

## Western Ecological Research Center

# Publication Brief for Resource Managers

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## Plot Shape Effects on Plant Species Diversity Measurements

Published studies of sampling designs have concluded that rectangular-shaped sample plots record substantially greater plant species than square plots of the same total area. This conclusion is based on both field samples as well as theoretical arguments and is important because if true, it casts doubt on the validity and comparability of many vegetation studies. It is of practical concern to resource managers who utilize plot sampling to accomplish multi-scale inventories.

A paper published in this month's edition of the *Journal of Vegetation Science* by USGS scientist Dr. Jon E. Keeley and colleague C. J. Fotheringham from the University of California, Los Angeles, disputes that conclusion. Their study compared three sampling plot methods that used 1000-m<sup>2</sup> plots with nested subplots that differed in shape and dispersion patterns. They sampled Californian plant communities, including grasslands, oak savannas, desert scrub, coastal sage scrub, chaparral, and conifer forests, with squares and 1:4 ratio rectangles at scales of 1, 100, and 400 m<sup>2</sup>. It appears that the increase in species richness obtained from surveying rectangular plots resulted from those investigators varying both shape and spatial distribution simultaneously.

Keeley and Fotheringham hypothesized that the reason theoretical studies conclude greater richness should be recorded from rectangular samples is because those studies ignore the important role of species gradients. Keeley and Fotheringham suggested that rectangles do not record greater diversity than squares because species turnover varies along complex environmental gradients that are both parallel and perpendicular to the long axis of rectangular plots. They contend that this also makes difficult any *a priori* conclusions about

### Management Implications:

- There is no evidence that sample plot shape has a consistent and predictable effect on recording species diversity.
- Previous researchers have advocated that to obtain maximum diversity one must position rectangular plots along the environmental gradient that generates the highest species turnover. In the ecosystems studied here there was no evidence of consistent trends along gradients either perpendicular or parallel to the slope contour.

the best orientation of plots, relative to the elevational contour. They also suggested that reports recording much greater diversity for highly elongated rectangular strips than for squares of the same area are not likely to be fair comparisons. Narrow strips of 1-2 m appear to include a much greater proportion of species that are not wholly contained within the plot (i.e., although plant stems may be entirely contained within the plot, both crowns and roots may occupy considerable space outside the sample area). Thus elongated strips potentially sample richness over niche space that greatly exceeds the presumed sample area. This effect would be substantially smaller in squares because squares have a smaller perimeter:area ratio than elongated rectangular strips.

*Keeley, J. E. and C. J. Fotheringham. 2005. Plot shape effects on plant species diversity measurement. Journal of Vegetation Science 16:249-256.*