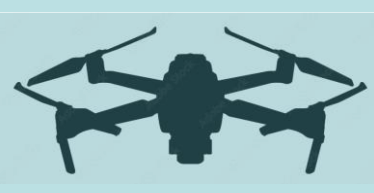
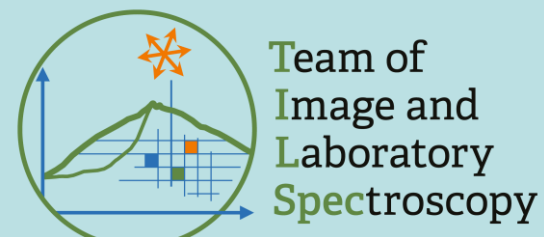




Monitoring native and alien species spread to alpine tundra: botanical research and airborne technology combined to assess conservation risk



Michaela Vítková¹, Lucie Kupková², Jan Pergl¹, Lucie Červená², Jan Čuda¹, Zábaj Hrázský^{2,3}, Natálie Kolombová^{1,4}, Klára Kušková^{1,4}, Josef Kutlvaš^{1,4}, Jakub Lysák², Irena Perglová¹, Markéta Potůčková², Jiří Sádlo¹, Petra Svobodová⁵, Lucie Brožková^{1,6}, Vojtěch Vitek^{1,6}, Petr Pyšek^{1,7}

¹Department of Invasion Ecology, Institute of Botany, Czech Academy of Sciences, CZ-252 43 Průhonice, Czech Republic

²Department of Applied Geoinformatics and Cartography, Faculty of Science, Charles University, Albertov 6, CZ-128 43 Prague, Czech Republic

³Krkonoše Mountains National Park Administration, Dobrovského 3, CZ-543 01 Vrchlabí, Czech Republic

⁴Faculty of Environmental Sciences, Czech University of Life Sciences, Kamýcká 129, CZ-165 00 Prague, Czech Republic

⁵Nature Conservation Agency of the Czech Republic, Administration of the Orlické hory Protected Landscape Area, Dobrovského 332, CZ-516 01 Rychnov nad Kněžnou

⁶Botičská Grammar School, Botičská 1, CZ-128 01 Prague, Czech Republic

⁷Department of Ecology, Faculty of Science, Charles University, Viničná 7, CZ-128 44 Prague, Czech Republic



Study sites: Krkonoše Mts (a tundra island in the heart of Europe) and Orlické Mts (Czech Republic, Europe)

- The objective is to develop an automated technology for monitoring the spread of selected invasive/expansive plant species and the efficacy of different management strategies in difficult-to-access mountainous areas using airborne technology.
- Field survey: multispectral UAV data with very high spatial resolution (Dron DJI Mavic 3 Multispectral) and botanical reference data (GPS mapping, relevés on permanent plots).
- Comparison between detection under ideal (mostly flowering period) and limiting conditions (e.g. sprouting of leaves, species mixture, steep slope, shading, mowing and grazing).
- Controlling the efficiency of different managements (grazing, mowing, chemical treatment, mulching, weeding).
- Verification of modern advanced technologies (UAV, remote sensing, satellite imagery), advanced statistical analysis and automated image processing techniques (machine learning, object classification).
- Our results will provide the user with an effective tool for the early detection and monitoring of risky species, and thus reduce the eradication costs.

