Using the Field-Map technology to protect endangered plant species: *Cypripedium calceolus* case study

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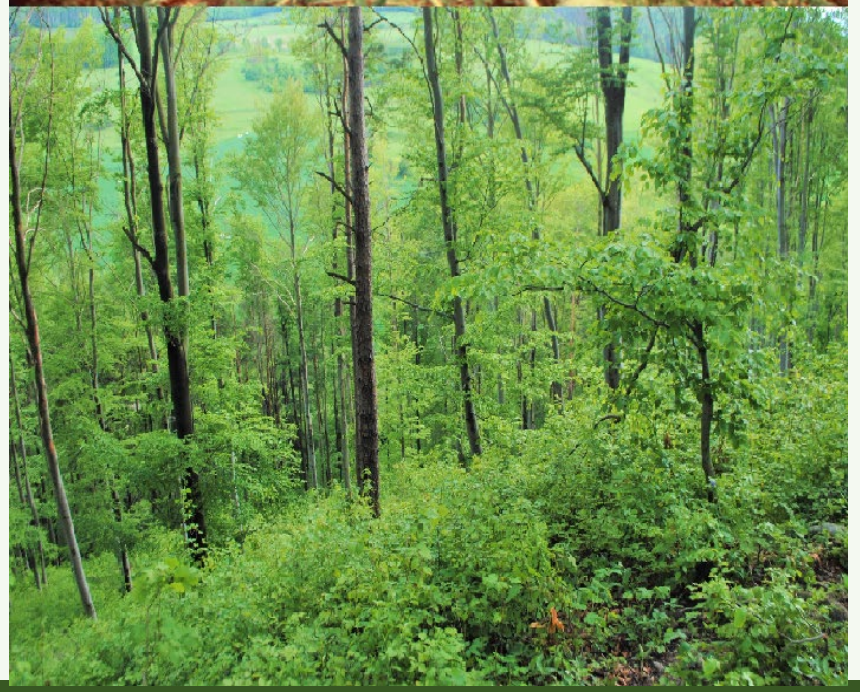
Background of the project

- Decline in *Cypripedium calceolus* L. population;
- Drought;
- Beech forest dieback;
- Conflict between State Forests and Activists;



Background of the project

August 2019

- Traineeship in Jilove u Prahy (IFER)

September 2019

- Field-Map measurments

Aim

Analyze the relationship between the occurrence of the *C. calceolus* ramets and variables related to forest stand structure. Additionally, the morphometrics of the individuals were taking into consideration.

Questions

1) What is the relationship between the distribution of trees and ramets of *C. calceolus*?

