INVESTIGATING SUPER-RESOLUTION ANALYSIS AND SCALE AND TIME OF OBSERVATION FOR CHARACTERISING BRACKEN (PTERIDIUM AQUILINUM) DISTRIBUTIONS

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ABSTRACT:

The bracken (Pteridium aquilinum) fern is environmentally significant due to its great abundance and swift colonisation, and its perception as a problem plant in degrading agricultural or ecologically sensitive land. Various attempts have been made to map bracken using remote sensing, but these have proved relatively unsuccessful, often apparently constrained by the lack of spatial detail associated with medium spatial resolution satellite sensors such as the Landsat series. In this study, bracken was characterised using a combination of 30 m Landsat imagery and 4 m IKONOS imagery. Various classification techniques were compared, including hard maximum likelihood classification, soft classification, and a super-resolution approach comprising sub-pixel contouring. These techniques were applied to a range of image dates, including summer, winter and multitemporal images. Image analysis was supported by extensive field data collection, comprising both a land cover survey and stakeholder interviews. For the hard classified Landsat imagery, the summer image proved least able to characterise bracken, due largely to the spectral similarity between (green) growing bracken and grasses and other vegetation. The winter images were more successful for identifying bracken due to the strong contrast between dead (brown/red) bracken and other vegetation. However, the multitemporal Landsat image was considerably more accurate than any of the single date images. Surprisingly, though the hard classified (late winter) IKONOS image was more accurate than the summer Landsat image for classifying bracken, it was only of comparable accuracy to the winter Landsat images and it was less accurate than the multitemporal Landsat image. This suggests the temporal nature of image acquisition is of particular significance for bracken classification, probably moreso than spatial detail. Also, the more limited spectral capabilities of IKONOS (four visible and near infrared spectral wavebands) compared to Landsat (six visible, near and mid infrared bands) may have reduced classification accuracy. Following soft classification of the multitemporal Landsat image, super-resolution sub-pixel contouring was applied to identify the boundary of bracken patches. Predicted bracken boundaries were assessed against actual boundaries identified using field observation and IKONOS image interpretation. For comparison, the bracken boundaries identified through hard classification (i.e. using pixel edges) were also assessed against the actual boundaries. Overall, the spatial accuracy of the super-resolution approach was considerably higher than that of hard classification.

TOPIC: Land cover classification
ALTERNATIVE TOPIC: Image processing and pattern recognition