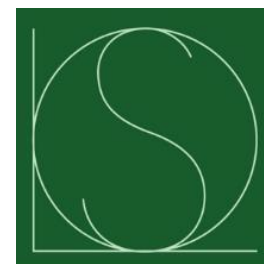




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Massive dying of Scots pine (*Pinus sylvestris*) forests in Czechia: current situation and research findings

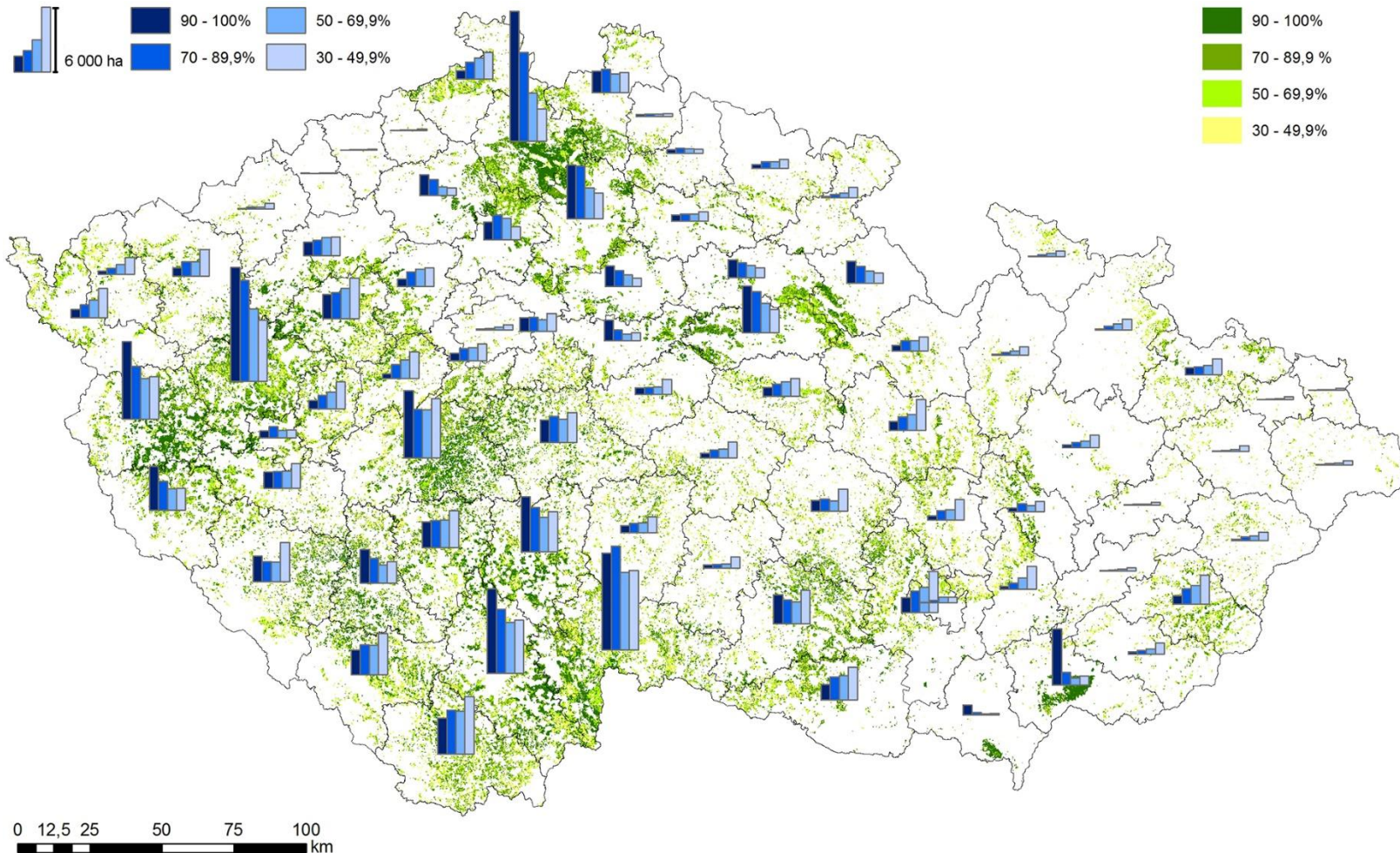


lesní ochranná služba

František Lorenc
for LOS team

Pinus sylvestris in Czechia

- Forests: 16.1 % - 2nd most important tree (1st *Picea abies* 48.8 %) (MZE 2021)