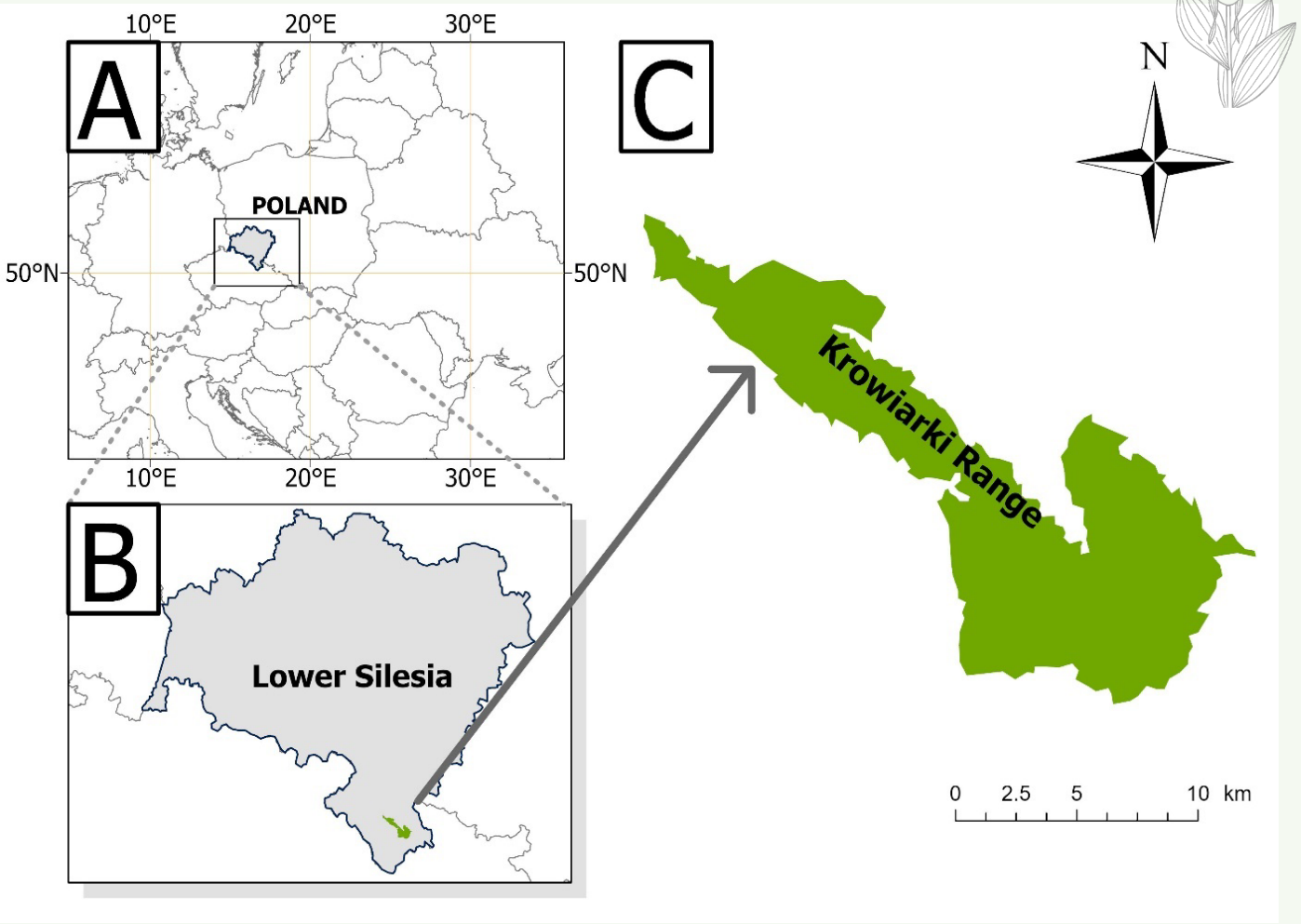
2) Is the distribution of *C. calceolus* affected by the presence of canopy gaps or tree saplings?

3) How does forest stand structure affect flowering and morphometric features of *C. calceolus* ramets?

only a few studies have dealt with the relationship between forest structure and this orchid species;

Sampling area

- Calcareous soils (fertile)
- High species richness



'Krowiarki Range' ('Pasmo Krowiarki') Natura 2000 site (C) in Central-European (A) and regional context (B)

