GENETIC AND ECOLOGICAL CONSEQUENCES OF POPULATION FRAGMENTATION IN THE BIRD AND MAMMAL POLLINATED WOODY SHRUB *CALOTHAMNUS QUADRIFIDIS*

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INTRODUCTION

The heathlands and shrublands of Western Australia have been subjected to extensive recent land clearing for agriculture, resulting in numerous fragmented and isolated vegetation remnants (Figs. 1, 2 and 3). The genetic and ecological factors that influence the viability of plant populations in these remnants are being investigated through studies of the bird and mammal pollinated, long-lived woody shrub *Calothamnus quadrifidis*.

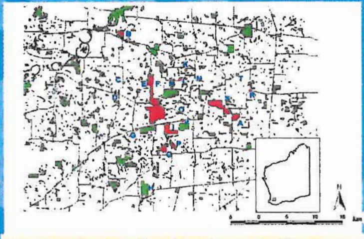

Figure 1. Areas of natural vegetation (green) and location of sampled populations of *C. quadrifidis* (red) in the Dongolocking area of south-west Western Australia.

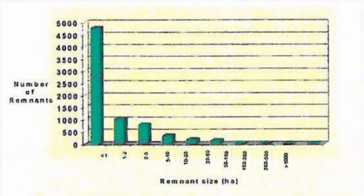

Figure 2. Number of remnants in different size classes in the Dongolocking study area.

MATERIALS AND METHODS

Genetic diversity and fecundity were measured in 20 populations with contrasting levels of isolation, and ranging in size from 1 to *ca.*3000 plants. Fifteen polymorphic allozyme loci were assayed. Fecundity was measured by determining flower to fruit ratios and number of seeds per fruit for 20 plants in 20 populations. In populations where there were less than 20 reproductively mature individuals all plants were used. Relationships were investigated between genetic variation, fecundity, population size, and level of disturbance by correlation and regression.

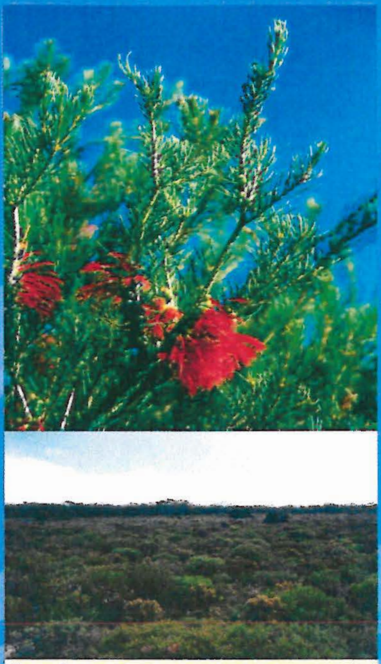

Figure 3. Heathland vegetation in a large remnant containing *C. quadrifidis*.

RESULTS

The four smallest populations (<12 plants) had less genetic diversity based on *A* and *He* than larger populations, with a significant correlation between population size and these genetic diversity measures (Fig. 4). There was no relationship between population size and the inbreeding coefficient *FIS* ($r = 0.11$, $p = 0.644$). A clear trend was evident between reduced fecundity (Fig. 5), assessed as fruit set and seed set, in smaller populations. The variance in fruit set was greater amongst small populations. Soil nutrients (a possible surrogate for population disturbance) and population size had a significant negative correlation (Fig. 6).

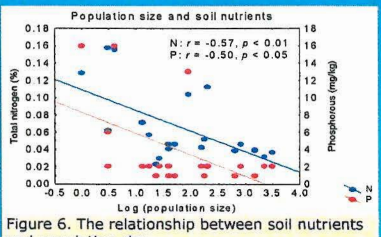

Figure 6. The relationship between soil nutrients and population size

DISCUSSION

Although genetic diversity was reduced in the smallest populations (<12), this relationship with population size was not evident in larger populations. Fruit set was more variable in the smallest populations which also showed a trend to reduced fecundity. Both trends are likely due to pollinator/mating effects rather than resource limitation as small populations have increased nutrients.

Mating systems, pollination biology, seedling fitness and patterns of gene-flow in relation to population connectivity are currently under investigation.

Genetic variation and fecundity data indicate that very small populations (<12) are unlikely to persist without habitat restoration actions.

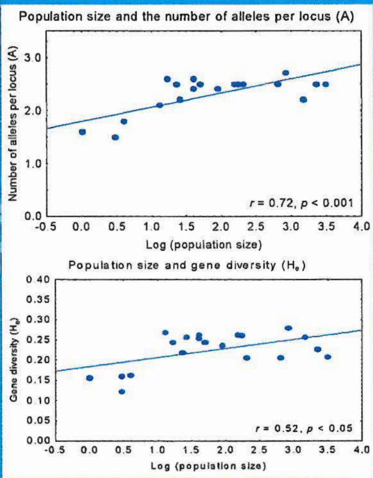

Figure 4. Relationship between allelic richness (*A*) and gene diversity (*He*), and population size

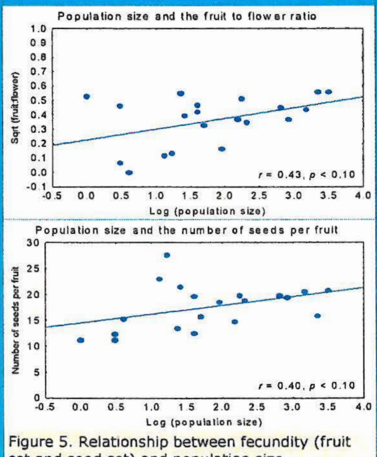

Figure 5. Relationship between fecundity (fruit set and seed set) and population size

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