*Fig. Share of *Pinus sylvestris* at forest area in districts of Czechia according to the pine percentage (blue columns, length of columns show covered area), and percentage of the pine in the stand (yellow – green points) (NEUDERTOVÁ HELLEBRANDOVÁ et al. 2020).*

Current situation

- Extreme warm and drought period 2015 –2018 → weakening of *Pinus sylvestris* + activation of secondary biotic harmful agents → decline and dying of many pine stands
- 2015-2017 difference Bohemia vs Moravia; later bark beetles prevailed



Bohemia: drought + fungal diseases



Moravia: bark beetles

Research project NAZV QK1920406

Aims

- Describe the process and causes of the disease, its spatial and temporal distribution, harmful biotic agents and propose forest protection measurements



Research team

Main researecher

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Other researchers

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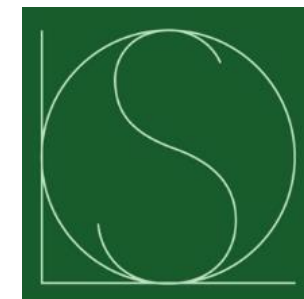
Other team members

Jana Fojtíková

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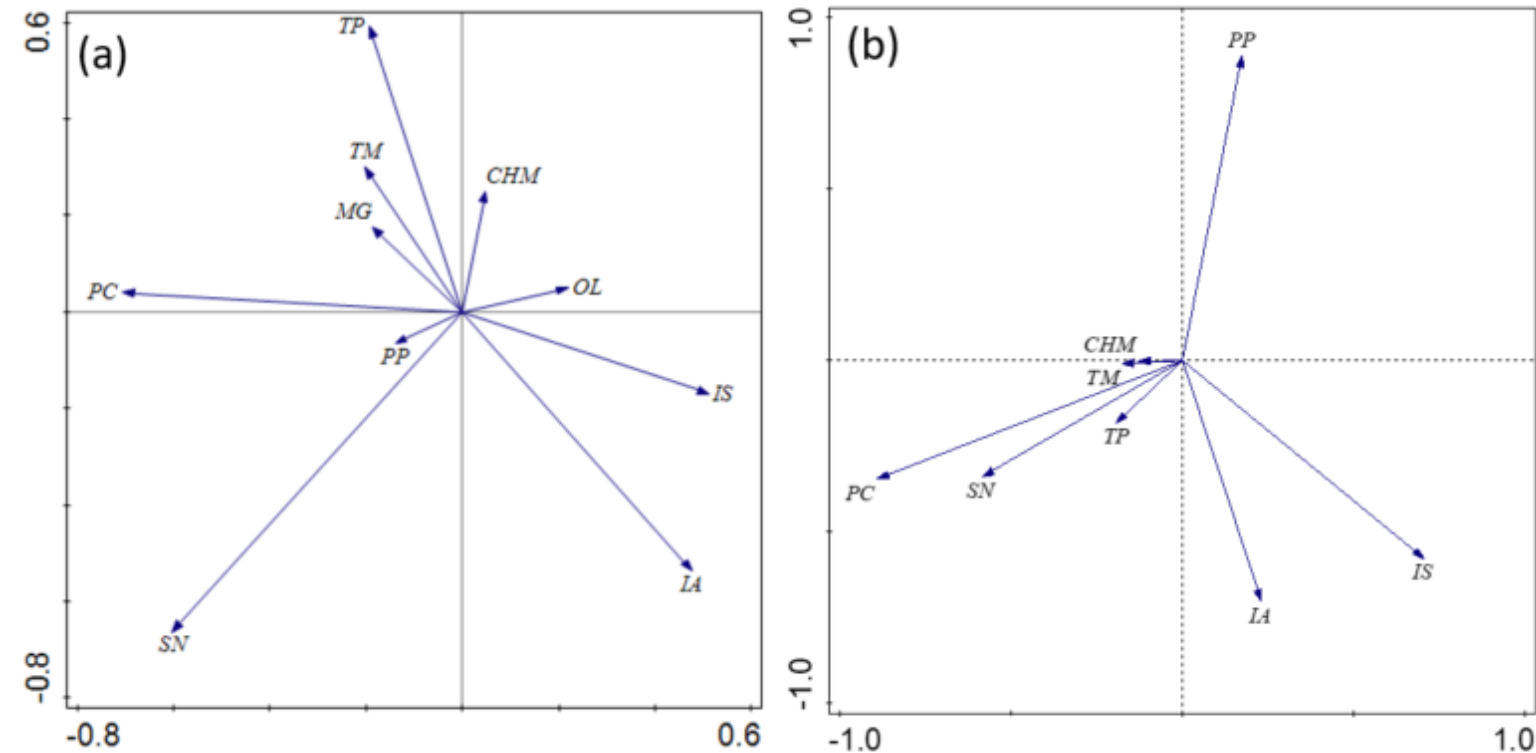
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Subcortical insects

