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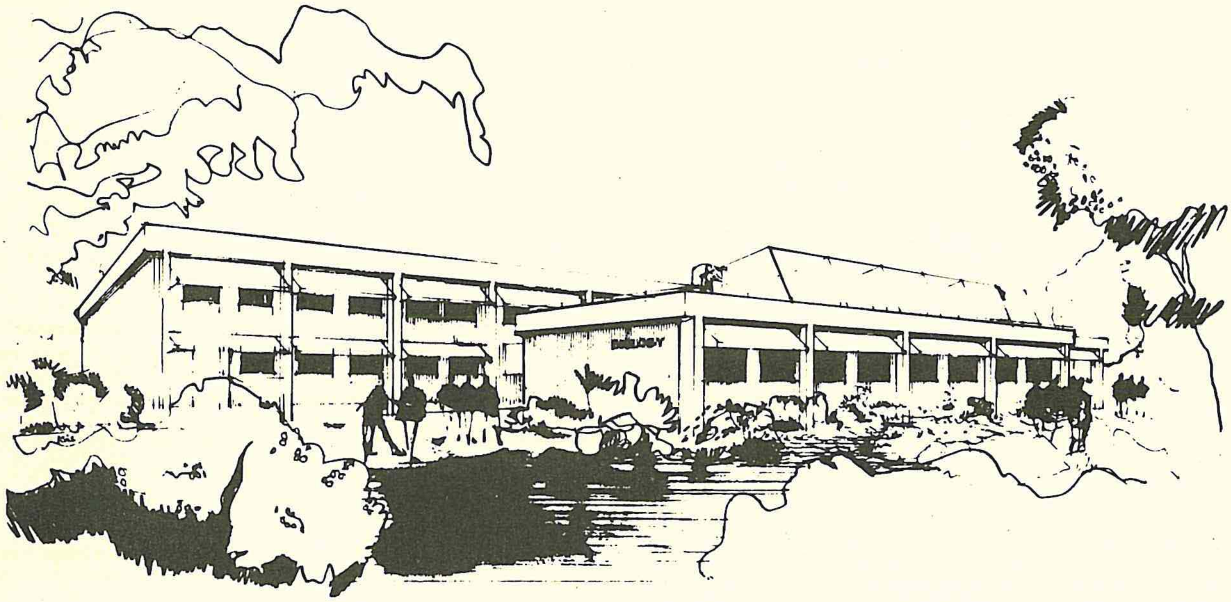
ROAD VERGES PLAY A MAJOR ROLE IN CONSERVING *Banksia menziesii*

by

Victoria A. Whitten, Byron B. Lamont, E.T.F. Witkowski, Rosemarie G. Rees and Neil J. Enright

Report to
Roadside Conservation Committee



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Abstract

Banksia menziesii is a tree at the mesic end (Swan Coastal Plain) of its range and a shrub, with a 47% reduction in canopy volume, at the xeric, more fire-prone end (Eneabba Plain). Plants in the xeric end produced 1.4 (road verge) and 2 (non-road) times as many fertile cones and 2 and 3 times as many seeds, and stored 8.9 and 8.5 times as many seeds in the canopy as those in the more mesic end. Fecundity on an absolute, as well as canopy volume, basis was therefore much greater for the plants in the more stressful environment. Since adults are less likely to resprout after fire at Eneabba and seedlings are less likely to survive the summer, this increases the probability of population maintenance after fire. Plants on road verges had 2.4 (Swan Coastal Plain) and 2.6 (Eneabba Plain) times larger canopies than those at least 50 m further from the road. Road edge plants supported 3.2 and 2.3 times as many fertile cones, produced 2.6 and 4 times as many seeds, and stored 3.5 and 3.7 times as many seeds as non-edge plants. This is interpreted as a direct response to increased access to water and nutrients from the road system. By enhancing growth and fecundity, road verges could play a major role in conserving this species especially in the xeric end of its range where populations are declining.

