

The effect of parthenium weed (*Parthenium hysterophorus* L.) on plant diversity in pastures in Queensland, Australia

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Summary Parthenium weed (*Parthenium hysterophorus* L.) is an invasive herbaceous weed of tropical and subtropical environments belonging to the Asteraceae family. The impact of parthenium weed on botanical diversity, both within the above-ground vegetation and the soil seed bank, was assessed at a pastoral site in Kilcoy, Queensland, Australia. The effect of parthenium weed was studied in areas infested with different densities of the weed (i.e. high – 16 plants m⁻²; low – 2 plants m⁻²; and no parthenium weed). The study area selected was on a gentle slope with good drainage and had a brown loam soil typical of the region. The site was studied in the summer of 2008/2009 (i.e. February 2009) and the winter of 2009 (i.e. August 2009). During the study, the land was grazed by cattle, and the annual chemical control management for pasture weeds was also applied. In each density area (i.e. high, low and no parthenium weed), two parallel transects, 30 m in length, were set out and 10 quadrats (1 m²) located at 3 m intervals along their length. Within each quadrat, species composition and density measurements were made on the above-ground vegetation and two soil cores per quadrat taken to assess the composition and abundance of the seed bank. The two soil samples taken from within one quadrat were mixed and then distributed thinly over a sterilised soil contained in a shallow germination tray that had been placed at random on a bench in a glasshouse. All the trays were then watered daily to field capacity and assessed for seedling emergence over a 7 month period.

The species diversity within the vegetation and the seed bank was assessed using the Shannon-Weiner index ($H' = -\sum p_i \log p_i$, where p_i is the proportion of the seed bank represented by the i^{th} species) (Krebs 1989). All data sets were then analysed using an Analysis of Variance with the model specified using General Linear Model procedure in Minitab – Version 15.

In total, 65 species were found in the above-ground and soil seed bank communities (19 Poaceae, nine Asteraceae, and 37 species from 22 other

families). The most dominant species in the above-ground plant community, under all infestation levels, were three grasses, *Digitaria didactyla* Willd., *Cynodon dactylon* (L.) Pers., and *Bothriochloa decipiens* (Hack.) C.E.Hubb. The above-ground plant community diversity was lowest ($H' = 0.844$) when parthenium weed was present at its highest density (i.e. 16 plants m⁻²). The plant community diversity was somewhat higher ($H' = 1.08$) when parthenium weed was present at lower densities (i.e. 2 plants m⁻²). However, the index was highest ($H' = 1.48$) in the two transects that had no parthenium weed present in the summer season ($P = 0.000$). When analysed in the winter season, a similar trend was found even though parthenium weed had died and was absent from the above-ground population ($H' = 0.9$, $H' = 0.8$, $H' = 1.34$, respectively for high, low and no parthenium weed) ($P = 0.001$).

A similar trend was seen in the soil seed bank community, with the species diversity being lowest ($H' = 2.03$ for summer and $H' = 2.31$ for winter) ($P = 0.000$) under the highest density of parthenium weed (4030 seeds m⁻² in summer and 915 seeds m⁻² in winter), a little higher ($H' = 2.46$ for summer) under the low density of parthenium weed (995 seeds m⁻² in summer, 190 seeds m⁻² in winter), and highest ($H' = 2.55$ in summer and $H' = 2.50$ in winter) ($P = 0.001$) where no parthenium weed was present.

In summary, the diversity of a pasture plant community in Queensland was found to be significantly reduced by the presence of parthenium weed, even when the weed was present in relatively low densities (i.e. 2 plants m⁻²). This trend was seen in both the above-ground plant community and the soil seed bank.

Keywords Parthenium weed, *Parthenium hysterophorus*, plant diversity, grassland, pasture.

REFERENCES

Krebs, C.J. (1989). 'Ecological methodology'. (Harper Collins, New York).