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Away from conflict — a new paradigm for industry, regional communities, environmental organisations and traditional owners to look after the Great Western Woodlands, Western Australia

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Abstract

The Goldfields region of Western Australia is one of the most mineralised areas in the world, being particularly rich in gold, nickel and iron ore. It also contains the largest remaining temperate and semi-arid woodland on earth. In this paper, the authors outline some of the outstanding natural values of the Great Western Woodlands (GWW). The authors then show why contemporary conservation methods, which aim to capture specific target levels of biodiversity in a 'reserve system', will not guarantee protection of biodiversity across this landscape. Instead, the continuing evolution of the region's biodiversity can only be ensured by appropriately managing key ecological processes, e.g. fire, eco-hydrology, gross primary productivity and trophically important species, over the entire landscape. The authors show why this can only be achieved by targeted research, and by working together with major stakeholders including traditional owners, state and federal governments, local communities, and resource-based industry groups which are increasingly utilising the region.

1 Introduction

The GWW bioregion encompasses the southern Goldfields region of Western Australia (Figures 1 and 2). It is a landscape dominated by a relatively undisturbed natural vegetation; at almost 16 million ha, it is more than twice the size of Tasmania and is similar in size to England. Despite being biologically distinct, the bioregion has never had a unique name, usually simply being referred to as part of the broader 'Goldfields' region. The name 'Great Western Woodlands' was selected because it best reflects its position and status as being in the west of the continent and containing the largest remaining area of temperate woodland in Australia (Figure 1).

2 The natural values of the Great Western Woodlands

The GWW, unlike other bushland areas of southern Western Australia, is dominated by eucalypt woodlands (Keally, 1991), woodland ecosystems resemble forests but with a more open canopy, although it contains significant areas of mallee, shrublands and grasslands. The authors review of the regions' natural values included peer-reviewed published papers, selected non-refereed reports from government departments and environmental non-government organisations (ENGOs), and interviews with published ecologists who have worked in the region. Data from the Western Australian Museum (Faunabase), the Western Australian Department of Environment and Conservation's Western Australian Herbarium (Florabase) and Birds Australia (Birds Atlas), and the results of the relevant biological surveys of the West Australian Goldfields (Newbey and Hnatiuk, 1984, 1988; How et al., 1988; Keighery et al., 1995) were obtained and analysed.

2.1 Plant diversity

The Western Australian Herbarium has records of 3,314 flowering plant species from 119 families in the GWW and over 4,200 different 'taxa', which is a list that includes undescribed species as well as subspecies, hybrids, varieties. It is estimated that almost half of these species are endemic to the southwest of Australia (Burgman, 1988; Hopper and Gioia, 2004). This is a large number relative to other regions of the world and shows that GWW belongs as one of the cornerstones to the southwest of Western Australia's 'biodiversity hotspot' (Myers et al., 2000).

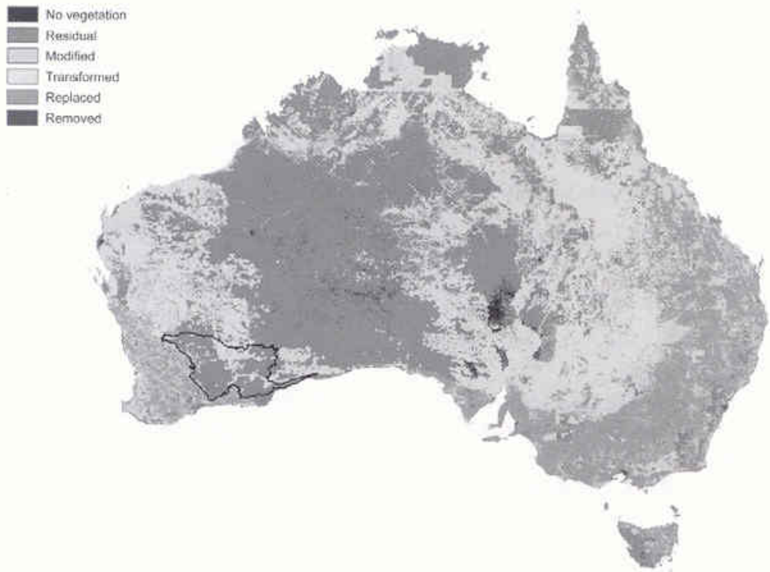

Figure 1 The relative condition of Australia's vegetation condition (Thackway and Lesslie, 2006). The black line shows the boundary of the GWW. The dark area that predominates in the GWW suggests that the vegetation has not been significantly affected by post European land use change. The GWW is the largest residual (or 'intact') non-arid landscape in southern Australia

