The wheatbelt of Western Australia

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DEVELOPMENT for broadscale wheat and sheep farming in Western Australia has produced a seemingly uniform landscape over much of the southwest of Western Australia. However, this area, commonly called the wheatbelt (Fig. 1), consists of at least four of the biogeographic regions designated on the basis of physical and biological measures (such as climate, geology, landform landuse, flora and fauna) in the Interim Biogeographic Regionalization of Australia (Thackway and Cresswell 1994). The four Interim Biogeographic Regionalization of Australia regions making up the wheatbelt are the Geraldton Sandplains, Avon Wheatbelt, Mallee and Esperance Plains, a total area of 24 766 406 ha.

The landscape of the wheatbelt is gently undulating with low relief. It has a Mediterranean climate of hot, dry summers and cool, wet winters. The region receives around 600 mm of annual rainfall in the west, dropping to about 300 mm in the east. The soils are poor in nutrients and heavily leached. It is rich in species and its floral diversity is extraordinary. There are about 8 000 species of higher plants in southwestern Australia and about three-quarters of these are endemic; many have restricted ranges and are rare. Over 40% of Australia's higher plants are found in the south-west, which occupies less than 5% of the continent. The area is one of the world's biological "hotspots". The vegetation consists of heaths and shrublands on the deep sands and laterites of the uplands, mallee and woodlands on the lower slopes, and fresh water and salt-lake systems on the valley floors.

Despite being nutritionally infertile by modern agricultural standards (Nulsen 1993), the soils of the region support a highly productive cropping and livestock industry. Wheat provides the primary source of revenue for the region with a gross value of $1084 million in 1992–93. Other crops, including oats, barley, lupins and canola, contribute an additional $404 million (Australian Bureau of Statistics 1995). Sheep are grazed throughout the region on sown pasture, usually in rotation with cereal crops.

CHANGES AS A RESULT OF DEVELOPMENT

Biotic impoverishment

Rapid and extensive removal of native vegetation for agriculture has meant that the wheatbelt is one of the most extensively cleared regions in Australia with only 10% of the area retaining native vegetation. This native vegetation is distributed among thousands of patches of varying sizes (mostly less than 20 ha), shapes, positions in the landscape, biotic composition, ownership, management histories, and degrees of degradation. Clearing was a highly selective process. Woodlands occurring on good agricultural soils were preferentially cleared resulting in their poor representation in the landscape, while vegetation occurring around granite outcrops is relatively well represented.

In the wheatbelt, 348 species of plant are listed by Hopper *et al.* (1990) as rare and endangered; one of the highest number for any region. At least 24 species of plant are believed to be extinct (Leigh *et al.* 1984). Many species which existed as isolated populations before clearing are now surrounded by a hostile matrix, and the remnants on which they survive are degrading.

Eight-five per cent of the area of remnant vegetation is on private property and being degraded by weed invasion, grazing by domestic livestock and rabbits, and by changing ecological conditions in the surrounding agricultural land. An assessment of the conservation value of remnant vegetation in the Kellerberrin area of the central wheatbelt revealed that only about 3% of the area of original vegetation could be considered to be in good condition (Lambeck and Wallace 1993).

Native animals have been similarly affected. Thirteen mammal species of the original complement of 43 species (excluding bats) occurring in the wheatbelt prior to clearing have disappeared (Kitchener *et al.* 1980) and only 12 are abundant or moderately common. There are several species which persist on larger remnants, but these are endangered, and mammals are still being lost from the region (Hobbs *et al.* 1993).

One hundred and ninety-five species of bird have been recorded in the central wheatbelt since clearing began; 95 (49%) have declined in range and/or abundance. Two species are extinct in the region (Saunders and Ingram 1995). More species dependent upon native vegetation may become extinct because their populations are too fragmented and isolated to be viable. Apart from mammals and birds, there are few data available on other animal groups, particularly invertebrates and their role in ecological