- Investigation of insect pest species in pine plantations (77 localities in 6 regions)
- Bark beetles and wood-boring insects prevailed; no abundant foliophagous insects
- Most dangerous: *Ips acuminatus*, *Ips sexdentatus*, *Phaenops cyanea*, *Sirex noctilio*
- Pine mortality due to subcortical insects will probably increase

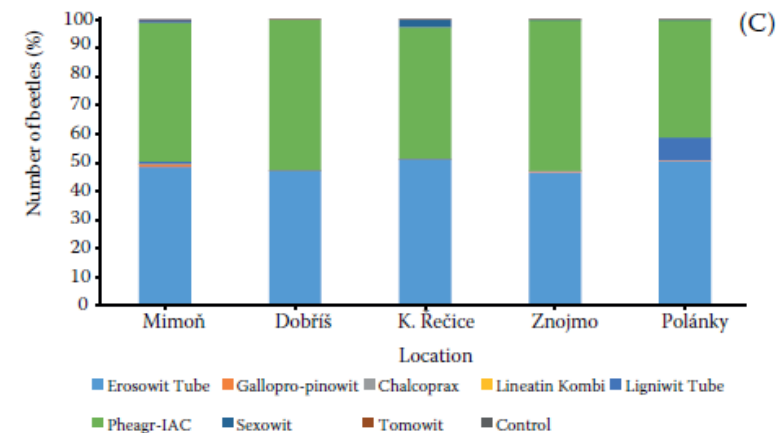
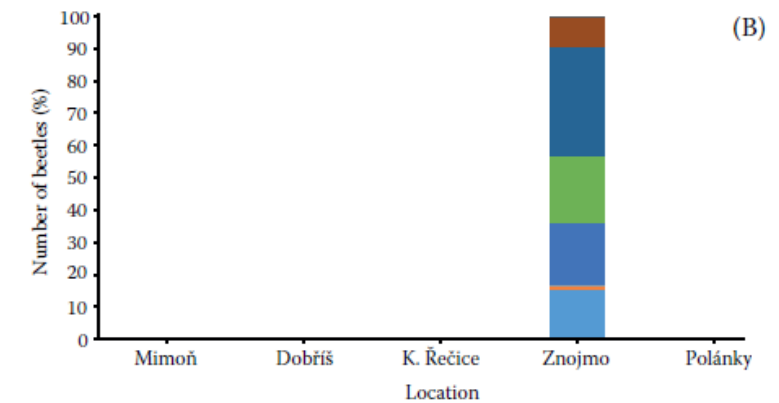
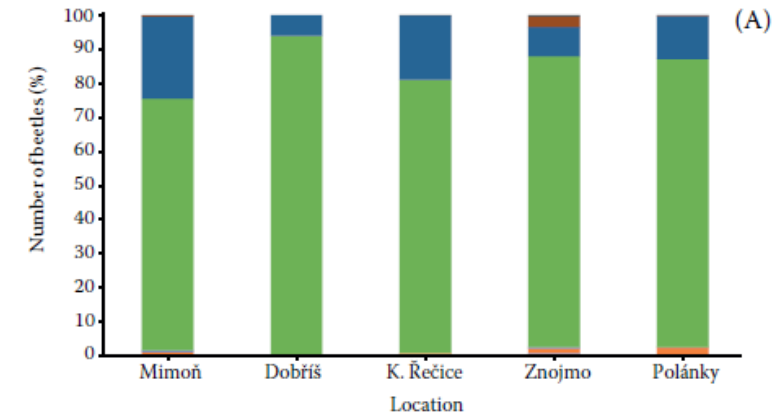