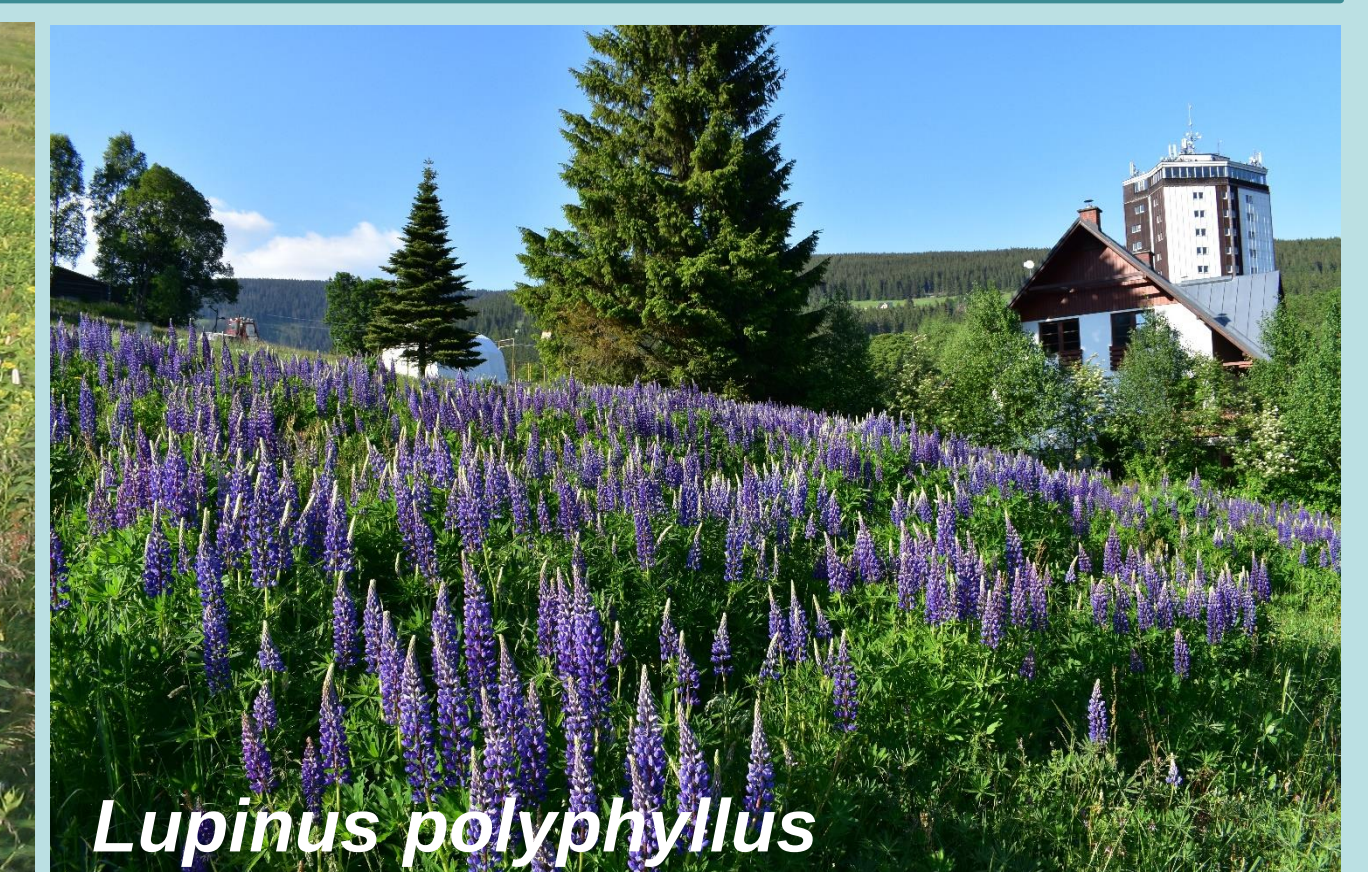
The species studied represent risk to valuable mountain vegetation

Native expansive species

Alien invasive species



Senecio nemorensis agg.