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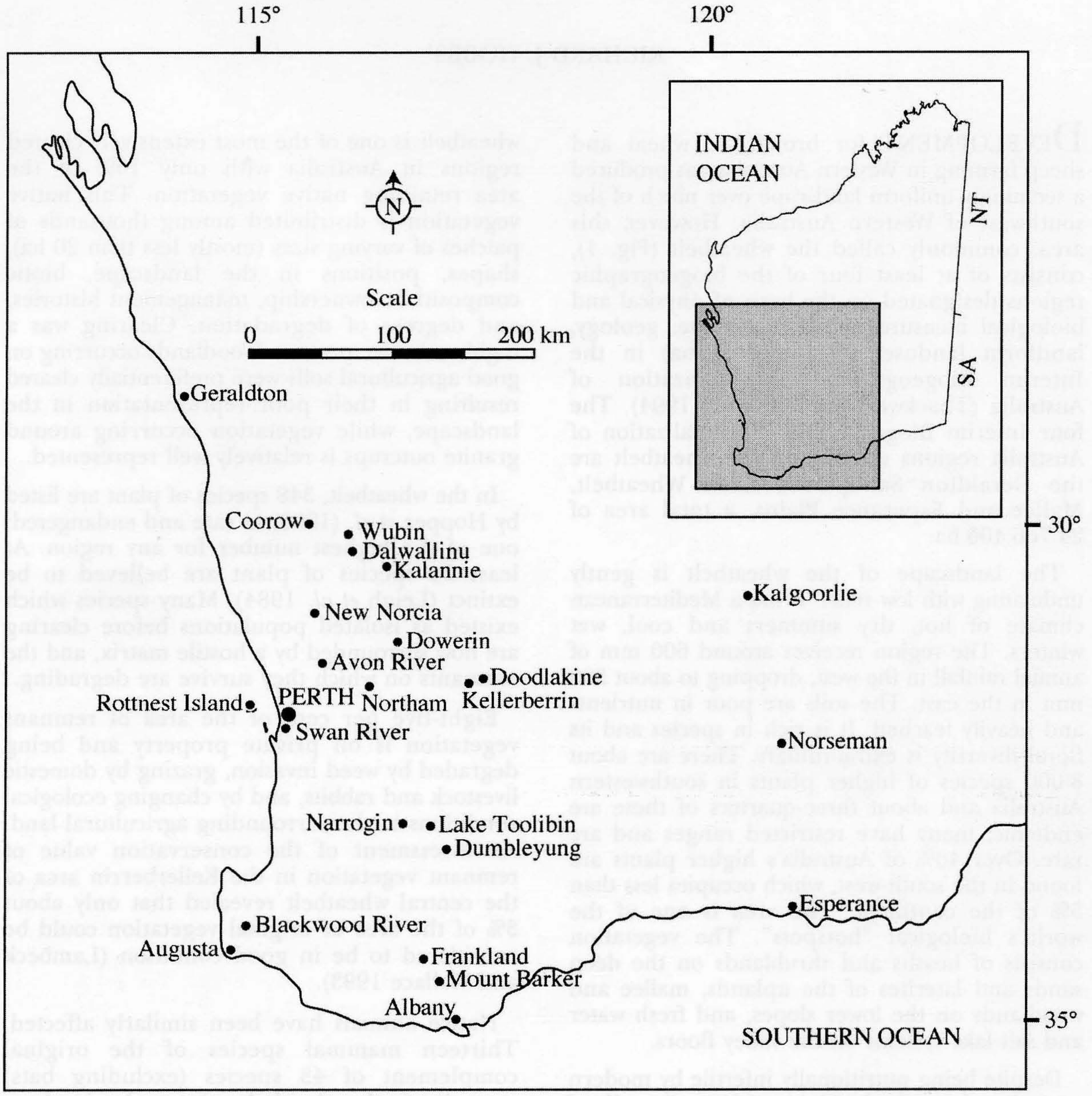

Fig. 1. Southwestern Western Australia. The wheatbelt roughly occupies the area south of Geraldton, east of Northam and Narrogin, north of Frankland and Esperance and west of the line joining Geraldton and Esperance.

processes (see Abensperg-Traun 2000; Abensperg-Traun *et al.* 2000; Main 2003). The point is that we have little knowledge of what we have lost or of the ecological consequences of those losses (e.g., disruption of soil formation, interruption to pollination).

CHANGES IN ECOLOGICAL PROCESSES

The large scale clearing of native perennial vegetation and replacement with shallow-rooted annual exotic plant species has resulted in major changes in ecological processes, particularly the hydrologic balance. Water tables are rising, in some cases by more than 20 m since clearing began (George *et al.* 1995), bringing salt to the surface. Estimates by George *et al.* (1995) are that up to 25% of many landscapes and up to 40–50% of the lower slopes and valley floors will become salt affected within this century. Most native vegetation occurs on susceptible areas, while adjacent lakes and wetlands will either decay or be permanently altered by salinity. Lake Toolibin, the most important surviving freshwater system in the wheatbelt, is threatened in this way.

There is evidence to suggest that the changes imposed on the wheatbelt may have resulted in changes in the climate, particularly in rainfall. Between 1913 and 1986 the region had a 4% decrease in winter rainfall, while the uncleared woodlands to the east had a 6% increase (Pittock 1988). Changes in radiation balance over cleared land may mean that rain, which before clearing would have been induced to fall on the wheatbelt, may now be passing further inland and falling on the uncleared Goldfields (Smith *et al.* 1992). These changes are also affected by enhanced global warming with computer models predicting continued declines in rainfall (particularly in winter) and increased temperatures.

CHANGES IN SOIL STRUCTURE

Much of the wheatbelt has light or sandy soils that are highly susceptible to wind erosion, and estimates are that nearly 13% of agricultural land is affected. Waterlogging affects about 3% of the land; however, the area affected can double in years when rainfall is greater than normal (Nulsen 1993). This problem will increase as soil compaction, water repellence, deterioration of soil structure, and rising water tables decrease the drainage capacity of the soil (Nulsen 1993). This will also increase water erosion and seepage in the valley floors, which contain the best agricultural soils and where salinity problems are more severe.

Deterioration in soil structure affects about 11% of cleared land, and has the potential capacity to halve agricultural productivity. Estimates are that the area affected may double, producing major economic consequences. Additionally, soil acidity is a major problem. Between 2 and 3% of agricultural land is affected by acidification, and estimates indicate that 65% of agricultural land could suffer significant decreases in productivity from acidification within the next 100 years (Nulsen 1993).

We are not managing the landscape of the Western Australian Wheatbelt in a manner which is sustainable at present. We need management systems which recognize the ecological realities that affect agricultural and natural systems and treat them as of equal, or greater, importance than the economic realities.

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