Graph. Unconstrained PCA ordination. Co-occurrence of 10 species in (a) mature stands and (b) pole timber stands. IA – *Ips acuminatus*, TM – *Tomicus minor*, SN – *Sirex noctilio*, PC – *Phaenops cyanea*, IS – *Ips sexdentatus*, TP – *Tomicus piniperda*, PP – *Pissodes* spp., CHM – *Chalcophora mariana*, MG – *Monochamus galloprovincialis*, OL – *Orthotomicus longicollis* (LIŠKA et al. 2022)

Subcortical insects

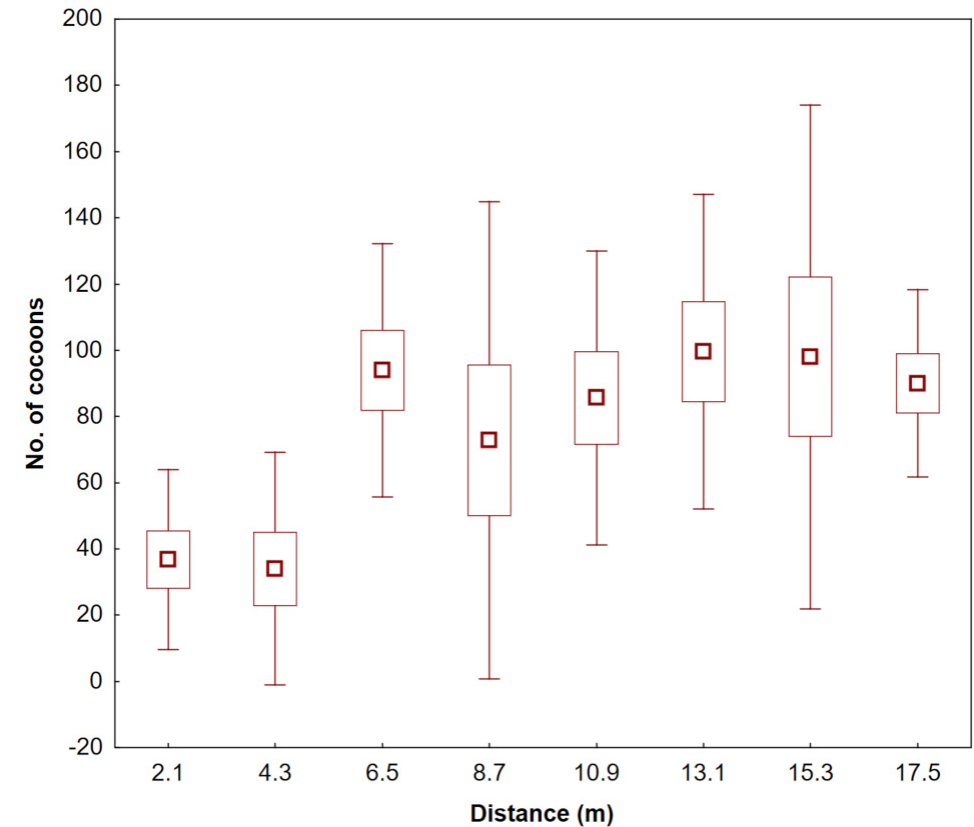
- Testing the efficacy of commercially available pheromone synthetic lures (10 trap series - 8 lures, 2 controls)
- *Ips acuminatus* and *I. sexdentatus* were most abundantly captured in Pheagr-IAC- and Sexowit-baited traps
- *I. typographus* was also captured, most often in with Pheagr-IAC and Erosowit Tube traps
- The number of captured beetles was consistent with the gradation phase of bark beetles
- Suitability of pheromone traps for bark beetle monitoring

Graph. % of beetles captured in different pheromone traps at the five study sites. (A) – *I. acuminatus*; (B) – *I. sexdentatus*; (C) – *I. typographus*; (*I. sexdentatus* shown in Znojmo only – small numbers in other localities (KNÍŽEK et al. 2022)).