Lupinus polyphyllus



Veratrum album ssp. *lobelianum*



Rumex alpinus

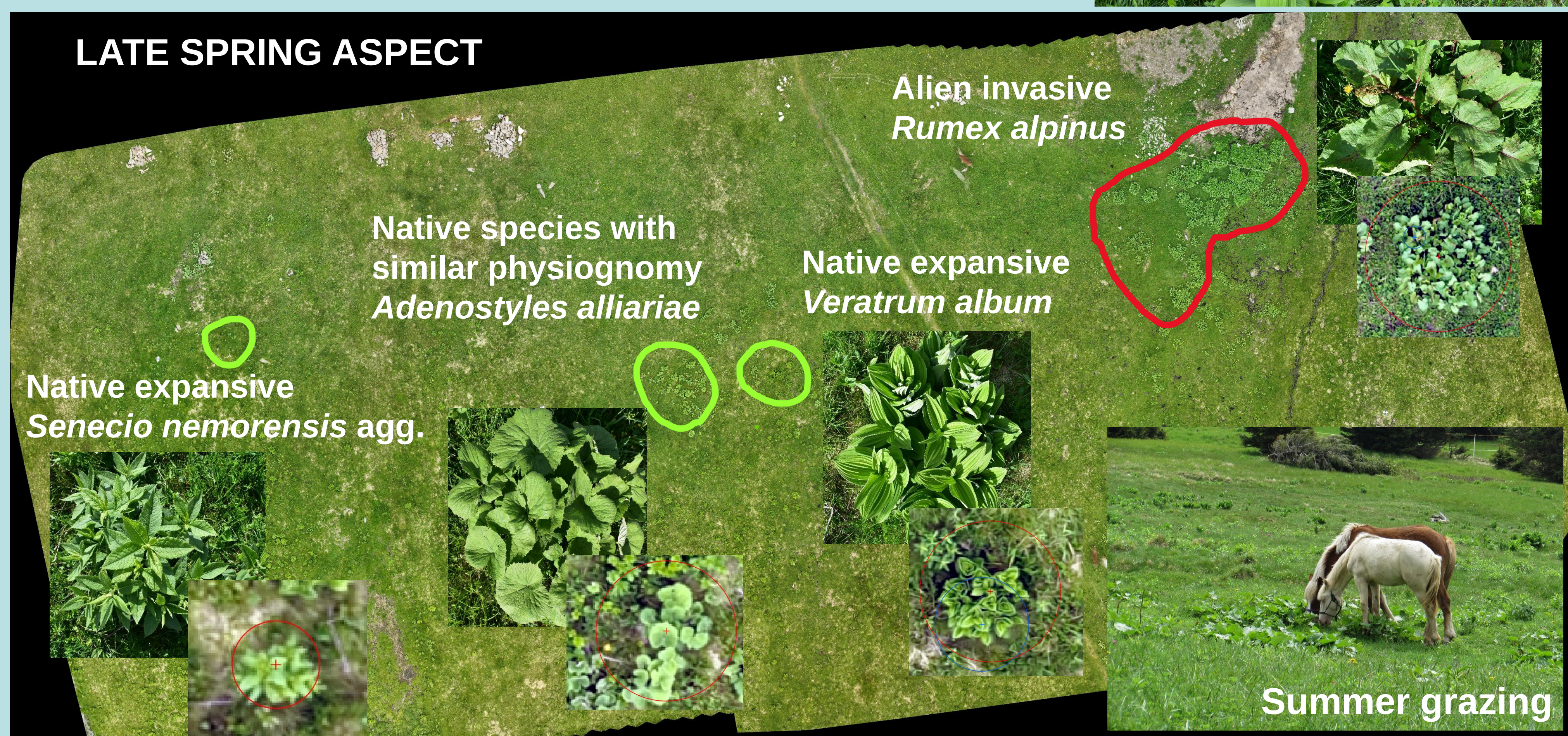
The first five months working on the project:



