Hyperspectral mapping of Rhododendron in a woodland

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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 plant pathogen *Phytophthora ramorum*. Therefore, in the UK, there is a management focus to identify and map the presence of Rhododendron to allow its removal. This presents a complex series of challenges for remote sensing because Rhododendron is an understorey species, it is often obscured by an overstorey, it has a similar spectral signature to many other understorey species (e.g., Cherry Laurel and Holly) and can range from less than a metre across to covering hectares of woodland.

In this study, we compared the capability to map Rhododendron coverage using Sentinel-2, Pleiades and an airborne Hyspex hyperspectral system. Of these systems, the airborne provided the finest spatial scale and finest spectral resolution data but was limited in its coverage compared with satellite systems. The satellite systems provided a wide spatial coverage but were limited in the size of Rhododendron assemblage that could be spotted and could only identify 'potential Rhododendron' coverage. Three different ground validation tools were used: parcels of estimated percentage cover, specific located targets, and vicarious photography. These methods had different advantages and disadvantages with respect to how they were able to be used and the time and logistical difficulties in their implementation. 'Potential Rhododendron' were mapped, using Sentinel-2 data, with an overall accuracy of 68%. While the Pleiades data provided a finer spatial resolution, the limited spectral information impaired the identification of 'potential Rhododendron'.

The observation of the woodland understorey required the analysis of winter data sets. This provided deciduous leaf-off conditions but also introduced the problems of a low sun angle casting shadow and an elevated risk of imagery being obscured by cloud cover. The difficulty of obtaining a leaf-off image without cloud cover was such that in some years there was no cloud free data available over the UK target woodland sites.

Processing utilised object-based analysis (using eCognition) and was supplemented by pixel-based signal matching. However, only the airborne hyperspectral system could identify actual Rhododendron from 'potential Rhododendron' and was the only data capable of identifying these classes for Rhododendron assemblages smaller than a metre across. Of the three UK mixed-woodland sites, two had high levels of Rhododendron coverage but had different land management histories. The variation between these sites demonstrated the difficulties in the development of a general processing methodology and the use of additional a priori data sets proved to be a significant asset for limiting misclassification.