Introduction

Recent research on the population biology of *Banksia* species (Proteaceae) in relation to environmental constraints has provided the basis for devising suitable management practices for their conservation and utilisation (Cowling, Lamont and Enright 1990; Burgman and Lamont 1992; Enright and Lamont 1992). Banksias are a major component of the fire-prone shrublands and woodlands of south-western Australia, accounting for 61 of the total 76 described species in the genus (George 1981; Taylor and Hopper 1988). The massive infructescences (cones) bear few to many woody fruits (follicles) each containing at most two seeds. These develop from large and colourful blooms which give many species the potential for use in ornamental horticulture and as cut flowers (George 1987; Fuss and Sedgley 1990). Much of the seed is retained in the follicles until released following fire and seedling to the immediate post-fire period (Lamont, le Maitre, Cowling and Enright 1991a). Sound management of banksia-dominated vegetation may therefore be necessary for both conservation and economic reasons (Cowling *et al.* 1990). The subject of this study was *Banksia menziesii* R.Br., a major species in scrub-heath and banksia woodland in south-western Australia (Taylor and Hopper 1988).

Northwards from Perth, where it is a tree 5-8 m tall, *Banksia menziesii* declines in height with decreasing rainfall and higher temperatures until it occurs as a shrub 1-3 m tall at Eneabba - Mount Adams near the northern limit of its distribution (Cowling and Lamont 1985b). Following fire, mature plants may resprout from lignotubers or epicormic buds but parent mortality is high relative to other resprouting species (Cowling and Lamont 1987). *B. menziesii* is only weakly serotinous (few seeds are stored in the canopy for more than a year, Lamont *et al.* 1991) and is therefore largely dependent on the current year's seed crop for recruitment following fire. However, it is one of the least fertile of up to six co-occurring banksias and seedling recruitment under any circumstances is extremely rare (Cowling and Lamont 1987, Enright and Lamont 1989). From these observations it appears that this species is declining, even on conservation reserves, and appears to be contracting at its northern limits due to increasing aridity (Pittock 1988) and more frequent fire (Enright, unpublished). In addition, rare colour variants of the blooms (pale pink to red, sometimes yellow or rusty-brown George 1984), which are of considerable horticultural value, are currently well-represented in the xeric end and could be threatened by this decline.

Of Australia's total 870 000 km of roads (National Association of Australian State Road Authorities 1987), about 90% are outside towns (Clark 1985 in Cooper 1991). Land clearing, mining, urban sprawl, pollution, invading plants and pathogens, lowering of the water table and increased exploitation of natural products currently threaten the survival of many indigenous species in Australia. Thus, there is considerable potential for road verge reserves as conservation areas. For example, the retention of a 10 m strip of native vegetation along 10 000 km of roads would conserve 10 000 ha. Preliminary observations indicated that roadside individuals of *B. menziesii* near its northern limit were larger and flowered more profusely than individuals located away from the road. Road verge plants could act as a source of extra seeds which might buffer populations against local decline and possible extinction. The potential significance of road edge populations of *B. menziesii* was therefore examined by measuring population attributes, plant size and cone, follicle and seed production, and canopy seed store near the extremes of its climatic gradient (Taylor and Hopper 1988) and comparing them with non-edge populations. Specific hypotheses tested were:

(a) In response to the more mesic growing conditions southern (Swan Coastal Plain) individuals of *B. menziesii* are larger than northern (Eneabba Plain) individuals (confirming Cowling and Lamont 1985a) (b) To enhance the likelihood of post-fire seedling recruitment, plants at the xeric end produce and store more seeds than at the mesic end (Lamont *et al.* 1991a) (c) Road edge plants are larger than those located away from the road edge, due to greater resource availability (Stock *et al.* 1989), (d) Road edge plants have more blooms, fertile cones and seeds than those located away from the edge of the road because the plants are larger (Lamont *et al.* 1991b), (e) Decrease in plant size and fecundity away from the road edge is more marked in the xeric populations as the diminished rainfall is more likely to be limiting growth (Lamont *et al.* 1991b).

