Management for conservation of plant diversity in native grasslands of the Moree Plains, NSW

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Sorry if I have forgotten anyone!

ABSTRACT

Over 50% of the alluvial plains of the Moree Shire are used for dryland and irrigated cropping, and most of the remaining land is grazed by livestock. The *Dichanthium sericeum* (Queensland Bluegrass) and *Astrebla* spp. (Mitchell Grass) tussock grasslands were once common on the fertile clay soils of the region, but have suffered large reductions in area through cultivation. These grassland communities are also poorly conserved and only occur within one reserve (Kirramingly Nature Reserve) in New South Wales. There has been little conservation-oriented research into these grasslands, and there is a need for research to determine the best management strategies to conserve their plant diversity.

Two grassland vegetation surveys were carried out to determine the influence of management history, sampling time and other environmental variables on plant species composition and richness. A regional vegetation survey sampled different locations and land tenures (e.g. private property, travelling stock routes, nature reserves) throughout the Moree Plains. A second survey was carried out on a smaller scale at Kirramingly Nature Reserve and on the surrounding stock routes. Some sites in both surveys were sampled in different seasons and years. Experiments were also carried out at Kirramingly Nature Reserve to determine the influence of fire, kangaroo grazing, mowing and disc ploughing on native grassland composition, species richness, evenness (Smith and Wilson's Index) and heterogeneity (Simpson's Index).

A total of 364 plant taxa were recorded in the regional survey. Species richness varied considerably over time and corresponded with fluctuations in rainfall prior to sampling. Canonical Correspondence Analysis determined that environmental variables accounted for a greater proportion (19.4%) of the variance in species cover data than disturbance-related variables (10.5%). Soil type, sampling time and altitude had a strong influence on species composition. Of the disturbance-related variables, cultivation (number of consecutive cultivations) and stocking rate were the most influential. Type of grazing (not grazed, periodically grazed or continuously grazed) did not have a significant influence on native species richness, although native species richness was significantly higher at Kirramingly Nature Reserve than at grazed sites over the Moree Plains. Ordination suggested that cultivated sites were generally in poorer condition (defined by richness and cover of native and introduced species and the amount of bare ground) than

uncultivated sites. Total and native species richness were significantly higher at uncultivated sites. Lower native species richness was evident even for sites that were last cultivated at least 15 years prior to sampling. Flooding had a relatively small influence on species composition, although the frequencies of certain species were influenced (e.g. *Astrebla lappacea* was less frequent in flooded sites). Across all sites, flooding had no influence on native species richness, but total, introduced, forb, grass and graminoid species richness were significantly affected.

Some 173 taxa were recorded at Kirramingly Nature Reserve and surrounding stock routes. Species richness varied greatly between sampling periods, with variations between seasons and years. Sampling time and the occurrence of cultivation had the greatest influence on species composition in this data set. Previously cultivated areas within the Reserve were associated with higher introduced and annual species richness, although introduced species richness fluctuated at cultivated sites depending on seasonal conditions. Native species richness was significantly lower at previously cultivated sites, but was not significantly influenced by grazing exclusion at a quadrat scale of 0.1024 ha. Disturbance in the form of livestock grazing is not necessary to maintain plant species richness in Kirramingly Nature Reserve. In fact, at the 2-m^2 scale, richness was significantly greater at ungrazed sites than at grazed sites. The highly variable climate may play an important role in the coexistence of species by negating competitive exclusion and allowing interstitial species to persist.

Experiments at Kirramingly also demonstrated the strong influence of sampling time (season and year) on species richness and composition. Species richness and composition recovered more rapidly after spring burning than after autumn burning. This was expected given that most species in the area grow during warmer conditions and rainfall was below average in the winter following the autumn burn. Species richness and composition were similar to those of control sites within 12 months of both burns. Repeated fire (two fires separated by 3 years) and kangaroo grazing, post-fire, had no long-term influence on species richness, evenness or heterogeneity. Annual or short-lived species were generally more responsive to fire than perennials. Six species, including four annuals (*Eragrostis parviflora, Sporobolus caroli, Portulaca oleracea* and *Medicago truncatula*) and two perennials (*Panicum buncei* and *Boerhavia dominii*) increased in frequency in response to fire. Three annual forbs (*Vittadinia cuneata, Sonchus oleraceus* and *Hedypnois*

rhagadioloides) and one perennial (*Oxalis perennans*) were negatively affected by fire, but no species were completely eliminated from burnt areas. Most species were able to survive fire by resprouting vegetatively. Seed head production of three grass species (*Astrebla elymoides, A. lappacea* and *Dichanthium sericeum*) varied significantly over time, but not in response to fire.

Mowing had no sustained effect on species richness and evenness over time. Repeated mowing (twice in 1 year) and height of mowing (10 cm and 30 cm above the ground) also had no effect. Species frequencies did vary in response to mowing. Annual and short-statured species (e.g. *Chloris truncata, Vittadinia cuneata, Eclipta platyglossa* and *Portulaca oleracea*) were more frequent at mown sites. Disc ploughing resulted in significantly lower species evenness and heterogeneity and marginally lower total and native species richness. Some annual grasses were more frequent at ploughed sites (e.g. *Chloris truncata, Eragrostis parviflora* and *Sporobolus caroli*), while perennial grasses (e.g. *Astrebla elymoides, Aristida leptopoda* and *Enteropogon acicularis*) were less frequent at ploughed sites. These perennial species probably rely heavily on vegetative reproduction for persistence and may take some time to re-establish from seed in ploughed areas.

Some important features of these grasslands in their response to disturbance (or lack of disturbance) are: (1) the resilience of most native species to livestock grazing, kangaroo grazing and mowing; (2) the lack of decline in diversity when livestock grazing is removed for several years; (3) their capacity to recover after fire without major changes in composition; (4) the resilience of most native species to flooding; (5) the ability of most native species to recover after once-off disc ploughing; and (6) their ability to recover after drought. Despite their resilience, some forms of disturbance (i.e. cultivation and over-grazing) can result in removal of the dominant perennial grasses (e.g. *Astrebla* spp. and *Dichanthium sericeum*) and an increase in disturbance specialists, including species that are undesirable from a grazing and conservation perspective (e.g. *Urochloa panicoides, Tribulus terrestris, Sclerolaena muricata* var. *muricata, S. birchii* and *Rapistrum rugosum*). The need to conserve native grasslands on the Moree Plains without a history of cultivation is particularly important. Given the varied responses of native species to different types of disturbance, a range of disturbance regimes over the landscape will be beneficial to plant diversity. There appear to be few ungrazed remnants on the

Moree Plains, but such areas are important in the landscape to prevent the loss of grazing-sensitive species.

Certification

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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