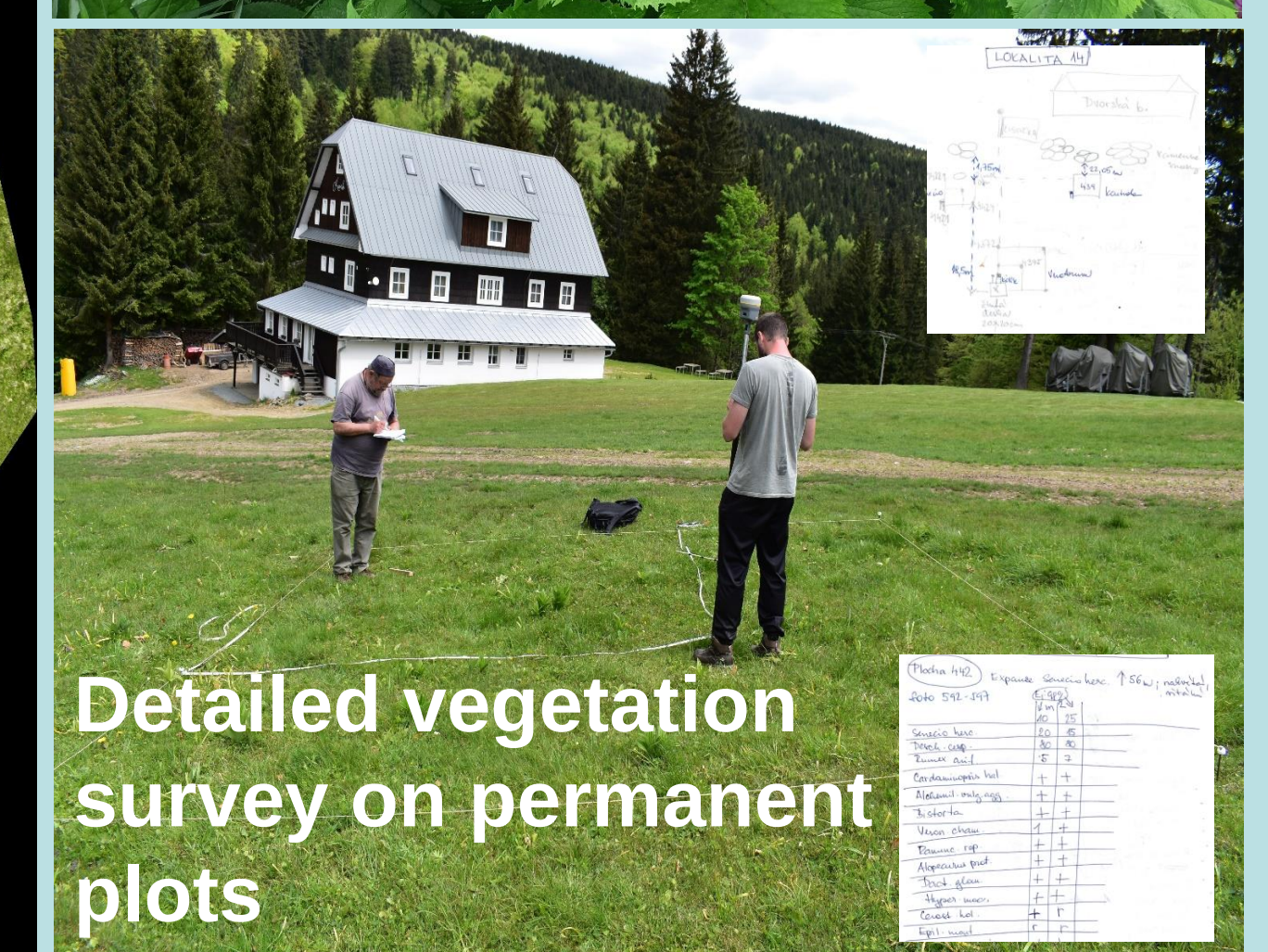
First step:
Collection of the time series of UAV/drone multispectral data (4-time horizons).



