

Spatial dependence of predictions from image segmentation: a method to determine appropriate scales for producing land-management information

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A significant challenge in ecological studies has been defining scales of observation that correspond to relevant ecological scales for organisms or processes. Image segmentation has been proposed as an alternative to arbitrary scales of pixel-based methods for scaling remotely-sensed data into ecologically-meaningful units. However, to date, the selection of image object sets to represent landscape patterns has been largely subjective. Changing the scale of image segmentation affects the variance and spatial dependence of measured variables, and this information can be used to determine appropriate levels of image segmentation. In a previous study, we used observations of percent bare ground cover from a southern Idaho (USA) semi-arid shrub-steppe ecosystem to look at changes in spatial dependence of regression predictions and residuals for 10 different levels of image segmentation. We found that segmentation levels where the spatial dependence of regression predictions closely matched that of the field samples had the highest predicted-to-observed correlations for bare ground. This suggested that an appropriate scale could be defined for percent bare ground cover in our study area. However, the applicability of these results to other areas and other variables has not been established. In this paper, we report on the application of this method to predicting the density of invasive western juniper (*Juniperus occidentalis*) in a different southern Idaho study area. Because the best analysis scale may vary between ecosystem attributes, methods that can perform well across a range of scales and perhaps not at a single, ideal scale are important. More work is needed to develop methods that consider a range of approaches to segment images into different scales and select scale sets that perform best for addressing specific objectives. The robustness of ecological landscape analyses will increase as methods are devised that remove the subjectivity with which observational scales are defined and selected.