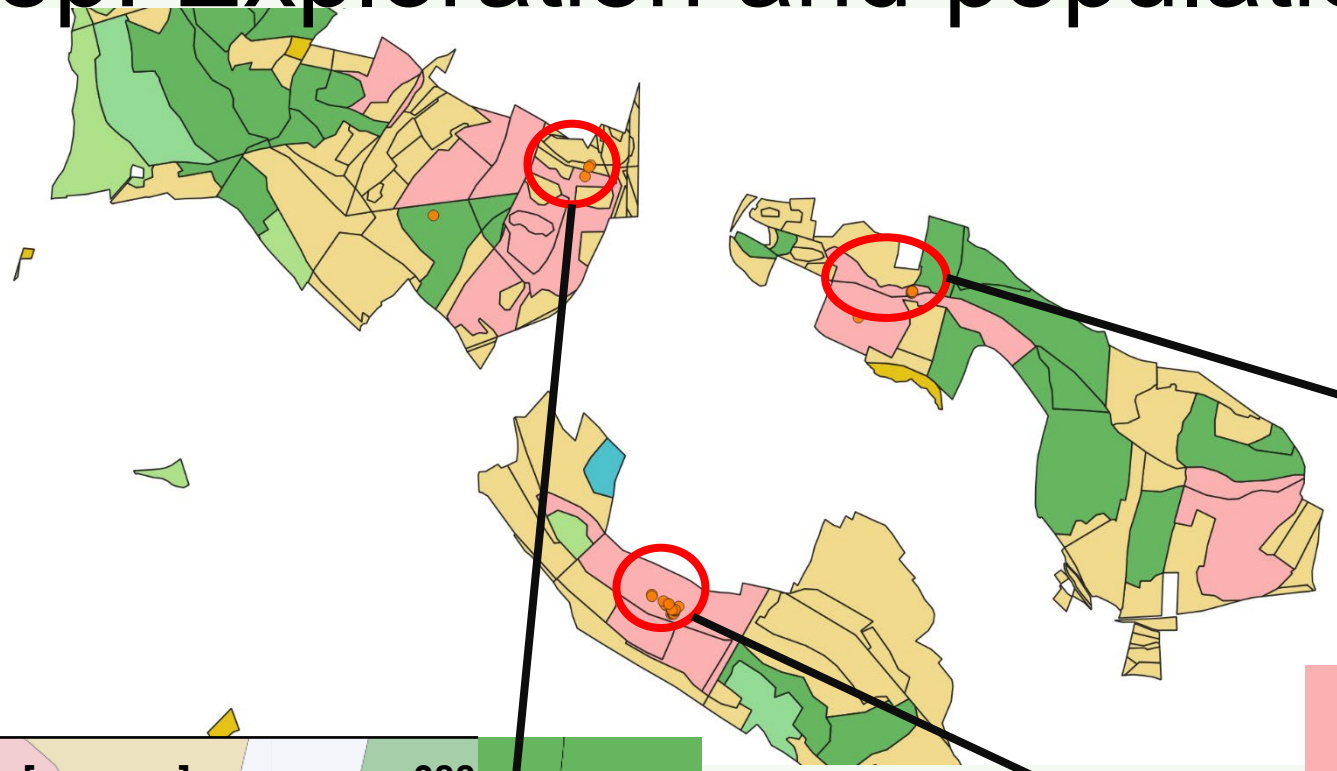
Study object

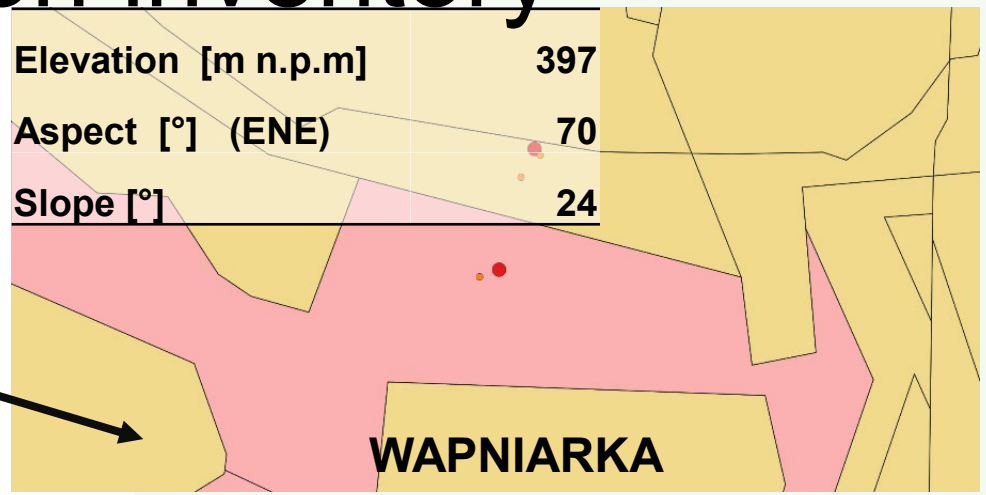
❖ Field sampling

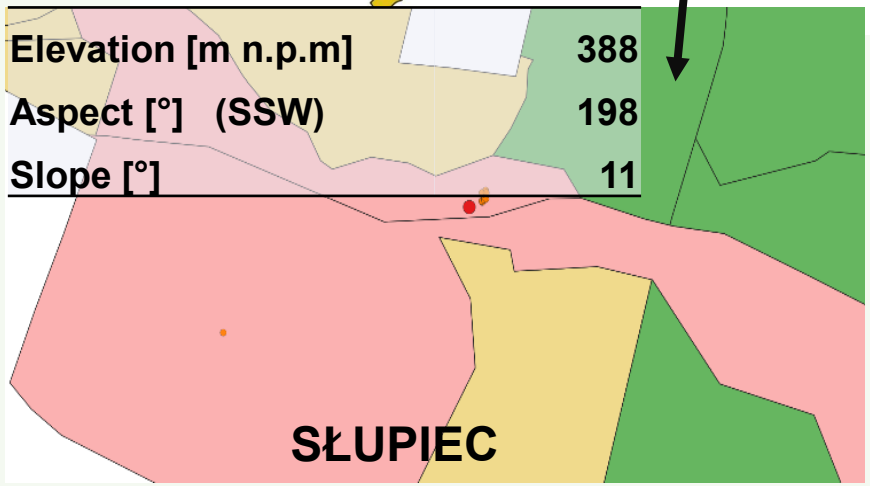
❖ Vegetation season 2019 and 2020