Second step:
Botanical field survey
Repeated GPS mapping
Phytosociological relevés (10 and 25 m²; cover in %)



Telekia speciosa



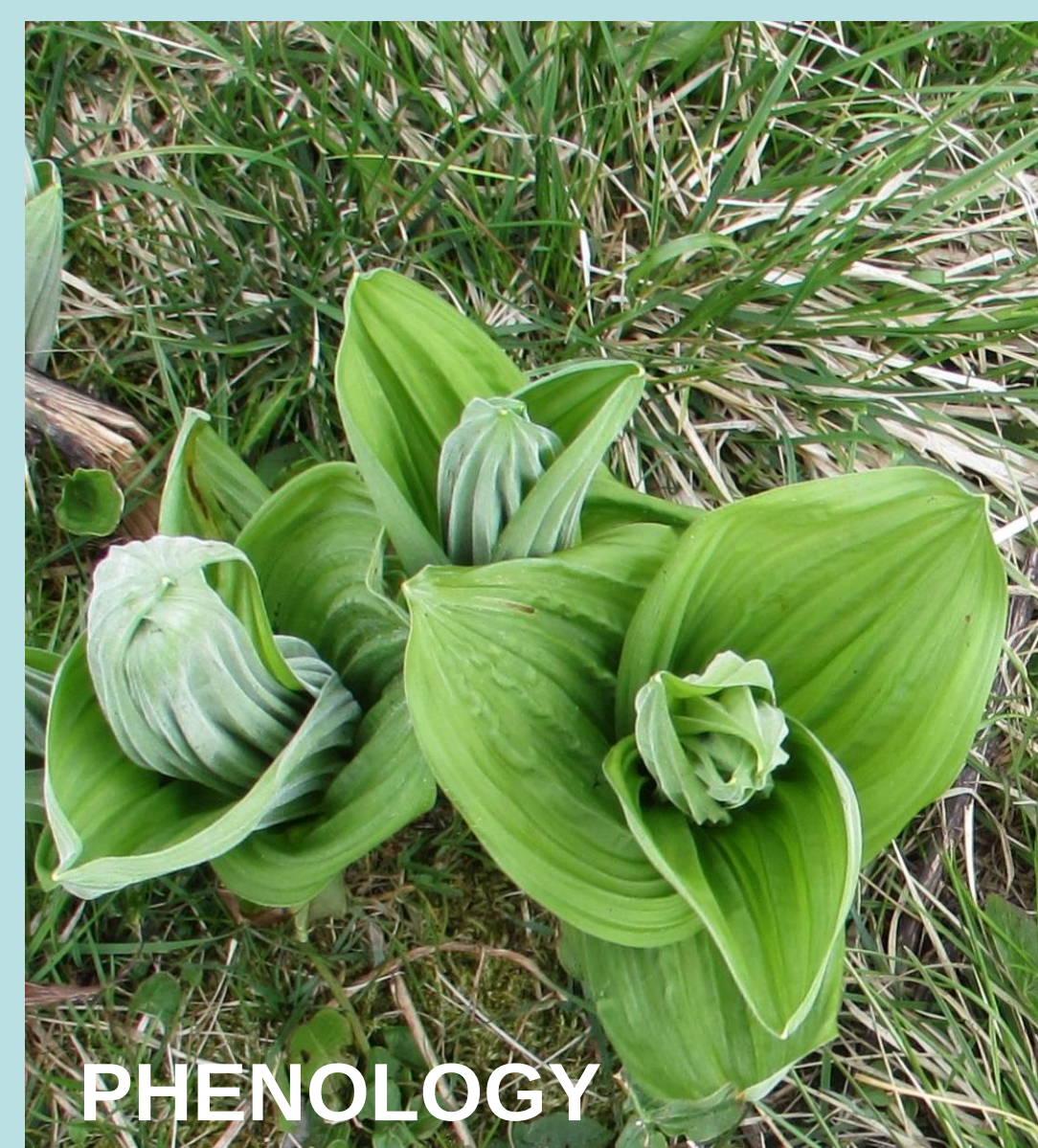
Detailed vegetation survey on permanent plots



