

**IMPACTS AND MANAGEMENT OF *CENCHRUS CILIARIS*
(BUFFEL GRASS) AS AN INVASIVE SPECIES IN NORTHERN
QUEENSLAND**

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Abstract

Cenchrus ciliaris L. (buffel grass) (Poaceae) is recognized as one of Australia's most serious environmental weeds. This introduced grass is associated with loss of native species and alteration of fire regimes. However there is considerable controversy regarding its weed status as it is also highly valued as a pasture species for arid and semi-arid zones. Quantitative studies are needed to determine its ecological effects. In addition, its spread into non-target areas, including conservation reserves, means that there is considerable interest in strategies for containing or eliminating *C. ciliaris*. These two issues, the effects of *C. ciliaris* on native species and strategies for managing *C. ciliaris*, are the focus of this thesis.

The relationship between *C. ciliaris* and herbaceous species richness was investigated in two studies at a range of scales up to 64 m² in open woodlands in north-eastern Queensland. In the first study, the herbaceous species composition of sites with and without *C. ciliaris* were compared. *Cenchrus ciliaris*-dominated sites had fewer herbaceous species than non-*C. ciliaris* sites at all scales investigated and this pattern was found for the major plant groups (perennial grasses, legumes and other forbs) present. In the second study, the relationship between varying levels of *C. ciliaris* biomass and species richness was investigated at one site. The relationship between varying levels of a dominant native grass, *Bothriochloa ewartiana* (Domin) C.E. Hubb. (Poaceae), and species richness was also determined for comparison with the *C. ciliaris* biomass-richness relationship. In this study, species richness was negatively associated with increasing *C. ciliaris* biomass at some scales and it appeared that *C. ciliaris* had a greater effect on richness than *B. ewartiana*. The negative association between *C. ciliaris* and species richness is consistent with the view that invasion by *C. ciliaris* poses a threat to biodiversity. However, the precise cause of the relationship has yet to be determined.

The strategic use of fire offers potential to control unwanted species. To evaluate fire as a tool for reducing *C. ciliaris* abundance, the effects of season of burning on two *C. ciliaris*-dominated communities in north Queensland were investigated. Three treatments were imposed in small plots at both sites: early dry season burn, late dry season burn and control (no burn). These treatments were selected to exploit differences in fire characteristics and vegetation responses to fire associated with different season of burning. The herbaceous species present and their cover were recorded before and after the fires and post-fire seedling emergence was monitored. To help understand the mechanisms by which fire may alter community composition, burning treatment effects on the availability of establishment sites and propagules were also investigated. Fire affects establishment site availability by

reducing resident plant competition, by altering nutrient availability and by altering soil surface condition. Three studies were conducted to investigate treatment effects on establishment sites: (1) *C. ciliaris* plants were monitored to determine mortality, (2) a bioassay technique was used to assess plant nutrient availability and (3) a 'pot' experiment was conducted to examine the effects of different soil surface cover on seedling emergence to help predict the effects of litter removal on emergence patterns. Fire effects on propagule supply were investigated by monitoring flowering in *C. ciliaris*. A germination method was used to determine soil seed bank composition.

Overall, burning had little effect on these communities. The intensities of the fires were low to moderate (300-3030 kWm⁻¹). At Dalrymple there was an unexpected reversal of intensities; the mean intensity of early dry season fires was higher than that of late dry season fires. The fires caused no major changes in composition, few *C. ciliaris* plants were killed and no changes in nutrient availability or seed bank composition were detected. Although these short-term studies of single fires do not allow definitive recommendations regarding the use of fire to manage *C. ciliaris*, they provide information that will aid future research. I found that fire could kill *C. ciliaris* plants and reduce *C. ciliaris* cover. This contrasts with the positive fire feedback model generally proposed for *C. ciliaris*. *Cenchrus ciliaris* mortality was higher with early dry season burning at Dalrymple, suggesting that higher intensity fires will be more effective in eliminating *C. ciliaris* plants and/or that *C. ciliaris* plants may be more susceptible to fire at this time because they have not fully senesced. Apparent low densities of perennial grass seeds in the seed banks of these communities may be exploited: over-sowing with native perennial grasses after fire may encourage shifts in perennial grass dominance.

There is an urgent need for management strategies that reduce, prevent or contain invasive weed invasion. Further work is required to investigate the application of fire regimes in *C. ciliaris*-dominated communities. Of particular interest are differences in growth and/or phenology between *C. ciliaris* and native species in these grasslands that may be exploited to disadvantage *C. ciliaris*.

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