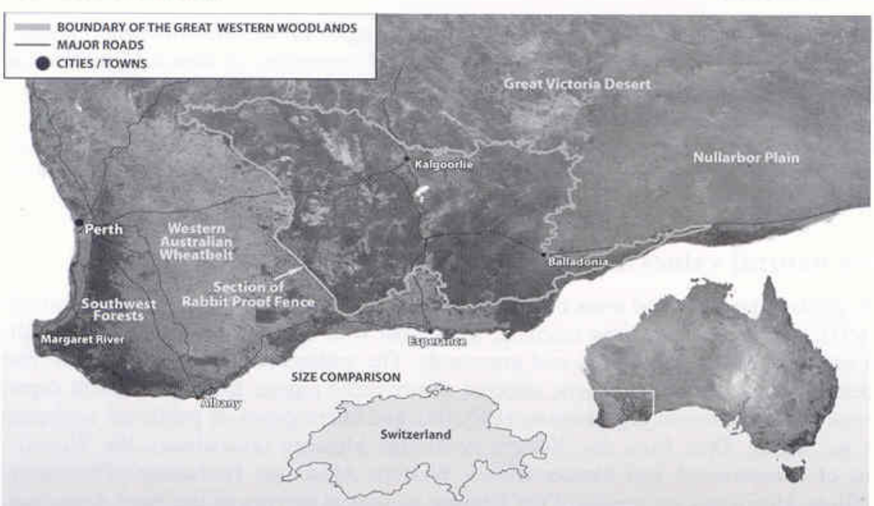

Figure 2 The boundary of the GWW was established by researchers from the Australian National University and was drawn using MODIS satellite data and methodology that identified a characteristic "Eucalypt" spectral signature (Berry, 2002) that is found throughout the GWW. The boundaries discriminate the eucalypt woodlands from the Mulga (*Acacia aneura*) country to the north, the treeless Nullarbor Plain to the east, the moist coastal heath to the southeast, and agricultural land to the west and south

Since the GWW bioregion is still largely intact there are fewer rare, threatened or endangered species in this region than are found in more disturbed regions of the state such as the wheatbelt. Nevertheless, the GWW contains many species that are listed as threatened by government. For example, 44 plant species are listed as 'declared rare flora' by the state government because they are rare, in danger of extinction, or in need of special protection. A further 422 species have been listed as 'priority' species (Priority 1 = 129 sp., Priority 2 = 103 sp., Priority 3 = 131 sp., and Priority 4 = 59 sp.). The 464 declared rare flora and priority species are distributed across the GWW, although the western and southern boundary appears to contain many more species per cell than recorded in other parts of the region (Figure 3). This could reflect sampling bias, that is more sampling has been conducted in these cells, as well as the fact that this boundary abuts a landscape that has been heavily modified for agriculture.

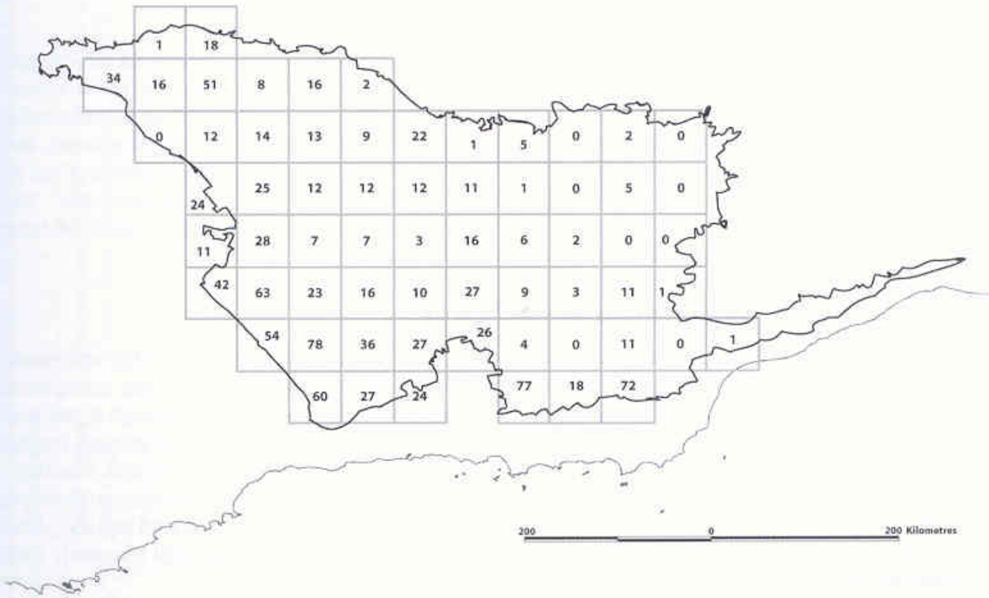

Figure 3 The distribution of the declared rare flora and priority plant species. A comparison of the cells shows that priority species are spread across the landscape. Many of these are by nature, found only in tiny pockets and are threatened by a range of disturbances. It is likely that many of those in the western and southern part of the GWW are threatened because much of their original distribution has been cleared for agriculture

