



**The Intensity of Competitive Interactions as a
Function of Fertility, in Mediterranean-type old
fields in South Australia**

Brenton Ladd

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**School of Environmental and Earth Sciences
The University of Adelaide, Australia
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Abstract

I studied the establishment of tree seedlings in Mediterranean-type oldfields in South Australia, to test for a correlation between habitat fertility and the intensity of competition. I also investigate whether resource competition and invertebrate herbivory were confounded with each other, so that it was possible to evaluate the Unified Concept of Competition (UCC), with both a mechanistic, and a phenomenological definition of competition. The species of tree that I studied are dominant in the over-storey of grassy woodlands in the Adelaide Hills. This community type has been extensively cleared and is heavily infested with exotic grasses and herbs. I tested for a correlation between fertility and the relative intensity of competition. To do this I used a quantitative literature review in combination with field and glasshouse experiments. Although experimental tests of this relationship are abundant, they have produced conflicting results. Studies that use natural fertility gradients generally support the argument that the two are positively correlated, while studies that use artificial nutrient gradients generally refute this argument. Artificial gradients may differ from natural gradients because they include a lower range of fertilities, because artificial gradients are less complex than natural gradients, or simply because different species and/or phenotypes are present at different points along natural gradients, but not necessarily on artificial gradients. I used a wide range of fertility levels creating an artificial resource gradient that was multivariate in nature. I also used a range of different species. In the glasshouse experiment the relative intensity of competition (RIC) increased with fertility in a logarithmic fashion. There was also a positive relationship between fertility and RIC in the field, and in the literature

review. However, the results from the glasshouse experiment suggest that the positive relationship between fertility and RIC in the field, and in the literature review may have been related to the magnitude of the gradients, rather than the complexity of the gradients, or to the range of competitors considered. These results demonstrate that physical resource gradients can produce dynamics similar to those observed on gradients of standing crop, and that a definition of environmental adversity that is based upon the physical environment is possible.

I also performed a comparative study with two species of eucalypt, to determine why *E. camaldulensis*, and *E. microcarpa* have such markedly different populations structures within the Waite Hills Reserve. Previous experiments have shown that competition may be an important process operating in this system, and that it may limit the establishment of eucalypt seedlings. I found that a lack of *E. microcarpa* establishment in the reserve may be attributable to interference from exotic grasses. This suppression is caused by two related mechanisms. I found evidence of resource competition between *Avena barbata* and the relevant eucalypts, and also found evidence that *Avena* may modify abiotic conditions, so that germination of *E. microcarpa* occurs in highly competitive neighbourhoods. In contrast to *E. microcarpa*, *E. camaldulensis* requires high temperatures to germinate, and may therefore germinate when winter annuals (e.g. *Avena barbata*) are senescent. As a consequence it may experience less competition from exotic pasture grasses during the critical seedling establishment phase. The results from this study suggest that direct effects (e.g. resource competition), and indirect effects (e.g. invertebrate herbivory) may be heavily confounded, and that a positive correlation between fertility and the intensity of competition, is most

probable when a phenomenological definition of competition is used. I argue that a phenomenological definition of competition is reasonable because a number of direct and indirect effects are confounded at this, and other field sites, and because it may speed the development of ecological theory.