Gondwanan Botany: A Perspective on Remnant Management in South-West Australia

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INTRODUCTION

Botanical research in vegetation remnants of south-western Australia has been increasing over several decades. This has led to a new Gondwanan perspective on the flora, which has significant implications for management. In this extended abstract, I aim to summarise some pertinent research results, highlight their management implementation, and conclude with recommendations for achieving better integration of research and management. Due to the required length of the paper, factual material is not referenced. For further information, interested readers should consult references in Hopper (1979, 1992), Hopper *et al.* (1990), and the popular reviews of Australia's fossil record by White (1986, 1990) and Rich and Rich (1993).

SIGNIFICANT RESEARCH RESULTS — THE GONDWANAN PERSPECTIVE

A new and deeper appreciation of the great antiquity and unique attributes of the south-western flora has emerged in recent years. The present-day flora sits on a landscape that has not been glaciated since the Permian (260 million years ago), and has remained above sea level, sometimes as an island, during all subsequent inundations of the Australian component of Gondwana.

The terrain of the South West, mountainous when Triassic-Cretaceous dinosaurs dominated the fauna, has been progressively eroded flat to the point where most soils are highly impoverished of nutrients, and drainage inland of the Meckering Line is largely uncoordinated and incapable of flushing salt from the system.

The flora has responded to this unique environmental history in ways quite different to those of the very recent, invasive, post-glacial floras of Europe and North America about which most botanical science and teaching are based. For example, the gathering and storing of nutrients from highly infertile soils has placed a selective premium on the evolution of novel root systems — for example, the fine mat of subsurface proteoid roots of banksias, or symbiotic partnerships with soil microorganisms such as mycorrhizal fungi. The diversity of such fungi has scarcely been documented, but Syme's discovery of more than 300 macrofungi in Two Peoples Bay Nature Reserve suggests a complexity equal to that of the better documented flowering plants.

The 50 million year old fossil banksias from the Kennedy Range inland from Carnarvon indicate the great antiquity of some extant south-western genera, and suggest that much of the diversity in wildflowers we see today originated when dinosaurs probably grazed the then mountainous terrain of the South West.

Superimposed on the great antiquity of components of the flora have been opportunities for explosive speciation among the relatively few genera that survived the onset of aridity and great extinction of the south-western rainforests that dominated our vegetation for much of the last 100 million years. The progressive aridity began some seven million years ago as Australia drifted northwards from Antarctica. A Mediterranean climate became established, and the South West then entered a period of climatic turbulence during the ice ages of the past two million years. This precipitated differential soil erosion, with the present-day Wheatbelt from Shark Bay to Israelite Bay experiencing greater climatic and erosional change than either the high-rainfall forests or the arid interior.

The flora responded dramatically, with rapid evolution yielding one of the world's richest wildflower regions. The South West has an estimated 8 000 species, 75% of which are to be found nowhere else, 30% are yet to be described by botanists, and possibly as much as 75% are yet to be grown in cultivation.

Plant biodiversity, consequently, is concentrated in complex patterns in Wheatbelt remnants, with rapid turnover across landscapes. Lateritic uplands, for example, as little as half a kilometre apart, may have less than 50% of their species in common. Distinctive floras are evident over short distances as one travels through the Wheatbelt. Burgman's (1988) studies between Ravensthorpe and Cape Arid National Park indicated that nature reserves need replication every 15 km in mallee, to capture most plant diversity.

Not surprisingly, threatened plants are concentrated in Wheatbelt remnants, and are less frequent in the forests to the south-west or in the arid zone inland.

Threatening processes, largely attributable to human activity, include land clearance, rising saline watertables, nutrient poisoning through fertiliser usage, grazing by exotic animals, inappropriate fire regimes, weed invasion, disease, harvest and eradication of economic wild species, and loss of native animals and the ecological processes they supported.

Moreover, it is evident that the recruitment biology of native plants is complex, and restoration of plant communities is very challenging. For example, Wheatbelt granite outcrops have exceptionally rich floras, with high numbers of fire-sensitive plants, whose management has yet to be investigated in any detail.

Despite the above challenges, conservation of intact remnants is very cost-effective, and remains the highest priority strategy from a biodiversity perspective.

MANAGEMENT IMPLEMENTATION

Remnant conservation programs on private and Crown lands should be managed in a way which recognises the high turnover of plant diversity in the landscape. In particular, a high degree of geographical replication is called for. However, a floristically complex vegetation and paucity of botanists have hampered the general inventory of remnants, and have led to difficulties in developing local district management priorities to maximise conservation of plant diversity.

Threatened plant distribution and abundance data have been effectively included in management considerations in some districts, but poorly in others (dependent on interest of local communities). More integrated efforts are required.

As would be expected, active management of remnants to maintain plant biodiversity is embryonic, as is research. Management has quite rightly focused on stemming the tide of direct human destruction and degradation of remnants. However, we have reached the point where active restoration management is needed. It is here that the Gondwanan perspective has much to contribute.

RECOMMENDED ACTIONS

Firstly, I firmly believe that botanical researchers need to focus more on communicating their findings in plain concise English to the media and public, and especially to managers. Botanists need to monitor public understanding and use of their results as much as how often papers are quoted in the scientific literature.

Secondly, integrated research approaches are essential. A combination of process research (necessarily confined to few sites) and descriptive research (wider geographical scope) is needed to yield cost-effective and efficient conservation of biodiversity.

Thirdly, it is vital that there be collaborative interaction of managers and researchers, combining the operational and investigative skills of each group — for example, in long-term monitoring and experimental management.

In terms of applicable prescriptions, in view of the floristic complexity to be found in remnants, conservative management and highly replicated conservation activities across the landscape are recommended, focused on intact remnants with the highest biodiversity (genetic, specific, community, landscape — for example, the Stirling Range, Fitzgerald River, and Lesueur national parks, remnants in the western central Wheatbelt, granite outcrops).

I would suggest that managers need to pay more consistent attention to ensuring biodiversity conservation in remnants — local activity must be integrated with regional and global goals. This will occur if clear objectives, integrated actions and performance-measured outcomes are required for both research and management of remnants.

Finally, we need to become Gondwanan botanists and managers. We are dealing with an incredibly diverse flora of great evolutionary antiquity. Many components are poisoned by conventional fertilising and watering regimes. They respond to disturbance in new and often unpredictable ways. Their recruitment is triggered by a range of cues whose significance is only just becoming apparent. Even the ubiquitous impact of fire on germination and flowering has remained enigmatic for large numbers of species, and has defied traditional research tools developed on northern hemisphere floras (although recent experiments with smoke-induced germination by Kings Park and Botanic Garden staff show significant promise). Few other regions of the world demand such urgent and integrated collaboration of researchers and managers to meet conservation aims.

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