2.2 Vertebrate diversity

The Western Australia Museum (Biological Survey of the Goldfields and FaunaBase) and Birds Australia (Australian Ornithological Club) Atlas database has recorded 49 mammals, 138 reptiles, 14 frog species and 215 species of bird in the region. The authors research, which is also based on consultants reports, the notes of amateur enthusiasts, and the habitats requirements of species published in the peer-reviewed literature, suggests there are likely to be an additional 51 species (nine species of mammals, 18 species of reptile, six frogs and 18 bird species) present in the GWW. While the level of vertebrate richness is not high on a world scale for mammals and birds, the number of different reptile species makes the study area exceptional among the world's reptile communities. Different reptile communities are spatially and temporally variable, reflecting the heterogeneous vegetation communities and periodic rainfall events that occur in the region (Cowan and How, 2004; Thompson and Thompson, 2005).

The region contains many rare and vulnerable animal species. On the state government's rare and endangered fauna list there are 34 threatened vertebrate species that either exist, or are likely to exist, in the GWW. These comprise 15 mammal, ten bird and nine reptile species. The Wilderness Society conducted a vertebrate fauna survey of the Honman Ridge — Bremer Range, and found 19 species that were of conservation significance in that area alone (Duncan et al., 2006). In addition, four species that are globally extinct were once found in the GWW (Pig-footed Bandicoot, Long-tailed hopping mouse, Crescent Nail-tailed Wallaby and the Broad-faced Potoroo).A further six species are extinct in the GWW region and now only exist either on predator free islands, in enclosures designed to keep cats and foxes out of them; or in very remote areas of Australia (Burrowing Bettong, Banded-Hare Wallaby, Western Barred Bandicoot, Greater Stick-nest Rat, Plains Mouse and Djoongari). With improved management, it could be possible to re-introduce these animals back into GWW.

2.3 Ecosystem diversity

An analysis of Australia's vegetation by the Australian Government in 2001 identified 23 'vegetation groups' across the continent (Commonwealth of Australia, 2001). Fourteen of these vegetation groups are found in the GWW. The GWW contains more vegetation groups than iconic areas such as Kakadu and Cape York in northern Australia. With the exception of Tasmania (which contains 15 vegetation groups), there is no other area in Australia of equivalent size to the GWW that has as many vegetation groups. Four of the vegetation groups found in the GWW bioregion ('Eucalypt woodlands', 'Eucalypt open woodlands', 'Mallee woodlands' and 'Acacia forests and woodland') have been substantially cleared in other regions of Australia (Table 1). In the GWW, these four ecosystems remain largely intact.

3 Conservation management in the GWW

Historically, the environmental values of the GWW have been largely overlooked, and the environmental impacts of economic activities in the area generally discounted. Less than 15% of the bioregion is in conservation reserves, and the majority is designated as 'unallocated crown land'. Although it has become mandatory to assess the local environmental impact of large, site-specific projects such as mining, the current process frequently ignores cumulative environmental impacts outside the immediate local area. Similarly, the widespread and pervasive impacts of activities such as infrastructure corridors and their cumulative effects are not considered. The believe these are symptoms of an ad hoc episodic approach to land use and planning, with a narrow focus on site-specific, acute development pressures. Such an approach will ultimately result in the incremental erosion of the region's outstanding biodiversity and natural values.

The conventional approach to conservation typically focusses on achieving (as efficiently as possible), a minimal target level of protection for representative samples of each mappable class of ecosystem (usually defined in terms of major vegetation types), or populations of particular target species (typically threatened plants and animals), and/or other specified special features (Woinarski et al., 2007). The authors suggest that this type of planning exercise does not work in, or acknowledge, such diverse and largely intact and functional landscapes as the GWW (Soulé et al., 2004, 2006). The end result of such exercises is often a landscape fragmented by contrasting isolated land uses, with conservation areas scattered throughout a landscape largely transformed by modern land use activities (Woinarski et al., 2007). Generally, these conservation areas are isolated and few in size and number, surrounded by disturbance, and in locations chosen for their low economic value, often because these are infertile, too steep, or otherwise of low productivity (Ford et al., 2001; Recher, 2004).

