TREE HEALTH MONITORING USING VEGETATION INDICES

DERIVED FROM HIGH-RESOLUTION MULTISPECTRAL IMAGERY

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INTRODUCTION

Remote sensing (RS) data nowadays provide valuable information in many fields of Earth observation disciplines. When dealing with forest ecosystems, permanent monitoring, early identification of changes and consequent planning are essential in forest management. RS data provide global, spatially continuous and periodic data, which prove to be valuable in monitoring vegetation condition [1], particularly increasing threath of bark beetle outbreaks [2]. Early warning systems are needed to reduce the spread of bark beetles as well as to help foresters identify factors which facilitate the infestations. The effects of bark beetle on leaf properties affect reflectance in the near-infrared (NIR) and shortwave infrared (SWIR) spectral domains (i.e., 730–1370 nm) [3]. Approaches based on multi-temporal spectral indices have proven to be the most effective in detecting the impact of bark beetle in green-attack stage [4].

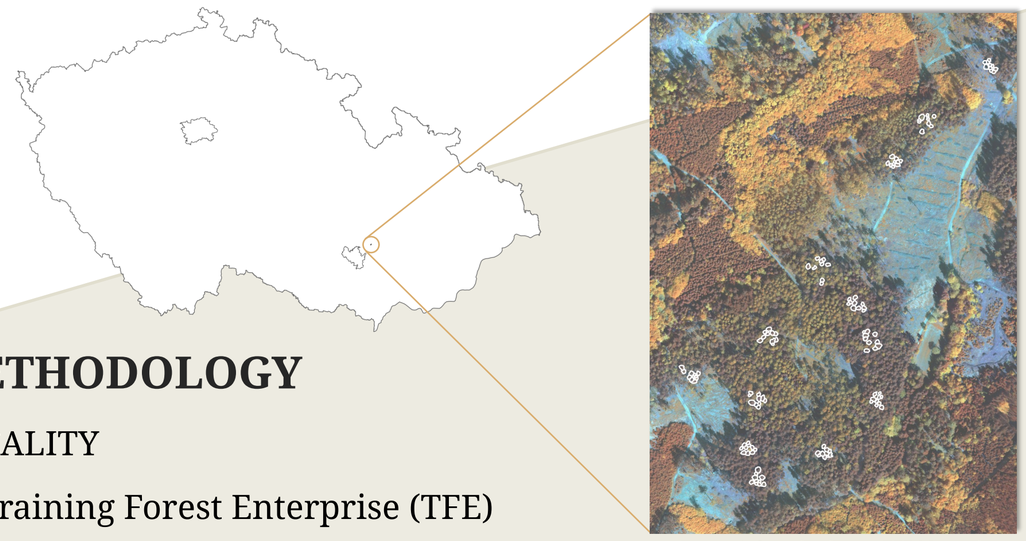

Figure 1: Sample plots in TFE Masaryk Forest Křtiny

METHODOLOGY

LOCALITY

- Training Forest Enterprise (TFE) Masaryk Forest Křtiny (Figure 1)

TRAINING AREAS

- Norway spruce forest stands
- 13 sample plots (Figure 1)
- Total of 130 individual trees selected
- Forest stands at a risk of bark beetle infestation

Figure 2: Tree health assessment based on visual ground evaluation

HEALTH MONITORING

- Ground evaluation - ICP Forest methodology (Figure 2)
- Index-based evaluation
- Theoretical spectral model of tree behaviour based on bitemporal regression

Figure 3: Unmanned aerial vehicle (UAV) senseFly eBee Plus

WORKFLOW

GROUND EVALUATION

- Visual evaluation of tree crown health
- Overall defoliation, percentage of secondary shoots, yellow discoloration and bronzing evaluation

AERIAL ASSESSMENT

- Unmanned aerial vehicle (UAV) flight mission (Figure 3)
- Every two weeks during vegetation season

DATA PROCESSING

- Canopy height model
- Individual tree crowns detection
- Multispectral (MSP) properties acquisition
- Vegetation indices (VI) calculation
- Statistics over spectral information of each individual tree selected

RESULTS

Trees with significant residual values represent infested ones. (Figure 5)

Changes in spectral behaviour of sampled trees during vegetation period based on calculation of Normalized Difference Vegetation Index (NDVI) show deteriorating health.

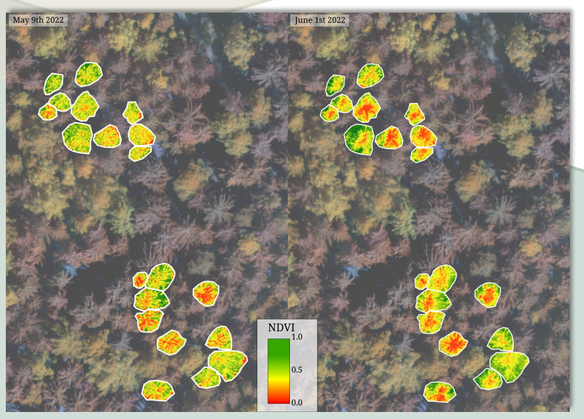

Figure 4: Tree health change during vegetation season - NDVI

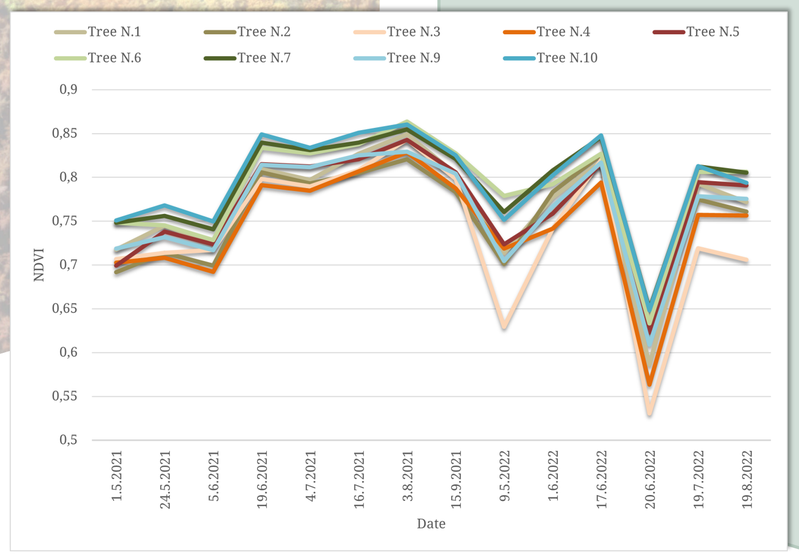

Figure 5: Mean NDVI of sampled trees (sample plot 18) throughout individual UAV flights during the vegetation season 2021 and 2022

*Within the project, an article - **Evaluating Recent and Future Climatic Suitability for the Cultivation of Norway Spruce in the Czech Republic in Comparison with Observed Tree Cover Loss between 2001 and 2020** - has been published.*

References

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