Materials and Methods

Study Area

The vegetation systems, geology and climate under which *Banksia menziesii* occurs can be divided into two physiographic units - the northern Eneabba Plain and the southern Swan Coastal Plain (Beard 1976, 1979). Three of the study sites were located on the Eneabba Plain between Eneabba (29°49'S, 115°16'E) and Mt Adams (29°25'S, 115°10'E), 300-350 km north of Perth, Western Australia. These sites were (1) Mt Adams (northern site), (2) Brand Highway (central, 29°34'S, 115°8'E) and (3) Beekeepers Reserve (southern site, 29°42'S, 115°14'E). Another three sites were located on the Swan Coastal Plain between Yanchep (31°30'S, 115°45E) and Guilderton (31°28'S, 115°4'E), 50-80 km north of Perth. The sites were (4) Wanneroo Road (northern site, 31°22'S, 115°47'E), (5) Wilbinga Grove (central site, 31°23'S, 115°47'E) and (6) Wabling Hill Firetower track (southern site, 31°25'S, 115°40'E).

As *B. menziesii* resprouts (often from the ground) after fire it was not possible to compare ages of the plants at these sites; however, all had not been burnt for at least 15 years, based on the annual branching pattern (Lamont 1985). One of the three sites in each region was located along the main road (sealed) while the other two were located along gravel roads which run-off the main road. Each of the study sites was selected where *B. menziesii* was present on the road reserve (edge) and at least 50 m away from the road in a natural undisturbed population (non-edge).

At the northern xeric sites, vegetation was scrub-heath (Beard 1976) with *B. attenuata* R.Br., *B. hookeriana* Meisn. and *B. menziesii* R.Br. forming a 1.5-4.0 m high canopy over a 0.25-1 m high heath understorey. This vegetation was restricted to leached sandy soils forming undulating dunes. At the southern mesic sites, vegetation was a low woodland (Beard 1983) consisting of *Casuarina fraseriana* Miq., *B. attenuata* and *B. menziesii* trees forming a 4-7 m high canopy over a 0.25-1 m high heath understorey. Soils are part of the Spearwood dune system of leached sands underlain by calcarenite at depth. The Eneabba Plain has an extra-dry mediterranean climate with a mean annual rainfall of 506 mm (meteorological data, AMC minesites Eneabba), and mean maximum temperature for the hottest month of 38.8^{o}C and minimum temperature for the coolest month of 9.2^{o}C. The dry mediterranean climate of the Swan Coastal Plain experiences a mean average rainfall of 639 mm per annum (Western Australian Meteorological Bureau for Lancelin), and mean temperatures as above of 29.8^{o}C and 9.7^{o}C respectively.

Population attributes

Ten *B. menziesii* plants were randomly chosen at both the road edge and non- edge positions at each of the six sites. Otherwise suitable sites were rejected if there was any evidence of significant differences in density of *B. menziesii* and/or other shrubs between the two positions. Densities were obtained from three 10 x 20 m plots at each position for each site. Height (H) and widest (W_1) and perpendicular (W_2) widths were measured on each plant of *B. menziesii*. These values were used to calculate canopy area ($0.7850W_1.W_2$) and canopy volume ($0.5236H.W_1.W_2$).

Seed bank dynamics

Cone age was determined by counting the annual branching pattern (Lamont 1985). Blooms, and fertile and infertile cones present in each annual age class, were counted for each of 10 randomly selected plants at the road edge and non-edge positions at each site. Three cones of each age-class (1 to 8 years old) were harvested from five of these plants each location. Collecting ceased for cones greater than eight years old as all follicles had opened and released their seeds. The numbers of open and closed follicles per cone were recorded. Cones were burnt to rupture the closed follicles, immersed in water and allowed to dry for 1-2 weeks to aid seed removal (Cowling and Lamont 1985b). Seeds were classified as aborted, eaten/decayed, firm or released. A minimum of 30 firm seeds for each age class and from each location were placed in moistened petri dishes containing vermiculite and lined with filter paper. Germination was followed for 50 days at the optimum temperature (15^{o}C; Cowling and Lamont 1987) to determine their viability. Only seeds which germinated were regarded as viable (Lamont and van Leeuwen 1988). Aborted, eaten/decayed, dispersed, viable and non-viable seed numbers were converted to proportions of the total seeds per year per plant. These values were then used to calculate the number of seeds of each type for the 5 plants per site and per position for which only numbers of fertile and infertile cones had been recorded.