Ernestia rudis

- *E. rudis* (diptera): important population regulator of *Panolis flammea* (moth), which causes extensive damage in pine plantations
- Impact of red wood ants (*Formica rufa* group) as predators on abundance of *E. rudis*
- *E. rudis* cocoons: 8 soil samples / anthill (nest) surrounding, 10 nests in 40-year-old pine plantations
- Considerably lower abundance of *E. rudis* only to 4.5 m from the nests
- *F. rufa* ants had no significant effect on *E. rudis* population in plantation forests, where ants populations are low



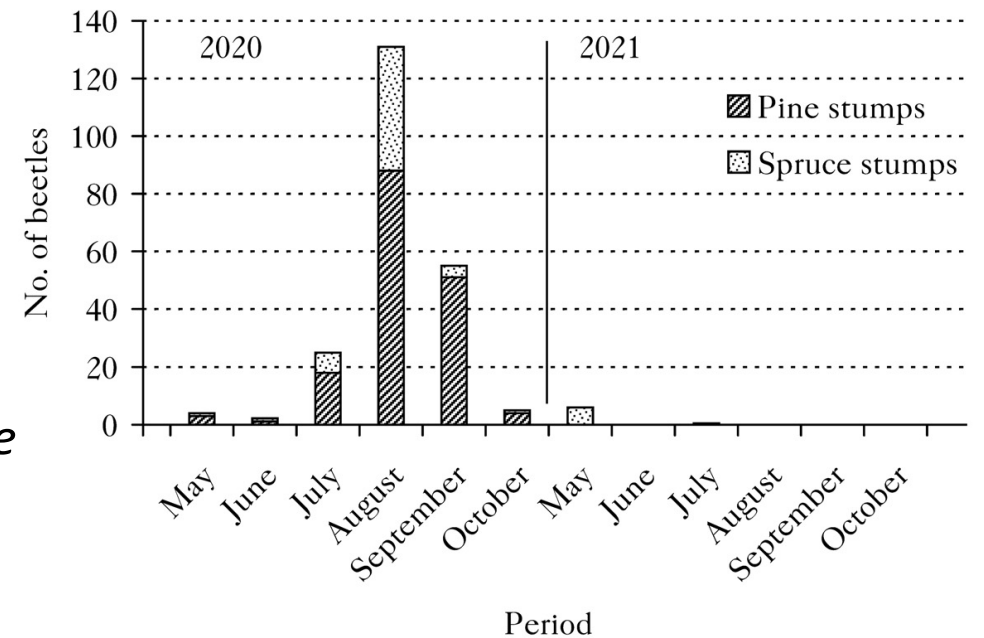
Graph. Mean, standard error (box) and standard deviation (whiskers) of the number of *E. rudis* cocoons according to distance from wood ant nests (VÉLE, DOBROSAVLJEVIČ 2022)

Hylobius abietis

- The most important insect pests of fresh coniferous plantations, outbreak in recent years

Suitability of spruce and pine stumps

- Fotoeclector traps: 18 pine, 18 spruce
- Beetles from spruce : lower numbers, higher weight, longer development time (lower nutritional quality, lower competition for resources)
- Sex did not depend on either tree species or stump diameter



Graph. Number of H. abietis beetles hatched from pine stumps and spruce stumps in each capture Period. No individuals were captured in March-April (VÉLE 2022).

Hylobius abietis

Impact of environmental factors on abundance

- Fotoeclector traps (fig. above), 36 stumps
- No impact: stump thickness, canopy, vascular plants
- Positive impact: moss (better microclimate, lower predation risk)
- Measures: remove moss



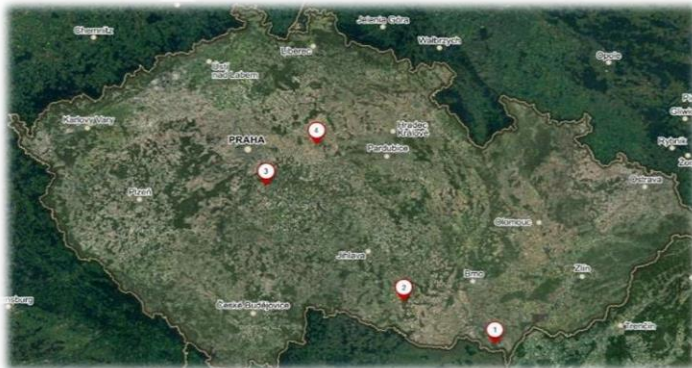
Influence of chipping of wood residues

- Earth traps (fig. below)
- Ca 2/3 of beetles caught on areas with non-chipped branches (higher volatile substances, more hiding places)
- Measures: chipping of wood residues and their incorporation into soil + keep stocking density low