Table 1 **The land cover of each of the Australian native vegetation assessment's major vegetation groups found in the GWW and a comparison of how much each type has been cleared since European inhabitation**

Major Vegetation Group	Total Cover Pre-1788 (km^2)	Total Cover 2001 (km^2)	Proportion of 1788 Cover Now Cleared (%)	Area in the GWW (km^2)	Proportion of the GWW Occupied (%)
Eucalypt woodlands	1,012,047	693,449	31.4	83,738	52.41
Mallee woodlands and shrublands	383,399	250,420	34.7	27,497	17.21
Low closed forests and tall closed shrublands	15,864	8,749	44.9	10,501	6.57
Acacia shrublands	670,737	654,279	2.5	7,499	4.69
Inland aquatic – freshwater, salt lakes, lagoons	N/A	-	-	6,171	3.86
Other shrublands	115,824	98,947	14.6	5,280	3.3
Hummock grasslands	1,756,962	1,756,104	0.1	3,322	2.08
Heathlands	47,158	25,861	45.1	3,051	1.91
Acacia forests and woodlands	657,582	560,649	14.7	3,001	1.88
Casuarina forests and woodlands	73,356	60,848	17.1	2,279	1.43
Chenopod shrublands, samphire shrublands and forblands	563,389	552,394	2.0	2,277	1.43
Cleared, non-native vegetation, buildings	N/A	-	-	2,243	1.4
Naturally bare – sand, rock, claypan, mudflat	N/A	-		2,036	1.27
Acacia open woodlands	117,993	114,755	2.7	643	0.4
Eucalypt open woodlands	513,943	384,310	25.2	156	0.1
Callitris forests and woodlands	30,963	27,724	10.5	49	0.03
Eucalypt low open forests	15,066	12,922	14.2	44	0.03
Total	5,974,283	5,201,411	-	159,787	

The authors believe that the conventional approach to conservation planning will not protect the values and future of the Great Western Woodlands because it fails to incorporate the landscape-wide ecological processes that sustain biodiversity (Soulé et al., 2004). These processes include managing eco-hydrology (defined as 'the relationships between water – both surface and ground water – vegetation, wildlife, and landform at local and regional scales) (Mackey et al., 2007); trophically important species, e.g. pollinators, (Soulé et al., 2003); ecologically appropriate fire regimes (Woinarski, 1999), and understanding temporal and spatial movements of species (Soulé et al., 2004). Management of these processes needs to occur across the entire landscape, not just within the minimalist reserve system, to ensure the conservation of the region's biodiversity and other environmental values. This is especially relevant in an era of rapidly changing climate; many ecologists now recognise that the conventional park system will not ensure the conservation of species as they attempt to move in order to find more favourable climate conditions (Hughes 2002; Howden et al. 2003).

The authors propose that managers of the region adopt the approach to land management and land use that has been developed in sparsely populated and largely natural extensive landscapes in North America, and subsequently adapted for Australian conditions (Soulé et al., 2004; Mackey et al., 2007). This approach recognises that conservation can only ever be successful in Australia when it occurs across all land tenures and when different stakeholders work together with a common aim of biodiversity conservation. The central component of this approach is to identify and conserve the key large-scale, long-term ecological processes and interactions that drive and enhance connectivity between ecosystems and species and maintain biodiversity at all scales (Soulé et al., 2004). In this context, connectivity draws attention to large-scale phenomena and processes that contribute to the maintenance of landscape ecological function and the diversity of native flora and fauna (Soulé et al., 2004; Mackey et al., 2007).

4 Conclusion

The authors have synthesised all readily available information on the plant and vertebrate diversity of the GWW bioregion. Our findings highlight the biological diversity has five distinct features. First, the high number of different major vegetation groups in the region when compared to other bioregions of Australia. Second, the extraordinarily high numbers of plant species makes this region worthy of global recognition. Third, the floristic composition and structure of these groups changes rapidly across small spatial scales across the landscape (Beard, 1981; Burgman, 1988). Fourth, while the degree of vertebrate richness is not high on a world scale for mammals and birds, the number of different reptile species makes the study area exceptional among the world's reptile communities. Lastly, the significant 'Wallacean', i.e. knowledge on species geographic and temporal range in the region, and 'Linnaen', i.e. knowledge on how many species actually live in the region, shortfalls for all the major species groups. Thus, more research is required to understand the key values of the system and to optimise management strategies.

The GWW offers a unique opportunity to study a highly distinctive, and in some places close to pristine, functioning and globally-significant ecological region. The challenge now and in the coming decades is to maintain the natural values of the GWW, protect the ecological processes that sustain these values, and repair any environmental damage that has already occurred. The authors suggest this can only happen by working together with major stakeholders including traditional owners, state and federal governments, local communities and resource-based industry groups which are increasingly utilising the region.

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