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Detection of rhododendron in a deciduous woodland using airborne hyperspectral remote sensing

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Rhododendron (Rhododendron ponticum) has been identified as an invasive non-native species (INNS) in the UK and a potential carrier of Phytophthora ramorum and therefore needs management. This study identified the presence and location of rhododendron from airborne hyperspectral data and compared the results with Random Forests classifications of Sentinel-2 and Pleiades satellite data. The multispectral satellite systems had two limitations. The first limitation was insufficient spectral resolution to identify individual understorey species in a deciduous woodland (e.g. rhododendron, cherry laurel and holly). In this instance the satellite systems were only able to identify the presence of 'potential rhododendron', rather than actual rhododendron, where the term 'potential rhododendron' included any understorey evergreen species in a deciduous woodland. The second was insufficient spatial resolution (10m and 2m, respectively) to discriminate individual understorey plants; which resulted in the understorey being represented by a majority of mixed pixels. In this situation no more than percentage estimates of 'potential rhododendron' in an area could be obtained.

The airborne data used in this study were collected using a HySpex hyperspectral VNIR sensor and Phase One (80MB) survey camera; these provided a spatial resolution of 0.32m and 0.07m, respectively. The HySpex VNIR sensor had 186 bands with a full-width-half-maximum of 4.5nm. This sensor combination was shown to have sufficient spectral and spatial resolution to identify individual understorey species. Discrimination of different understorey species was achieved using a combination of spectral analysis techniques, including spectral angle mapper (SAM), and object-based-image analysis (OBIA). Furthermore, overstorey and understorey canopies were separated through the inclusion of a separate airborne LiDAR dataset, collected earlier that year.

Remotely sensed optical data were collected in leaf-off conditions to minimise the influence of the overstorey vegetation canopy. However, this introduced specific issues relating to weak sunlight and low solar illumination angles; these influenced data quality, data analysis and validation of the final classification. Methods to mitigate these issues were developed (e.g. use of masks to remove long shadows cast by trees), but challenging obstacles remained (e.g. steep north-facing terrain casting large areas in shadow). Meanwhile, validation required botanical expertise, careful consideration of the relative dates when remotely sensed data and field validation data were collected, the geographical precision of field data and an awareness of any bias incurred by

shadow. As with other remote sensing studies, the number and distribution of validation samples and the selection of training data were major considerations. However, this multi-scale study demonstrates the advantages of using airborne hyperspectral systems for species mapping in complex environments.