Seed bank attributes were also determined on a mean plant basis by summing the data for each age class on a weighted mean basis. Sums of number of fertile cones, total cones, total follicles, seeds dispersed, seeds eaten/diseased, seeds aborted, non-viable seeds, viable seeds, potential seeds (2 x follicle production), seed production (potential seed - aborted seeds), cone fertility (%), and fruit set (follicles per cone) were made per plant for each of the 10 plants per position per site. The data were pooled for the three Swan Coastal Plain sites and three Eneabba Plain sites for each road edge and non-edge position.

Data analyses

Where necessary, data were normalised by log, square root or arcsin (percentage data) transformations (Zar 1984). Two-way ANOVAs were carried out initially. Student-Newman-Keuls multiple range tests were then used to determine any significant differences between means. The statistical tests were performed using the SAS package (SAS Institute 1985).

Table 1 Population attributes (mean with SD in parenthesis) of road edge and non-edge plants of *Banksia menziesii* at three Eneabba and three Swan Coastal Plain sites.
Results analysed by 2-way ANOVA between regions (R) and positions (P). ** P <0.01; *** P <0.001; NS not significant. Different letters indicate significant differences between means P<0.05; Student-Newman-Keuls). # denotes analysis of transformed data.

Region:	Eneabba Plain		Swan Coastal Plain		ANOVA		
Position:	Road edge	Non-edge	Road edge	Non-edge			
Attribute					R	P	RxP
Density (no./ha)							
B. menziesii	344 (168) a	400 (170) a	378 (186) a	433 (152) a	NS	NS	NS
other trees >4 m	150 (178) b	33 (56) b	633 (422) a	567 (308) a	***	NS	NS
other shrubs >1 m	5506 (1322) a	6633 (1705) a	6672 (2046) a	7039 (1874) a	NS	NS	NS
Height (m) #	3.6 (1.2) b	2.9 (0.6) c	4.8 (1.3) a	4.2 (1.1) a	***	**	NS
Canopy area (m^2) #	6.9 (5.9) ab	3.8 (2.5) c	9.5 (7.9) a	4.9 (3.6) bc	NS	***	NS
Canopy volume (m^3) #	20.0 (22.0) b	7.8 (6.0) c	35.4 (35.2) a	14.6 (13.1) b	**	***	NS

Results

Population attributes

Density of trees (plants > 4 m) on the Swan Coastal Plain was much greater (4.5x and 5.1x) than on the Eneabba Plain (Table 1), while there were no significant differences for shrubs or *B. menziesii* between regions. There were no significant differences in the densities of *B. menziesii*, other trees or shrubs at the road edge and non-edge positions within regions. *B. menziesii* individuals on the Swan Coastal Plain were larger than the Eneabba plants with almost twice the canopy volume. Road edge plants were taller and had a much greater canopy area and volume than non-edge plants in both regions (Table 1). The difference in canopy volume between positions in both regions was similar (2.5x).

Cone and follicle production

Road edge plants had more cones, fertile cones and mean number of follicles than the non-edge plants (Table 2, Figure 1). Values for road edge plants were twice as high in the Eneabba Plain and 3-4x greater in the Swan Coastal Plain than for non-edge plants. The total number of cones per plant was higher on the Swan Coastal Plain, especially on the road edge, while the number of fertile cones was much greater on the Eneabba Plain. Total number of cones per unit canopy volume was 1.8 times greater for the Eneabba plants than the southern plants. Relative cone fertility was greater for the Eneabba Plain plants than the Swan Coastal plants with no significant difference between positions (Table 2). There were more follicles per fertile cone were higher at Eneabba with road edge plants in both regions having more follicles per cone (by 24-60%) than the non-edge plants (Table 2).