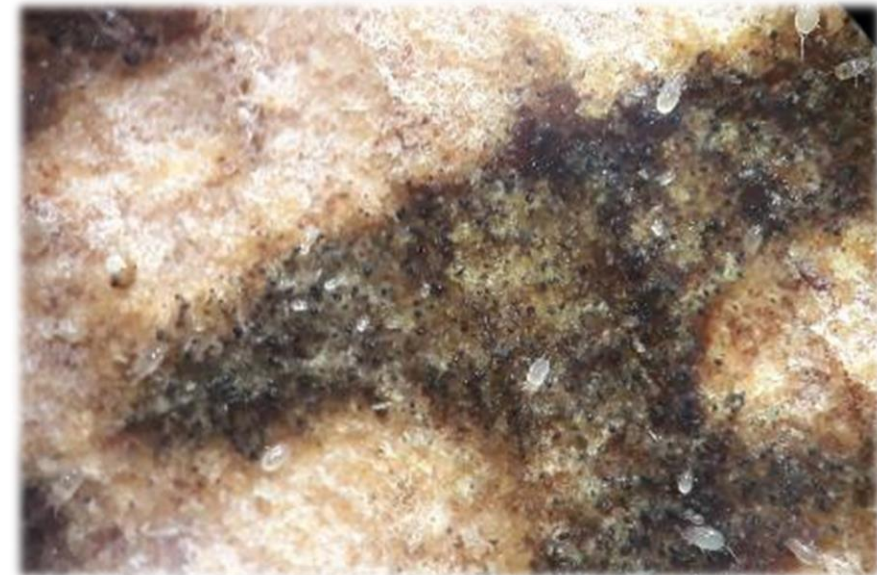
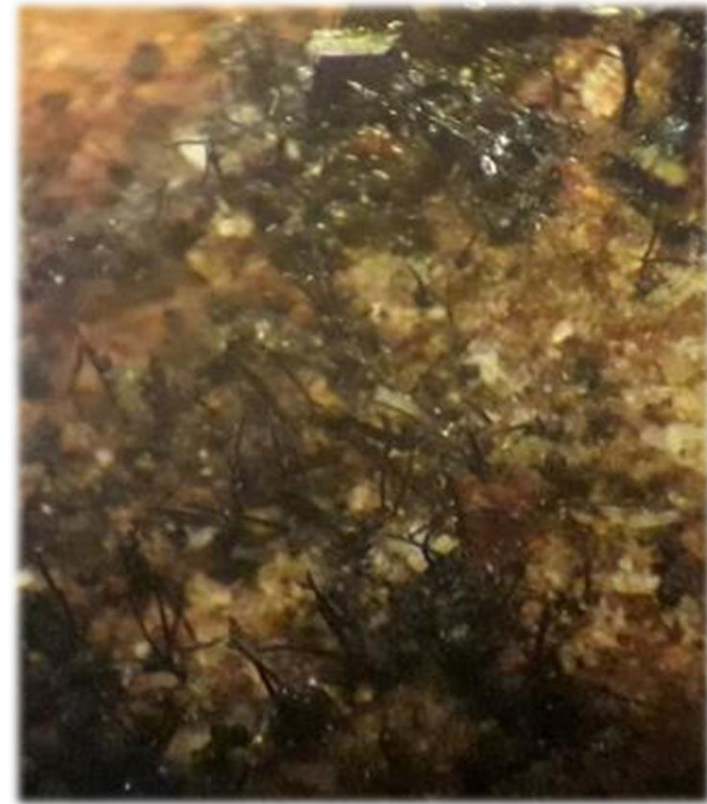
Sphaeropsis sapinea

- Fungal pathogen, since 2015 important on *P. sylvestris* weakened by drought
- Evaluation of *S. sapinea* colonization on *P. sylvestris* cones (N 520, 4 sites – see map) and trunks (N 340, at 17 sites)
- Positive relationship between *S. sapinea* and: (1) high humidity, (2) subcortical insects in inner bark, (3) subcortical insect in wood; not between *S. sapinea* and wood-decaying fungi
- Colonization and infection of *S. sapinea* may not be positively correlated
- Control: fruit bodies of *S. sapinea* - indicators of possible threat of pines in the coming years
- Measures: preventing colonization by subcortical insects



