The influence of remote sensing data acquisition date on vegetation succession species classification effectiveness on the example of Dolina Krasnej Natura 2000 protected area (PLH260001)

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The process of secondary succession is one of the most important threats to non-forest Natura 2000 habitats in Poland - shrub encroachment taking place on low productive agricultural areas leads to species compositional changes, biodiversity loss and in result landscape transformations. Creating the methodology of the airborne remote sensing data-based vegetation succession monitoring, both from quantitative - area, volume and qualitative - vegetation species perspective, is one of the tasks undertaken within the HabitARS project (Habitats Airborne Remote Sensing).

A key variable to be established when implementing the qualitative approach is the remote sensing data acquisition date determining the development stage of trees and shrubs forming the succession process. It is essential to choose the optimal date in which the species' spectral and geometrical characteristics make them as different from each other as possible. As part of the presented research an effectiveness comparison of classifications prepared on the base of remote sensing data acquired in three different phenological seasons - the spring (1st June 2017), the summer (7th July 2017) and the autumn (27 September 2017) was carried out for the Dolina Krasnej (Poland) research area.

The remote sensing data used in the research included hyperspectral imagery (from the HySpex VNIR-1800 and SWIR-384 cameras) and LiDAR data (from Riegl LMS-Q680i scanner) acquired simultaneously from the same aerial platform. The first dataset type was processed to obtain vegetation indices and MNF (Minimum Noise Fraction) products, while the second one enabled to calculate geometry-related indices. The classification was done using Random Forest algorithm and the set of features to be classified was determined by RFE (Recursive Feature Elimination) procedure. The classification reference was prepared on the basis of botanical field measurements made at the peak of the growing season.

The results show that the autumn is the most favourable season for discriminating succession species present on the research area - the Cohen's Kappa value was 0.77, while for spring - 0.69 and summer - 0.66. No differences in single species' accuracies were observed - for all three seasons the highest accuracy was obtained for Willow Salix (0.94 F1-score in autumn) and high for other succession species Silver Birch Betula pendula, Scots Pine Pinus sylvestris, Alder Buckthorn Frangula alnus (0.86, 0.80 and 0.80 F1-scores respectively). What lowered the Kappa value were the accuracies achieved for three "background" species included in the classification. The presented results, the advantage of the autumn data acquisition season, confirmed the conclusions made in the previous year of the research on another study site - the Ostoja Olsztynsko-Mirowska Natura 2000 protected area.