Table 2 Selected reproductive traits (mean per plant with SD in parenthesis) of road edge and non-edge plants of *Banksia menziesii* at three Eneabba and three Swan Coastal Plain sites. Results analysed by 2-way ANOVA between regions (R) and positions (P). * $P<0.05$; ** $P<0.01$; *** $P<0.001$; NS not significant. Different letters indicate significant differences between means ($P<0.05$; Student-Newman-Keuls). # denotes analysis of transformed data.

Region:	Eneabba Plain		Swan Coastal Plain		ANOVA		
Position:	Road edge	Non-edge	Road edge	Non-edge			
Attribute					R	P	RxP
Total cones #	69.8 (48.6) a	31.3 (23.2) b	100.0 (94.6) a	35.3 (25.8) b	NS	***	NS
Total cones/m^3 canopy #	7.4 (6.4) a	6.4 (11.2) a	4.2 (3.6) a	3.6 (2.8) a	*	NS	NS
Fertile cones #	54.2 (40.7) a	23.3 (17.3) b	37.8 (51.2) b	11.9 (5.9) c	***	***	NS
Cone fertility (%) #	76.0 (15.0) a	76.5 (14.5) a	37.7 (18.1) b	43.3 (22.5) b	***	NS	NS
Follicles/fertile cone #	7.7 (1.7) a	6.2 (1.6) c	6.5 (10.6) b	4.1 (1.5) d	***	***	NS
Mean no. follicles #	392.7 (296.0) a	137.9 (96.4) bc	189.5 (249.7) b	48.5 (32.6) c	***	***	NS
Potential seeds #	778.7 (595.6) a	276.1 (193.2) b	357.4 (498.2) b	96.8 (64.9) c	***	***	NS
Seeds produced #	466.3 (340.8) a	179.0 (136.7) b	237.3 (304.2) b	58.6 (47.3) c	***	***	NS
Seeds produced/m^3 canopy #	51.8 (43.7) a	12.1 (15.9) a	1.2 (1.5) b	0.7 (1.1) b	***	*	NS
Seeds produced (%) #	63.4 (15.4) ab	64.5 (16.0) ab	69.3 (18.4) a	55.4 (19.3) b	NS	*	*
Viable seeds stored #	202.2 (133.0) a	54.3 (38.4) b	22.7 (32.6) c	6.4 (12.7) d	***	***	NS
Viable seeds/m^3 canopy #	23.6 (21.0) a	33.5 (31.2) a	8.8 (7.1) b	6.2 (5.9) b	***	*	NS

Table 3 Condition of seeds (mean % per plant with SD in parenthesis) of road edge and non-edge plants of *Banksia menziesii* at three Eneabba and three Swan Coastal Plain sites. Degree of serotiny after Cowling and Lamont (1985b). Results analysed by 2-way ANOVA between regions (R) and positions (P). * P <0.05; ** P <0.01; *** P <0.001; NS not significant. Different letters indicate significant differences between means (P <0.05; Student-Newman-Keuls). # denotes analysis of transformed data. @ denotes results based on retained seeds.

Region:	Eneabba Plain		Swan Coastal Plain		ANOVA		
Position:	Road edge	Non-edge	Road edge	Non-edge	R	P	RxP
Attribute							
Seeds - released (%) #@	36.1 (20.2) d	46.2 (17.3) c	72.0 (12.3) b	84.2 (13.8) a	***	***	NS
- stored, viable (%) #@	27.6 (10.2) a	23.7 (14.1) a	9.0 (6.7) b	5.1 (7.9) c	***	**	NS
- stored, non-viable (%) #@	10.1 (34.6) a	1.9 (2.5) ab	1.6 (2.4) ab	2.0 (6.9) b	*	NS	NS
- stored, eaten/decayed (%)#@	9.5 (6.2) ab	8.2 (5.7) ab	12.2 (6.8) a	7.6 (6.0) b	NS	**	NS
- stored, aborted (%) #@	17.0 (9.3) a	11.6 (6.6) b	4.0 (4.4) c	2.4 (3.5) c	***	**	NS
Degree of serotiny	8.3 a	9.4 a	5.6 b	6.6 b	*	NS	NS

