



Habitat segregation of *Banksia marginata* and *B. spinulosa*



Shanti Virgona, Glenda Vaughton and Mike Ramsey

Botany, School of Environmental Sciences and Natural Resources Management, University of New England Armidale, NSW 2351

Introduction

Plant distribution reflects the outcome of a series of population processes, including seed production, dispersal and germination, and seedling growth and establishment. The segregation of species may reflect a dynamic equilibrium based on specific microsite requirements or tolerances. Alternatively, segregation may reflect non-equilibrium patterns caused by disturbance, site pre-emption or other factors. This study investigates habitat segregation of *B. marginata* and *B. spinulosa* shrubs by examining seed production, seed germination and seedling survival.

Study Sites and Species

Gibraltar Range National Park (GRNP) contains a matrix of vegetation types, including heath swamps and flanking sclerophyll woodlands. In 2002 the area was burned, providing an opportunity to examine the regeneration and habitat segregation of *B. marginata* and *B. spinulosa*.

Questions

Does the seed bank limit recruitment?

Methods and Results

Plant density was assessed from 5 quadrats (10m x 10m). Cone number was counted on 50 plants. The number of sound seeds was counted on one cone from 20 plants. Seed bank size was estimated as: plant density x cone number x seed number. The seed bank of *B. marginata* was larger than *B. spinulosa* ($p < 0.001$), but the seed bank of both species appeared sufficiently large so as not to limit recruitment (Table 1.)

Table 1. Estimated seed bank size. Data are means (SE).

Estimated means	<i>B. marginata</i>		<i>B. spinulosa</i>	
	WT	SC	WT	SC
No. Plants/ m ²	5.2 (1.3)	4.6 (0.9)	0.5 (1.2)	0.6 (1.1)
No. Cones/ plant	46 (4.5)	17 (1.8)	9 (0.9)	9 (1.2)
No. Seeds/ cone	57.7 (3.5)	24.4 (3.8)	30 (4.7)	33.3 (3.8)
Total Seeds/ m ²	13801 (1356)	1908 (266)	135 (15)	179 (19)

Does soil type affect germination?

1. Field
Replicate mesh bags, with 20 seeds were shallowly buried in each habitat (Fig. 3). Seed germination was assessed over 5 months. Seed germination was similar for both species in both habitats, although fewer seeds germinated in the woodlands (Fig. 4).

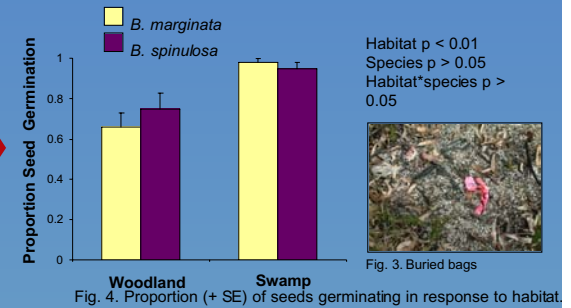


Fig. 4. Proportion (+ SE) of seeds germinating in response to habitat.

Does soil moisture affect seedling establishment?

2. Glasshouse
Seeds ($n = 320$) were sown in soil from each habitat. Emergence for both species in both soil types, indicates that soil type did not affect early recruitment ($> 95\%$, $p > 0.05$).

In the glasshouse, seedlings were placed in standard soil mix under three soil moisture treatments: dry (20-25% field capacity), moist (60-65%) and water logged (100%). Seedlings were monitored for 3 months. More *B. marginata* seedlings survived under the waterlogged conditions, but more *B. spinulosa* survived under the dry conditions ($p < 0.05$, Fig.5).

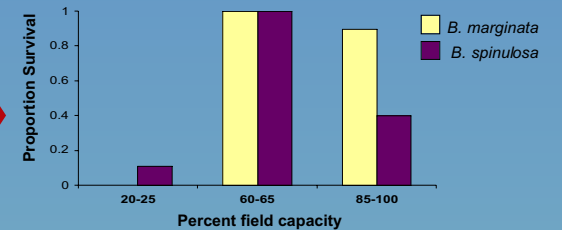


Fig. 5. Proportion of seedlings surviving in response to soil moisture.

Conclusions

- ◆ Seed limitation is unlikely to contribute to habitat segregation, providing seeds disperse into both habitats.
- ◆ Seeds germinate equally well on soil from both habitats, indicating differences in soil type are unlikely to contribute to habitat segregation.
- ◆ Differences in the ability of seedlings to cope with either wet or dry soils may explain habitat segregation. A reciprocal seedling transplant experiment is being conducted to examine survival under natural field conditions in the wet swamps and dry woodlands.

Habitat segregation of *B. marginata* and *B. spinulosa* may reflect specific microsite tolerances that affect seedling survival.

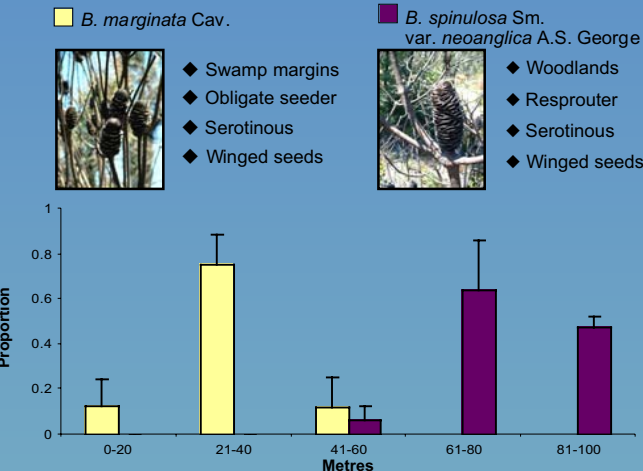


Fig. 1. Distribution of *B. marginata* and *B. spinulosa* at GRNP. Data are mean (+ SE) proportion of plants found on transects across the habitats. The swamp margin is depicted within the 0 m - 40 m zone and the woodland within the 41 m - 100 m zone.

Experimental design

We estimated seed production of the two species at two sites and used seeds from these sites for seed germination, and seedling survival experiments (Fig. 2).

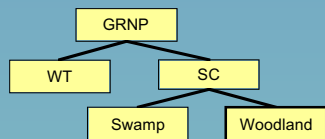


Fig. 2. Design for all surveys experiments.

Acknowledgments
Thanks to NSW NPWS for permits, Beadle Fund (Botany, UNE) for an Honours grant, and Monica Campbell for support.

