LAND FOR WILDLIFE
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SHAPE MATTERS TOO!

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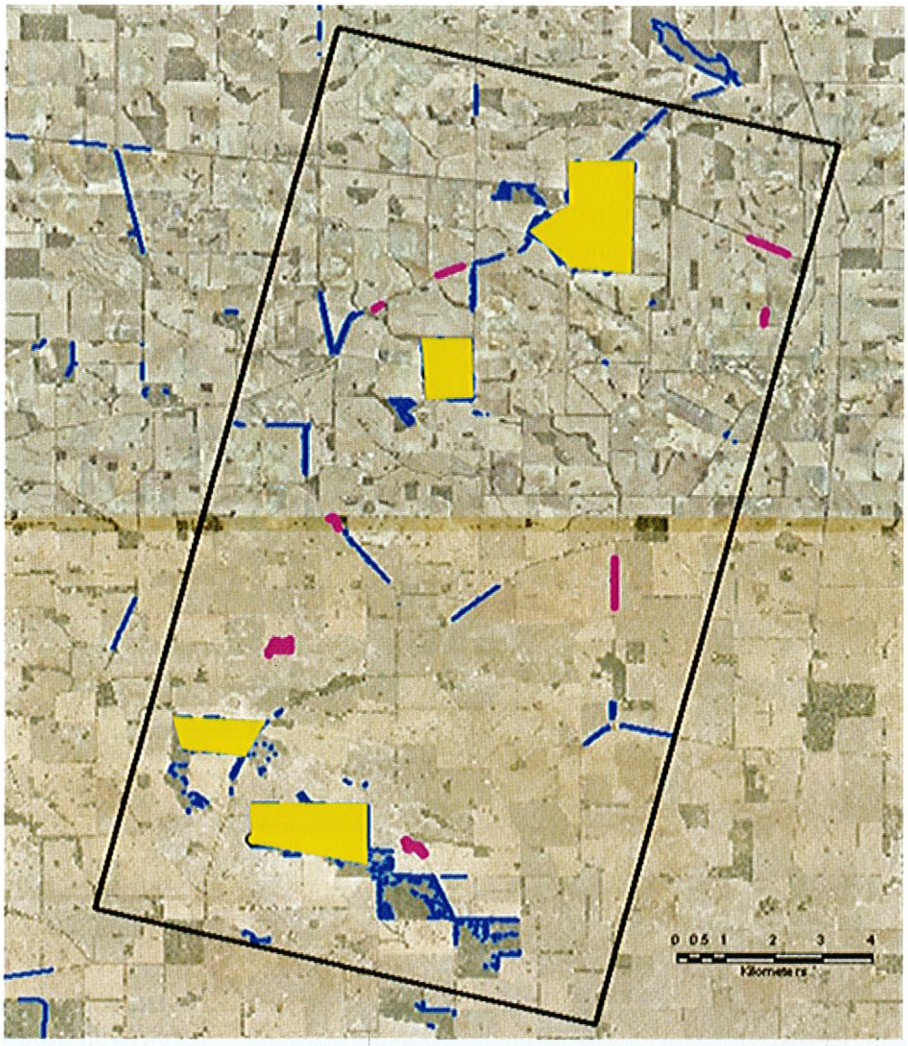
In many areas of Western Australia, our native vegetation is confined to a scattering of bush remnants that are vital in maintaining regional biodiversity and providing important ecosystem services. However, all native vegetation remnants were not created equal – they vary greatly in their physical characteristics, which can affect the way the local ecosystem functions and ultimately the long-term viability of the remnant's native plant and animal populations.

It is fairly well known that small populations are usually less viable than large ones, and that more isolated populations often fare worse than those that have better connections to other populations. These principles of size and connectedness are widely used in conservation management and in the design of conservation reserves.

Yet little is known about how remnant shape might influence population function and viability. This is particularly pertinent in many agricultural landscapes, where the most common remnant shape is often the linear strip along roadsides, railways or fence-lines.



