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REPEATED FIRE IN THE MANAGEMENT OF INVASIVE TROPICAL SHRUBS

A.C. Grice and J.R. Brown

CSIRO Division of Tropical Crops and Pastures, Private Bag P.O. Aitkenvale Qld 4814

ABSTRACT

*Fire has potential in the management of invasive exotic shrubs in northern Australian tropical woodlands. Rubbervine (*Cryptostegia grandiflora*) is fire-sensitive, experiencing significant effects on soil seed viability, plant survival and post-fire reproductive output; chinee apple (*Ziziphus mauritiana*) is fire resistant. Transition matrix models, based on growth and survival data from a site in north-east Queensland, were used to project the longer term impacts of hypothetical fire regimes. The models suggest that burning early in an invasion and repeated burning would severely reduce populations of* C. grandiflora *but that neither regime would greatly affect a population of* Z. mauritiana.

INTRODUCTION

Tropical woodland ecosystems of northern Australia are being invaded by exotic shrub species, including rubbervine (*Cryptostegia grandiflora*) and chinee apple (*Ziziphus mauritiana*) (Humphries *et al.* 1991). Fire is an important factor in this environment and has potential as a management tool (Grice 1996). Experimental work in north-east Queensland has demonstrated that fire kills a large proportion of established plants of *C. grandiflora* as well as reducing post-fire seed output and the viability of the soil seed bank. By contrast, fire kills only a small proportion of small individuals of *Z. mauritiana* (Grice and Brown 1995). Using these results we have modelled how fire may change the structure and size of populations of these species with a view to projecting the longer-term impacts of different fire regimes.

METHODS

The heights of tagged individual plants (*ca.* 540 *C. grandiflora* and 810 *Z. mauritiana*) were measured in April 1993 and April 1994 at a non-riparian site at Lansdown Research Station, 40 km south of Townsville. Growth and mortality rates over this period were calculated for six height classes for each species. In August 1994, portions of the site including approximately two thirds of the tagged plants were burned and the growth and survival of burnt and unburnt plants followed until April 1995.

These data were expressed in matrices that described the probabilities of transition between height classes over twelve-month periods. Separate matrices were developed for burnt and unburnt plants of each species. These were then used to simulate changes in population size and height class structure over a ten-year period under various scenarios. All simulations were made from a starting population consisting of 100 plants in the smallest height class. Such a situation can be taken to simulate the early stages of an invasion. Growth and mortality in years without fire were simulated using matrices derived from 1993-1994 data. Growth and mortality in years with fire were simulated using matrices derived from 1994-1995 data from burnt plots. Simulations included (i) unburnt for 10 years; (ii) burnt in year 1; (iii) burnt in year 3; (iv) burnt in year 6; (v) burnt in years 6 and 7.

RESULTS AND DISCUSSION

With all five scenarios, after ten years each simulated population of both species was dominated by plants in height classes 5 and 6. However, major differences between the two species were indicated. The model projected that fire at any time in the ten-year period would have a major impact on the population size of *C. grandiflora*. Greater reductions in total population size were projected under scenarios that simulated burning early rather than late in the ten-year period and repeated rather than a single fire. For *Z. mauritiana* reductions in total population size were much less than with

C. grandiflora, with the greatest reduction simulated being about 25%. This occurred under a scenario that included a fire in year 1 (Fig. 1).

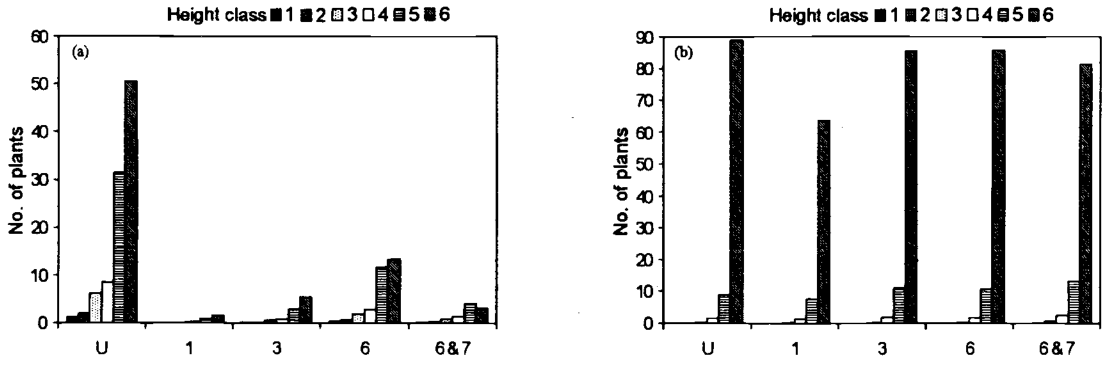

Figure 1. Projected structures after 10 years for populations of (a) *C. grandiflora* and (b) *Z. mauritiana*. Populations were either unburnt (U) or burnt in year 1, year 3, year 6 or years 6 and 7. Initial populations were 100 plants of height class 1.

These simulations are based on limited data. They must be interpreted accordingly and can only be applied to non-riparian populations. They suggest, for *C. grandiflora*, the efficacy of burning early in the invasion process and repeatedly, but that even for populations with a significant proportion of large individuals fire would be useful. For *Z. mauritiana* fire is unlikely to have much long-term impact, except perhaps if it is used when all plants are small.

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