GPS plant positions with respect to



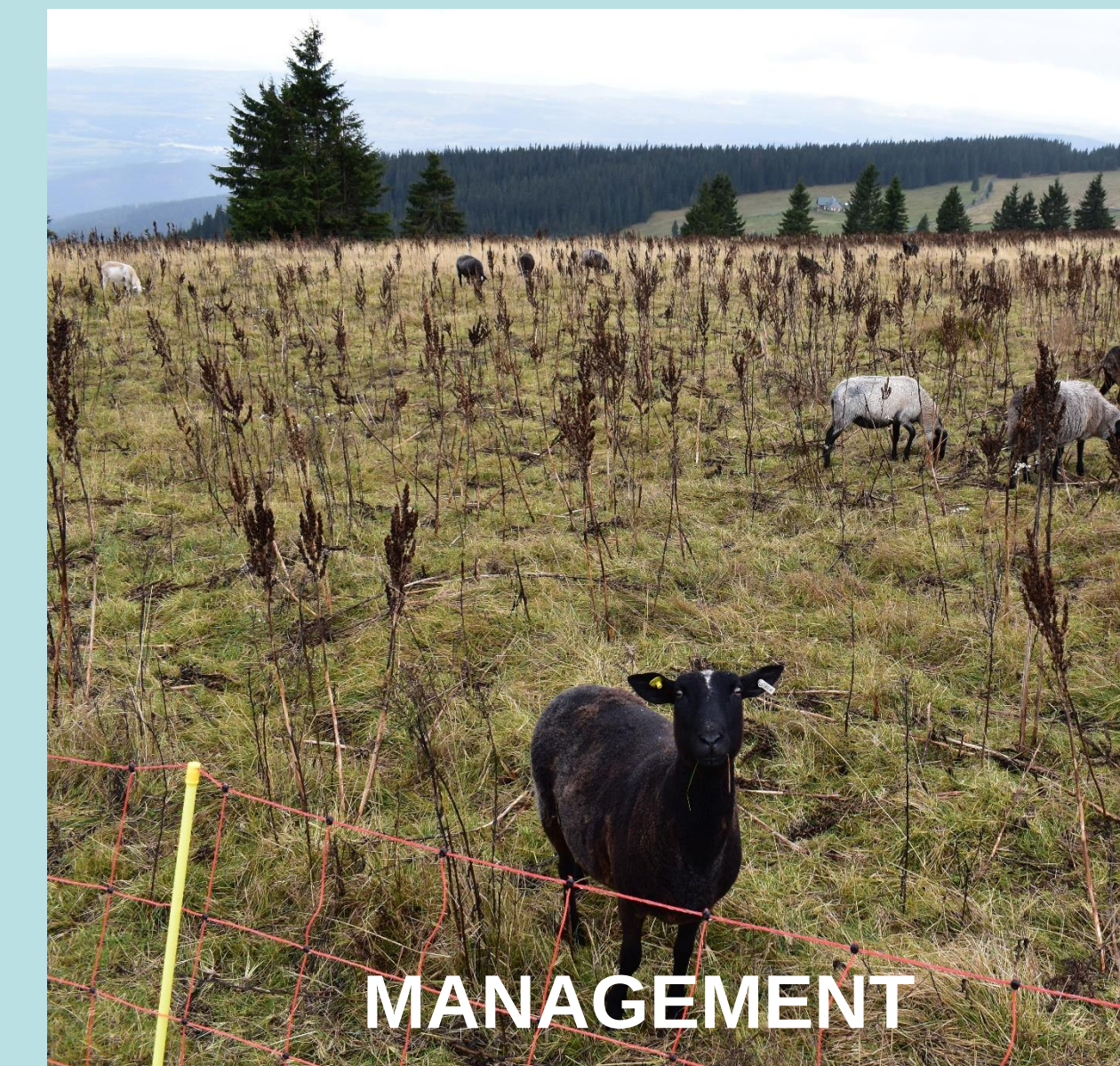
different



PHENOLOGY



FITNESS



MANAGEMENT



SITE CONDITIONS (slope, shading)

Next step:
Testing different classification/detection methods using reference field botanical data

A mosaic created from multispectral UAV images using the Pix4D software. False colour composites highlight the growth of vegetation.



Implication for nature conservation:
The crucial factor is early detection of invasion into unique mountain communities.



Lupinus invading the *Nardus* meadow