Potential and actual seed production

Road edge plants had 2.8x and 3.7x the number of follicles and potential seeds and produced 2.6x and 4.0x more seeds per plant than the non-edge plants in the Eneabba and Swan Coastal Plains respectively (Table 2). Seed production was 2-3x greater at Eneabba. Seed production per crop year increased in both regions with plant age with acceleration particularly marked in the Eneabba road plants (Figure 1). On a plant canopy volume basis total seed production by Eneabba plants was 19.6 times (road edge) and 17.3 times (non-edge) by the Swan Coastal plants (Table 2).

Canopy seed storage

The proportion of seeds produced which was still viable and retained in the canopy was greater on the Eneabba Plain (24-28%) than the Swan Coastal Plain (5-9%) (Table 3). Canopy seed store for the road edge plants was up to 3.5x greater than the non-edge plants in both regions. Eneabba plants had up to 6 times more viable seeds stored in 1 year old cones than Swan Coastal plants (Figure 1). The current seed crop contributed 70-90% of stored viable seeds in the Eneabba plants and 94% in the Swan Coastal plants. *B. menziesii* on the Eneabba Plain retained up to 5 times more viable seeds in the canopy as a proportion of seeds produced (Table 3). Viable seeds per unit canopy volume were 5.9 times (road edge) and 5.4 times (non-edge) more abundant in the Eneabba Plain than the Swan Coastal plants (Table 2).

At least 10% more of the total seeds in the non-edge plants had been released than the road edge plants in both regions. Swan Coastal plants had almost twice the percentage seed release as the Eneabba plants. Pre-dispersal seed predation and seed abortion were higher at the road edge in both regions (Table 3). Proportions of seeds eaten/decayed varied greatly between years, with values for both regions averaging 8-