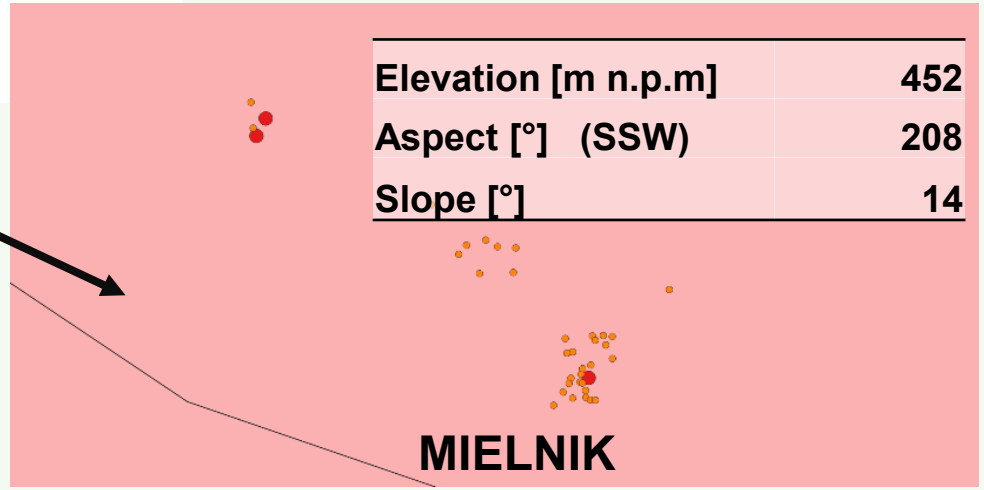
1. Exploration and population inventory
2. *C. calceolus* morphometric mesurments
3. Mapping main population
   - C. calceolus distribution
   - forest stand