Map of the 10km x 20km study area. Yellow: large populations; pink: small populations (including six linear populations); blue: Banksia sphaerocarpa *occurrence. Image: DPaW.*

A recent study by scientists from the Department of Parks and Wildlife (DPaW) provides some valuable insights into the effect of population shape as a significant aspect of habitat fragmentation. The study of the common bird-pollinated shrub *Banksia sphaerocarpa* var. *caesia* investigated 12 remnant populations in the Harrismith area of the southern wheatbelt that varied in size, isolation, shape and plant density, to determine the effects on patterns of plant mating (measured using genetic analysis of seeds), production of inflorescences (flower clusters) and cones, on the fitness of seeds and seedlings.

The results were quite surprising. While all four variables were strongly related to different aspects of plant mating, only remnant shape could explain the variation in inflorescence and cone production and the fitness of seeds and seedlings.

In linear remnants, plants were much larger and produced many more inflorescences and cones. This is most likely due to increased water and

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Shape matters too

nutrient runoff (e.g. from roads and paddocks) available to plants in linear remnants – a consequence of the much higher 'edge to area ratio' in linear remnants. But unexpectedly, these large and productive plants produced seeds that were much smaller, had poorer germination success, and produced smaller seedlings with poorer survival rates, when compared to the smaller, less productive adult plants found in non-linear remnants. Furthermore, even among linear remnants this effect became greater as the degree of linearity increased (as the ratio between remnant length and width increased).

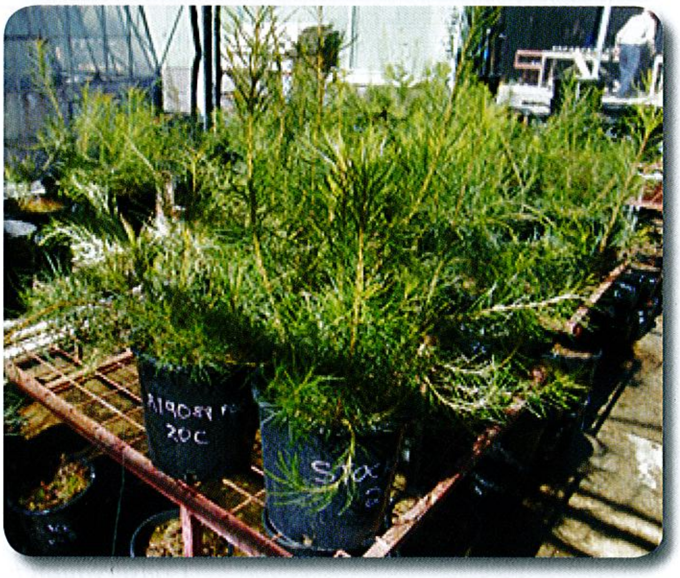
Further investigation revealed that the cause of the poor seed and seedling performance may be reduced paternal diversity – significantly fewer fathers were found contributing to seed crops in linear populations compared with non-linear populations, regardless of the size of the population. (Similar relationships between the paternal diversity of seed crops and the fitness of seeds and seedlings have recently been found in other plants, but the mechanism is not well understood.) How could a linear population shape reduce the number of fathers contributing to a plant's seed crop? In linear populations, plants have fewer near neighbours to mate with (because local mates are spread out along a narrow strip), and pollinators are forced to forage for nectar in one direction, so pollen transfer among plants is far from random. Also, much larger plants with many more inflorescences would encourage pollinators to make fewer foraging movements among plants than in non-linear populations.

So, what does this mean for native vegetation remnants? Firstly, linear populations are at greater risk of detrimental changes to their mating system, and reduced seed and seedling fitness will probably lead to poorer population viability over time. Increasing the width of the most valuable linear remnants may increase the long-term viability of their plant populations (and the animals that depend on them).

For anyone sourcing seeds for restoration work, linear and edge-dominated remnants should be avoided if possible – the abnormally large and productive plants found in these types of remnants do not necessarily produce the fittest seeds!

Finally, this research is relevant to anyone creating restoration or revegetation plots, or connectivity corridors – linear or edge dominated geometries should be avoided in order to maximize long-term viability.

The department sincerely thanks landowners in the Harrismith area for their enthusiastic assistance in accessing remnant bushland on their properties for this study.



Top: a linear roadside remnant containing Banksia sphaerocarpa.
Centre: old and new inflorscences of Banksia sphaerocarpa.
Bottom: Banksia sphaerocarpa *seedling growth experiment.*
Photos: Tanya Llorens

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