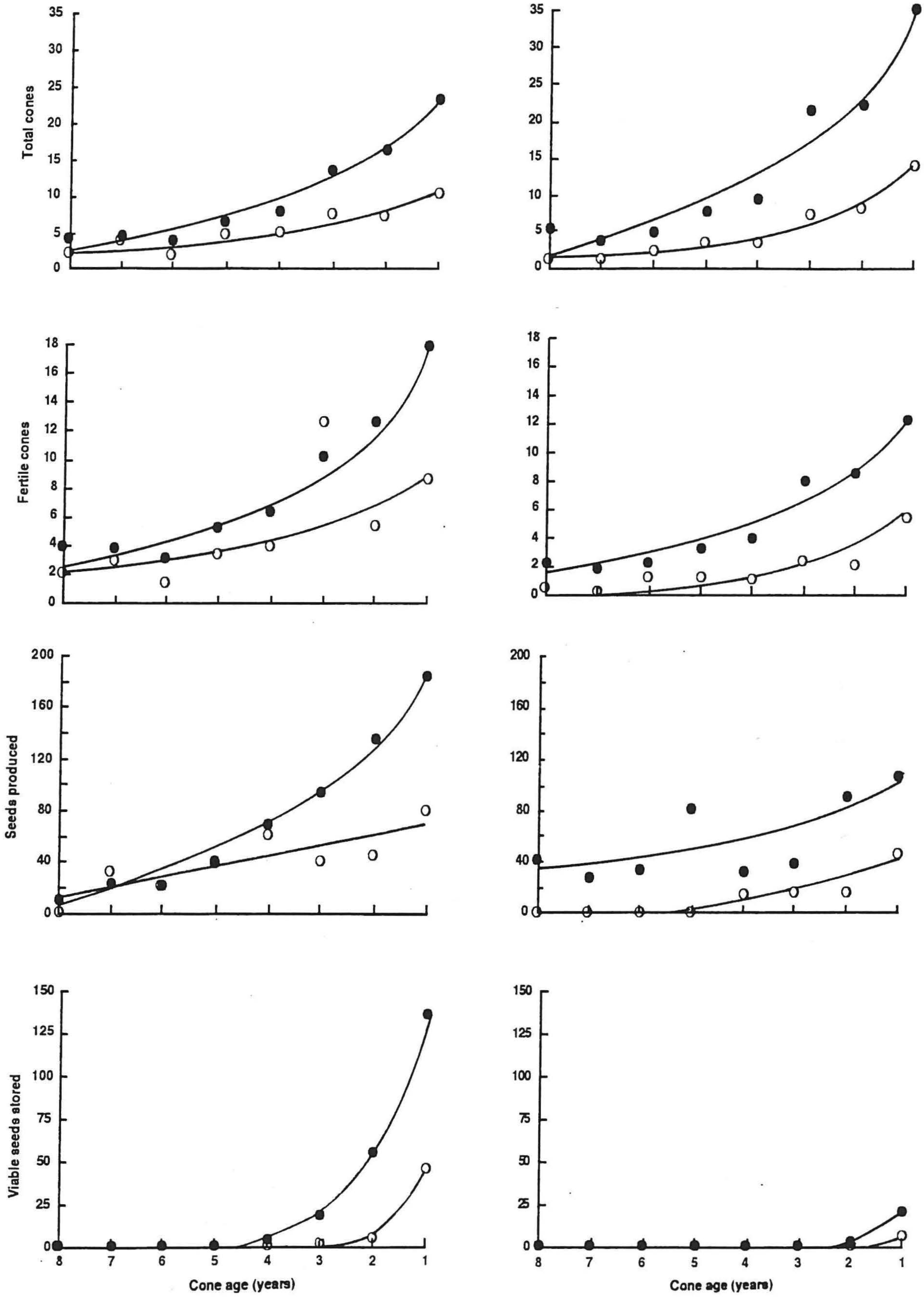

Figure 1 Number of total and fertile cones, seeds produced and viable seeds stored in each cone age class per plant for road edge (●) and non-edge (O) *Banksia menziesii* plants at three Eneabba Plain (left) and three Swan Coastal Plain (right) sites. Curves based on linear, power or exponential fit with highest r^2 - all significant at P<0.001.

12%. *B. menziesii* individuals on the Eneabba Plain had up to 6 times the abortion level of those on the Swan Coastal Plain (Table 3) although they also had retained more aborted seeds. Non-viable seeds were negligible in all but the road edge plants at Eneabba. Degree of serotiny (after Cowling and Lamont 1985a) was higher for the Eneabba plants (Table 3). A power function explained the relationship better than the linear, though the trends were identical. No significant differences in serotiny were found between the road and non-edge plants of either region.

Discussion

Individuals of *Banksia menziesii* were larger (taller, wider, greater canopy volume) at the mesic end of their distribution. This can be interpreted as a direct response to the longer growing season in terms of effective rain (Cowling and Lamont 1985a) and higher nutrient availability (Whitten 1992). As a result, the canopy is at a height equivalent to those of other abundant tree species enabling *B. menziesii* to compete effectively for space and light while retaining mutual protection against the strong prevailing winds. Slower growth rates at the xeric end and more frequent fires (Cowling and Lamont 1985a), which force the new shoots to the base of the trunks or lignotuber, result in many-branched, smaller plants of similar dimensions to other co-occurring dominants (Lamont and Bergl 1991).

This basal rejuvenation at Eneabba appears to explain the greater fecundity (cone production, follicles per cone) on a unit canopy volume basis - the many sturdy branches, almost connected directly to the root system, can each bear blooms. Not only are the large single trunks at the mesic end probably a trade-off with fecundity in terms of organic mass and mineral nutrient content, water will be under greater tension (less available) at the more elevated locations of the blooms. In addition, the growth habit of the Eneabba plants provides more apices per unit volume for conversion into blooms (Fuss *et al.* 1992). Alternative explanations of high cone fertility (but not cone production) could be related to pollinator activity. Nectarivorous birds are the major pollinators of *B. menziesii* (Ramsey 1988) and could be disproportionately attracted to the greater concentration of blooms even though total bloom production is not significantly different. In addition, flowering of the highly floriferous co-dominant *B. hookeriana* Meisn. overlaps with that of *B. menziesii* (Witkowski *et al.* 1991). This may enhance bird activity generally in contrast to the more mesic sites where *B. menziesii* is the only winter-flowering species visited by birds (Whelan and Burbidge 1980).