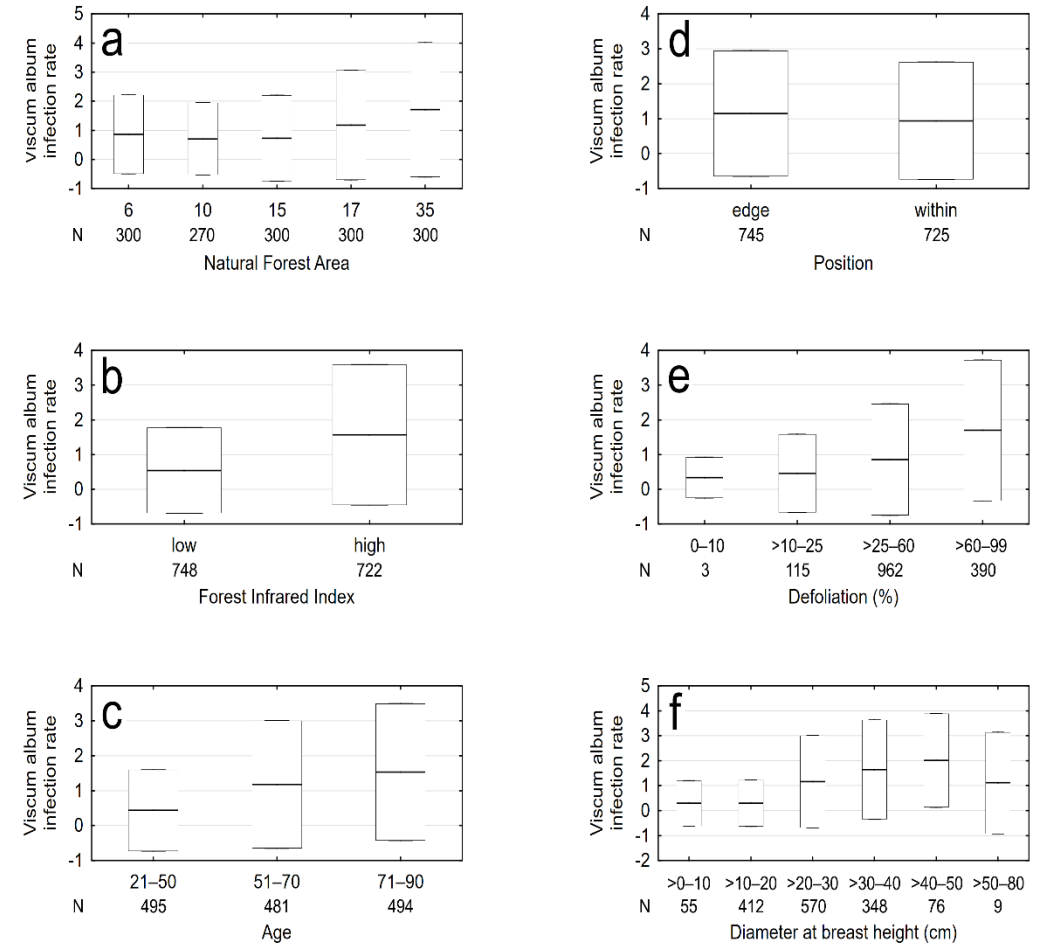
Ophiostomatoid fungi

- Evaluation of presence of ophiostomatoid fungi wood bolts (72) from freshly felled pines (24), cultivation in wet chambers for 8 weeks
- Oph. fungi present (fig. above) on 33 % of stumps (50 % trees)
- Positive relationship to: mites (fig. below), Nematocera larvae (long-legged insects) (vectors, food)
- Significant differences: sampling period (autumn > summer > spring)
- No significant differences: locality, tree age (30-40, 50-90), wood bolt (bottom trunk, middle trunk, twigs), defoliation
- Insignificant impact of oph. fungi on health of *P. sylvestris*



Viscum album subsp. austriacum

- Previously marginal, massive spreading during recent years
- Evaluation of infection rate (classes 0-6) in *P. sylvestris* in five natural forest areas (NFA)
- Higher mistletoe infection: stands with higher Forest Infrared Index (higher drought stress), older stands, stand edge, higher DBH, higher defoliation, NFA 35 Jihomoravské úvaly (south Moravia), upper and middle crown tree parts
- Measures: (1) selecting drought- and heat-resistant *P. sylvestris* varieties, (2) focussing plantation efforts to areas with lower temperatures and higher precipitation, (3) reduction of rotation period



Graph. *Viscum album* infection rate. Center line – arithmetic mean, box – standard deviation. N – number of observations (LORENC, VÉLE 2022)

Prognosis

- Further drought periods → further overgrowth of subcortical insects → continuing decline and dying of pine stands
- Pine stands on sandy soils and in colder areas have better chance to survive



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Thank you for your attention