I Step: Exploration and population inventory`









II Step: *C. calceolus* morphometric mesurments

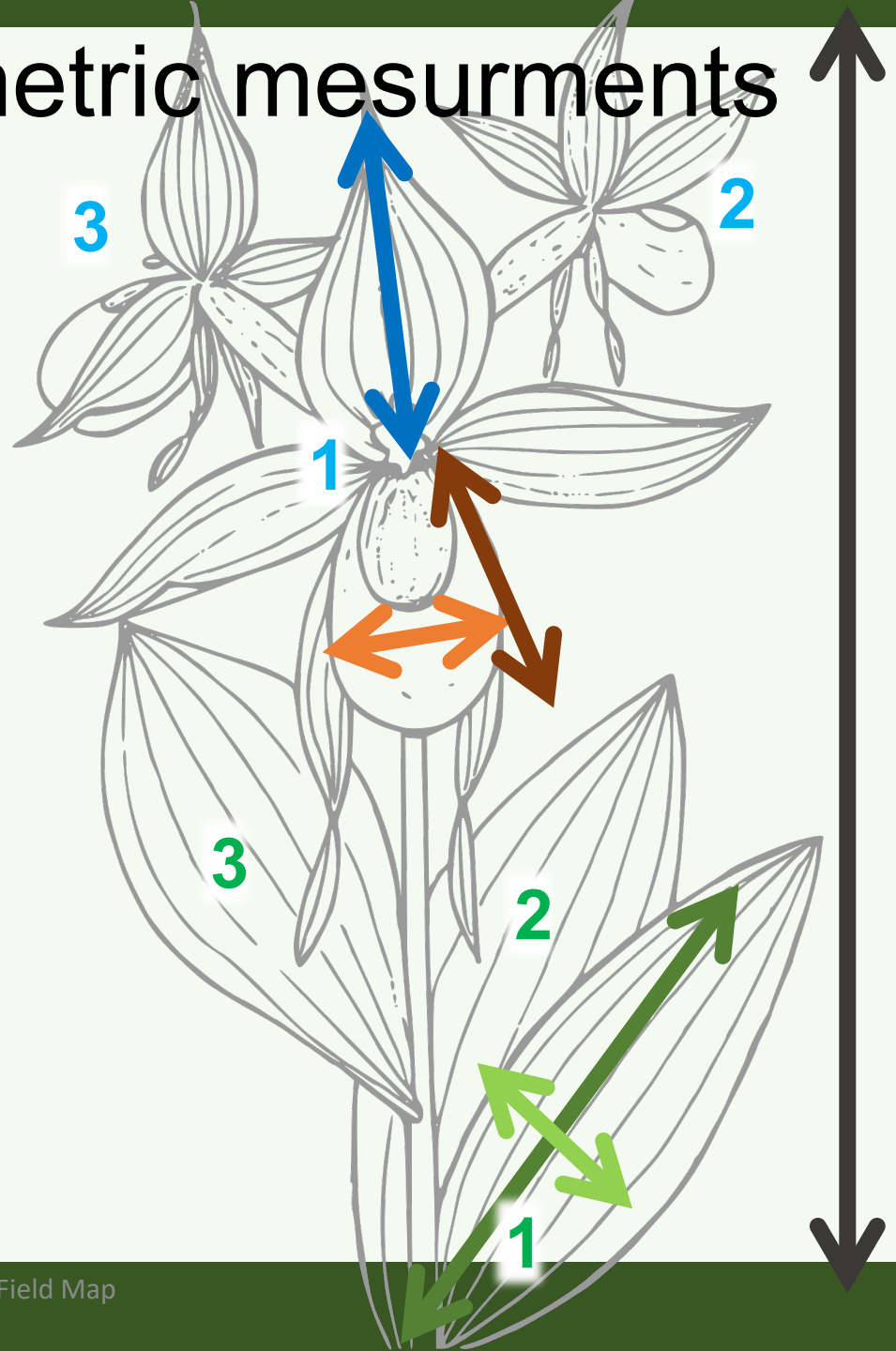
- Flowers:

number, labellum width and the lengths, and upper petal in the perianth

- Leaves:

number, length and width of every leaf

- Height of the whole plant



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III Step: Mapping main population

Field-Map

- *C. calceolus* distribution
- forest stand
  - spatial distribution of trees
  - crow projection
  - diameter at the breast height
  - sapling density (polygon)