These proximate effects on fecundity are coupled with a higher degree of serotiny, ie. a higher proportion of the viable seeds remains stored in the canopy, in the more xeric end, confirming the preliminary findings of Cowling and Lamont (1985a). Since seedling recruitment is restricted to the immediate post-fire environment (Cowling and Lamont 1987; Enright and Lamont 1989), this much greater seed storage on an absolute (9 times) and relative (5-6 times) basis has ultimate implications. The longer and hotter summer drought at Eneabba may decrease the likelihood of seedling survival following fire-induced seed release. Eventual seedling recruitment may be zero under some conditions (Cowling and Lamont 1987; Enright and Lamont 1989). In addition, adults are less likely to resprout after fires at Eneabba. Thus, fitness is increased by maximising canopy seed storage under more stressful environments - including more frequent fire (Lamont *et al.* 1991).

The road edge plants were larger, with 2-3 times greater canopy volumes, than the plants away from the road. This can be attributed to their greater access to water and nutrients (Whitten 1992) due to run-off from the road and absence of woody plants in the road apron leading to reduced root competition for resources. In turn, road verge plants had more cones on an absolute but, not relative, basis. This implies that the extra number of reproductive apices initiated balanced out with the extra elongation in the road edge plants (Fuss *et al.* 1992). In addition, there was a times difference infertile cones but no difference on a proportional basis. As cone fertility in *Banksia* is considered pollinator-limited (Copland and Whelan 1989), this indicates that visits to larger plants is directly proportional to bloom production rather than enhanced (c.f. Vaughton 1991). More follicles per fertile cone and viable seeds per follicle as also observed are more appropriately interpreted as a response to greater nutrient supply (Lamont and Barrett 1988) associated with the road effect.

The net effect was a remarkable 2-4 times increase in seed production by the road edge than non-edge plants on both an absolute and relative basis. Our initial expectation that this effect would be more marked in the Eneabba region was not supported. Among the 24 attributes measured, there were only two interaction effects, one due to reduced proportion of viable to potential seeds produced by non-edge Swan Coastal plants relative to the other three sites, and the other apparently due to the exceptionally high number of viable seeds stored in the Eneabba road edge plants. As argued above, the growth form of the Eneabba plants implies that they were probably no more resource-limited than those at more mesic sites - certainly water stress over summer in mature plants (but not seedlings) is minimal (Lamont and Bergl 1991). In addition, increase in resource availability through the road effect may not have been the same in both regions - it was probably smaller at Eneabba. Finally, the greater proportion of seeds retained in the road edge plants was probably due to the fact that younger cones made up a greater proportion of total seeds produced.

The enhanced fecundity of road edge plants of *B. menziesii* is a direct response to the greater availability of resources in a water and nutrient-limited environment. This morphological plasticity, finely tuned to small changes in resource supply even in old plants, may also increase fitness. By taking advantage of fluctuations in resource availability existing plants can continue to match equivalent responses by co-occurring species (Rees 1991) while increasing seed storage for post-fire release. In the highly competitive post-fire environment, extra seeds increase the chances of seedling recruitment (Enright and Lamont 1989; Lamont *et al.* 1992). From a conservation point of view, the greater canopy seed storage of road edge plants have the potential to buffer *B. menziesii* populations against possible local decline and extinction of genotypes. Maintaining road verge vegetation in pristine condition takes on an element of urgency as the apparent increasing aridity of southwestern Australia over the last 70 years has recently been attributed to the 'greenhouse effect' (Pittock 1988). Whatever the explanation, it appears the conservation value of road reserves should not be underestimated.

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