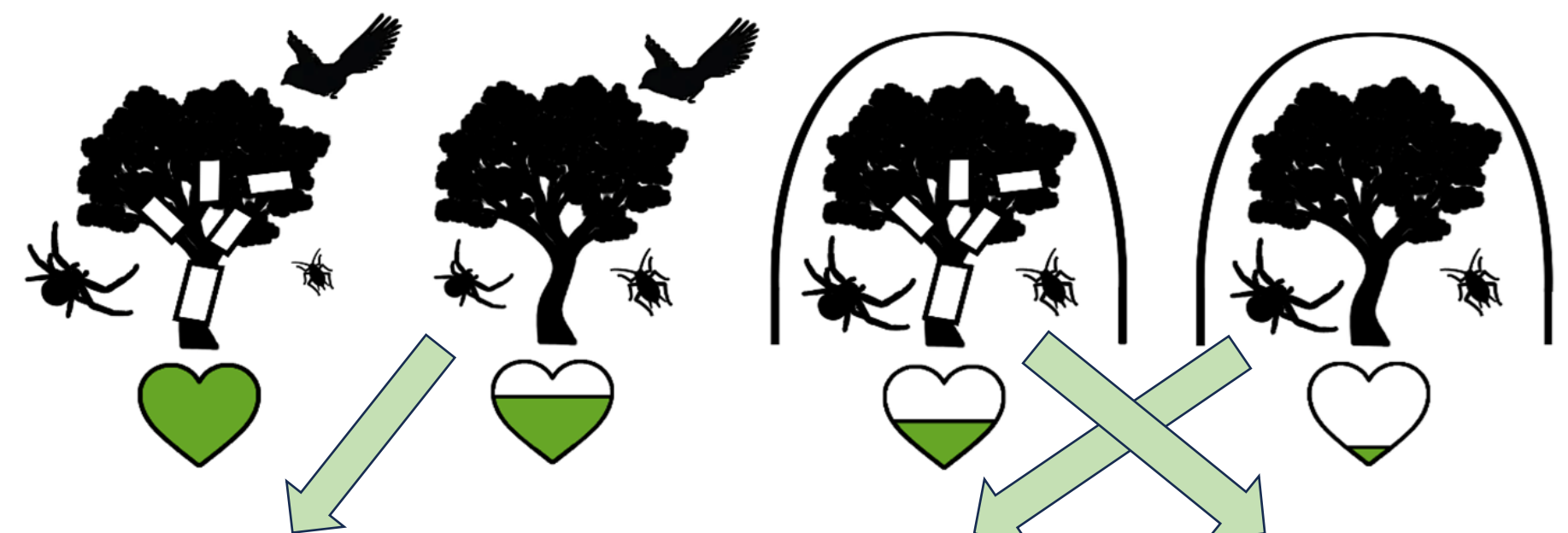


Fig. 2: Study design. Cardboard bands (A), birds & bats exclusion (B), combination of cardboard bands and birds & bats exclusion (C) (photo by Ondřej Košulič)

CONCLUSION

The results show that the invertivore vertebrates as top predators disrupted the biocontrol of pests by predation on spider mesopredators. Moreover, increased habitat heterogeneity (by installation of the cardboard bands) reduced intraguild predation by flying vertebrate predators on spider mesopredators and also among spider mesopredators. Our results highlight the crucial role that spiders play in enhancing tree vitality and productivity in pear orchards. By installing cardboard bands around tree trunks and branches, growers can foster spider populations in an affordable and environmentally friendly way. This simple intervention increases habitat heterogeneity and consequently reduces intraguild predation on spiders and among spiders, which supports healthier orchard ecosystem.

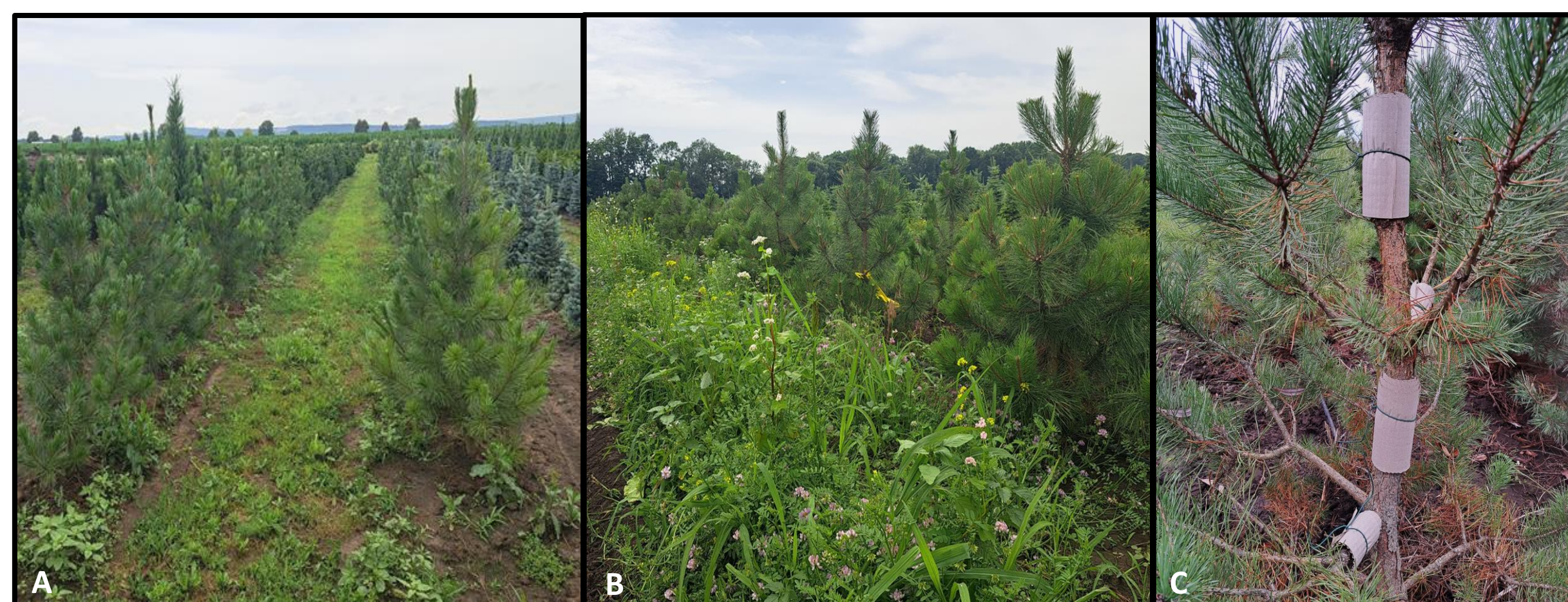


Fig. 6: Design of study in tree nursery: (A), row without flowering strip (B), row with flowering strip, (C) cardboard bands installed on selected pine trees (photo by Ondřej Košulič)

CURRENT RESEARCH

We have initiated a similar study in ornamental and forest tree nurseries, specifically focusing on pine trees. Our project aims to evaluate the effects of both indirect habitat modifications (flowering strips) and direct habitat modifications (cardboard bands, exclusion of birds & bats) on the vitality parameters and trophic cascades.

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