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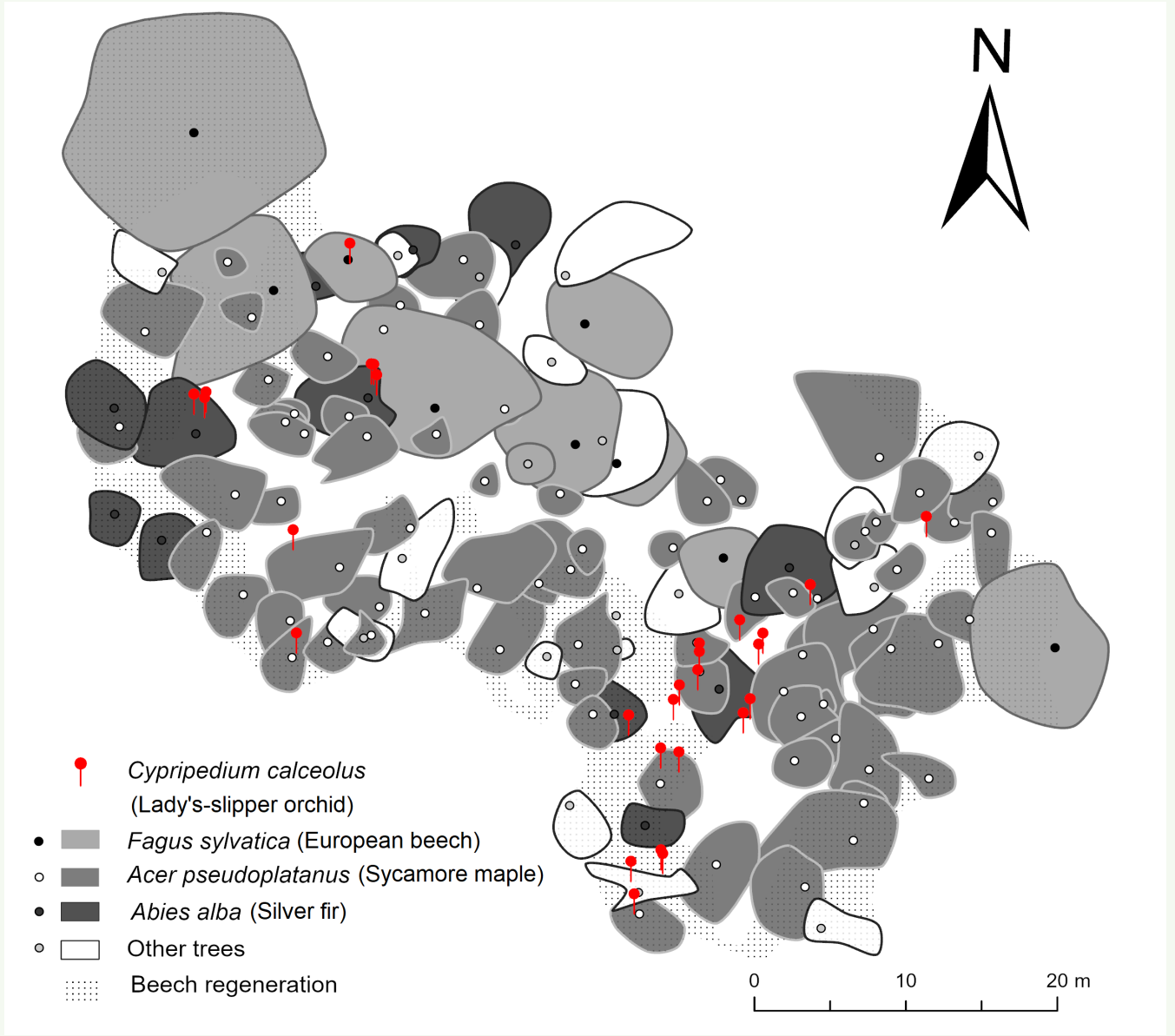
III Step: Mapping main population

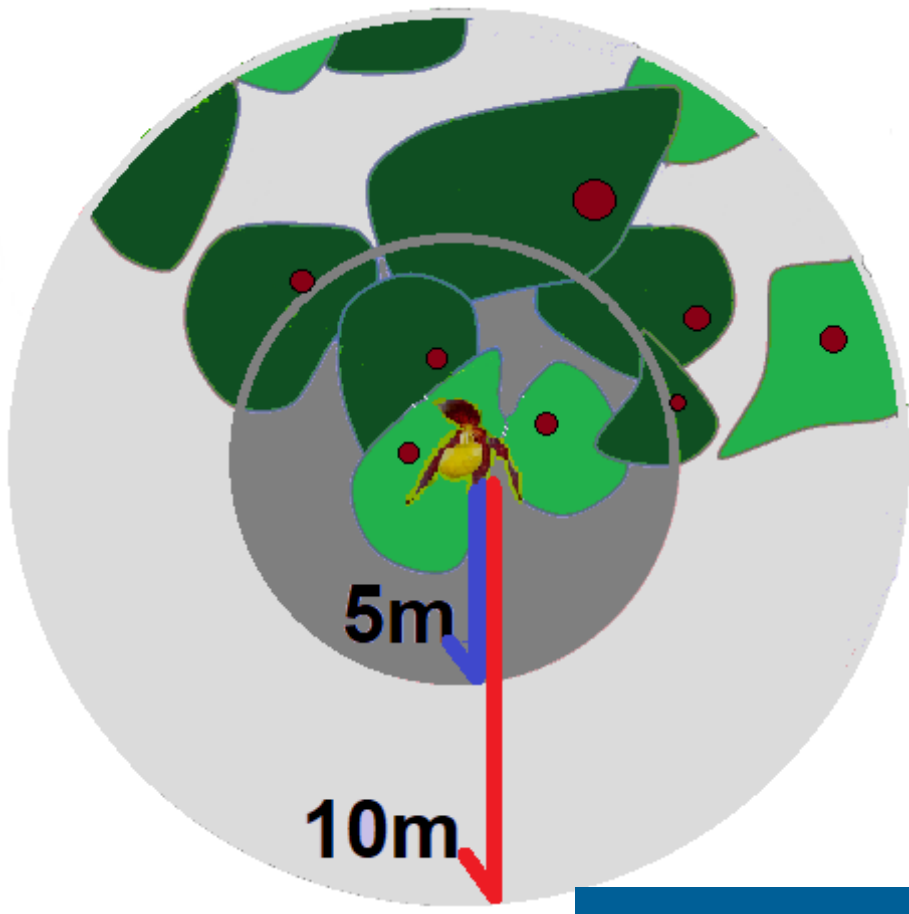


Calculation of environmental variables

❖ **Environmental variables:**

Calculated
in addition to
C. calceolus individuals also for 50 random points.

- Distanse to nearest tree
- Basal area of trees
- Canopy gaps
- Maximum DBH of the tree;
- Distance to tree crown;
- Localization inside regeneration patchs
- Etc.



ArcGIS Pro

Statistical analyses

❖**Statistical analyses**

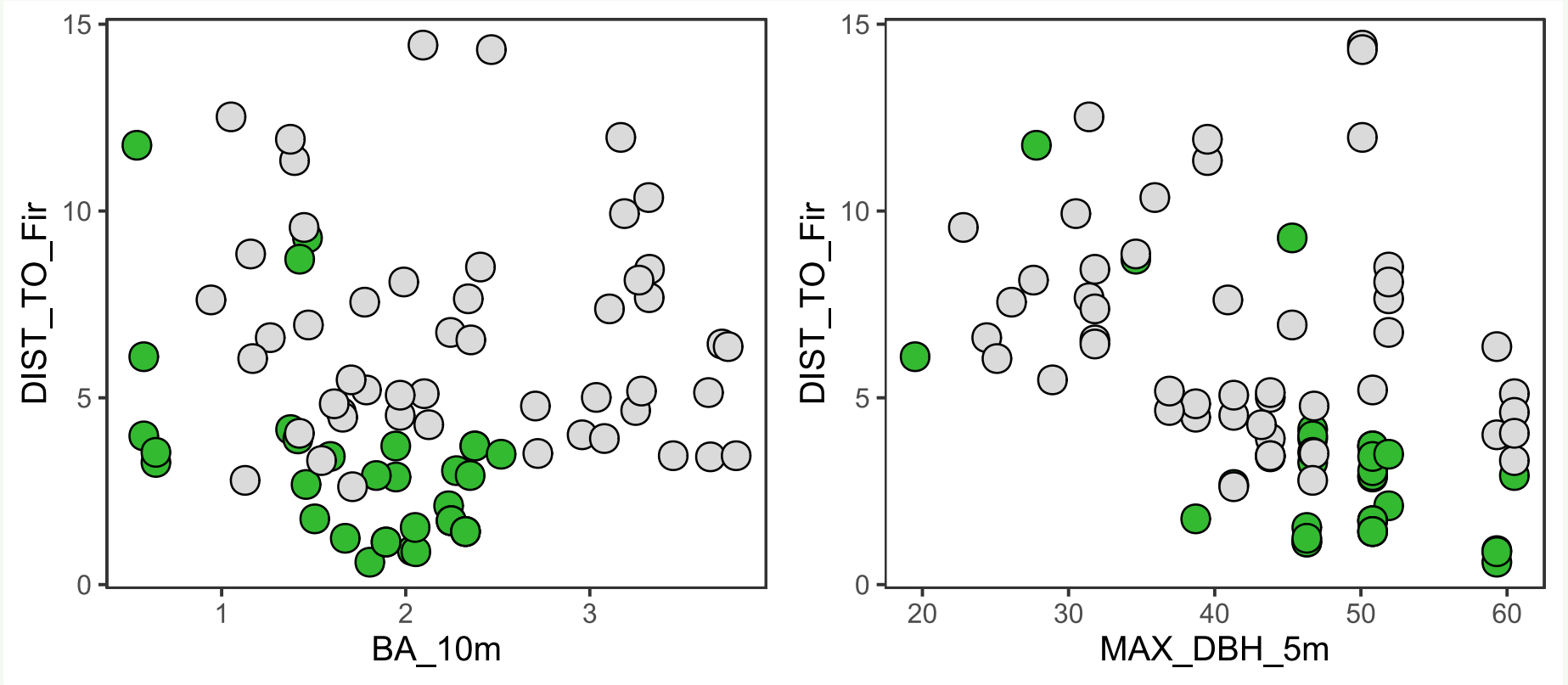
- multivariate logistic regression
- stepwise elimination method (stepAIC)
- one-dimensional logistic regression models
- Bonferroni-corrected p-values of the t-test for correlation (morphometric)

RESULTS I

- We measured 114 trees around 34 *C. calceolus* ramets;
- The probability of the presence of *C. calceolus* decreased with the distance to fir trees and with an increase in the basal area, but increased with maximum DBH in 5 meters buffer zone (next page table);
- The ramets growing close to European beech or sycamore maple had slightly lower leaf dimensions than the ramets in the surroundings of fir and a pattern of decreasing leaf size with proximity to beech or sycamore was visible;
- The flowers did not show any relationship with environmental variables.

RESULTS II

Variable	Label	Estimator	SE	z-value	p
(Intercept)		2.653	2.308	1.149	0.001**
Distance to nearest fir stem	DIST_TO_Abies	-0.567	1.174	-3.264	0.001**
Basal area within 5 m radius	BA_5m	-5.160	1.902	-2.713	0.006**
Basal area within 10 m radius	BA_10m	-1.376	0.593	-2.321	0.0203*
Maximum DBH within 5 m radius	MAX_DBH_5m	0.100	0.492	2.044	0.0409*



Cypripedium calceolus

random points

CONCLUSIONS

- The forest stand structure plays an important role in spatial distribution of *C. calceolus* ramtes*;*
- The strongest positive effect of silver fir can be related to water and moisture conditions;
- Negative impact of European beech on *C. calceolus* can be explained by light conditions and stemflow;
- The results of this research may help to tune-up forest management and protect this rare orchid.

RECOMENDATIONS

- planting silver fir in beech forests
- supporting forest regeneration by species other than European beech
- active protection in the dense pathes dominated by regeneration of the beech trees
- fencing population areas to exclude browsing pressure from wild ungulates
- management strategies focusing on the conservation of Lady’s slipper orchids should account for the presence of open sunny places and flowering plants as food resources for pollinators.

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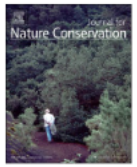

Effects of forest stand structure on population of endangered orchid species *Cypripedium calceolus* L.

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ABSTRACT

Lady's slipper orchid (*Cypripedium calceolus* L.) has suffered a dramatic decline and is one of the most endangered orchid species in Europe. It grows mainly on calcareous soils in deciduous and mixed forests. Although numerous studies have contributed to our understanding of the causes of *C. calceolus* decline, surprisingly, little is known about the effects of the forest stand structure on the spatial distribution and morphometric characteristics of *C. calceolus* ramets. In this study, we analyzed how the spatial distribution of tree species and several structural characteristics of the forest stand affect the distribution and morphology of ramets of *C. calceolus*. For this, we used a remnant population of this species located in extensively managed forests in the Krowiarki Range (the Sudetes, SW Poland). The alarming decline in *C. calceolus* in this region over the last century is commonly attributed to forest management and land-use changes (abandonment of pastoralism in forests). We analyzed the morphometric characteristics and spatial distribution of *C. calceolus* ramets in this population in relation to the spatial distributions of trees, canopy gaps, saplings and structural characteristics of the forest stand. For this, we combined precise measurements of the forest stand structure, spatial analyzes in GIS and multivariate logistic regression modeling.

The probability of the occurrence of *C. calceolus* was best predicted by its proximity to silver fir trees. We attributed this mainly to a positive effect by silver fir on the topsoil moisture, which can be especially beneficial to *C. calceolus* as this species is sensitive to drought. The occurrence of *C. calceolus* ramets was negatively affected by the basal area and positively affected by the diameter at the breast height of trees growing in a 5 m buffer

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