Setting the Scene–Research on Remnants during the Past Decade

Denis A. Saunders
CSIRO, Division of Wildlife and Ecology, LMB 4, PO Midland, WA, 6056

INTRODUCTION

Although I have been asked by Ken Wallace to review the significant changes in research into remnants of native vegetation over the past decade, it is worth putting these changes into context by examining briefly the changes in attitudes towards remnants over the past three or four decades. Early attitudes were usually hostile, because remnants were seen as harbours for noxious weeds and vermin, particularly poison native plants, rabbits, and macropods (not necessarily in that order), or were regarded as wasteland covered with unsightly scrub. One only has to fly over the Wheatbelt and see how many remnants of native vegetation have gravel pits and rubbish dumps on them to gauge early attitudes towards remnants. These attitudes were reinforced by the feeling of many people that the landscape was alien and did not resemble the sorts of landscapes with which they felt most at home.

Barbara York Main (1993) discussed the effects of settlement by Europeans in the central Wheatbelt and pointed out the degrading consequences of this settlement on the landscape and on remnants of native vegetation. One simple and overlooked example was the role of domestic poultry in changing native vegetation. Main wrote that "Farm fowls (as well as turkeys and other poultry) have undoubtedly contributed to the destruction of the biological cohesiveness of the remnants associated with farmhouses".

Main also discussed the attitude at this period towards the land and its biota. This attitude is summarised in the praise by Sutton (1952, in Main 1993) of the settlers who conquered "forest wilderness" and turned "virgin lands" into "well-ordered farms and gardens". As Main pointed out, by the 1960s the only ungrazed remnants of native vegetation were the reserves set aside for public use, such as water reserves, townsites, and other utilities, or a number on private property.

Then, in the 1970s, attitudes towards native biota changed. Land degradation, the realisation that too much had been cleared in some areas, the strong interest in native plants, the loss of native species, the strong push for conservation through reserves, and a developing sense of "belonging to the landscape" all played a part in changing hostile attitudes towards native biota in general and remnants of native vegetation in particular. These changes were instrumental in a major push in the 1970s, by the WA Department of Fisheries and Wildlife, to have set aside, for the conservation of flora and fauna, as many of the significant Crown reserves in the Wheatbelt as possible. This meant that many of the larger remnants became flora and fauna reserves, or had conservation of flora and fauna added to their original gazetted purpose.

As part of this process in the early 1970s, the Department of Fisheries and Wildlife contracted the WA Museum to carry out a series of flora and vertebrate fauna surveys on 23 remnants of native vegetation the Department had recently acquired as conservation reserves. The aim of those surveys was to assess the conservation importance of the remnants in the extensively cleared Wheatbelt of Western Australia. The results of the surveys were published in a series of papers in *Biological Conservation, Australian Wildlife Research* and *Records of the Western Australian Museum*. The findings are interesting from both scientific and management points of view. The data they provided are still one of the best sets available on species–area relationships in fragmented landscapes, and have been widely quoted in the international scientific literature during the debates on the theory of island biogeography, a theory which has given little of practical importance to managers of conservation areas (Saunders *et al.* 1991). While it does provide an idea of how many species of selected taxa one can expect to occupy an area over time, it does not identify the species involved, which is of much greater importance and relevance to managers of conservation reserves.

The results of the surveys by the Museum gave some reasons for managers to be optimistic about the importance of the scattered conservation system in the Wheatbelt for the conservation of much of the remaining vertebrate biota. For example, Darryl Kitchener *et al.* (1980a, b) noted that remnants as small as 30 ha have value as sanctuaries for lizards (although varanids were not found on reserves under 272 ha) and specific mammal species, and are valuable conservation areas for plants. They noted (1980a) that "although the haphazardly spaced wheatbelt reserves are inadequate to preserve entire communities of large mammals and

apparently also of birds and snakes, we conclude that the reserve system is probably adequate to preserve representative lizard communities". They added (1980b) "that with careful management of the wheatbelt reserve system most of the native animal species still extant in this region should persist for periods within the time framework considered by contemporary conservationists ... (1 000 to 10 000 years)".

They also pointed out (1980b) that regardless of the size of the remnant, mammal species lost from particular remnants would almost certainly not re-establish themselves by natural processes, because the isolation of remnants had disrupted movements which would foster recolonisation in the event of local extirpation. Kitchener *et al.* (1982) noted that the long-term persistence of much of the avifauna of the Wheatbelt depended on the 500 randomly scattered nature reserves, occupying 2.4% of the area of the Wheatbelt. They were unable to indicate any loss of bird species from reserves during the period of land clearing in the Wheatbelt (the 70 years prior to their surveys), which they took to imply that loss of species of birds from reserves will be a slow process. They also pointed out that small nature reserves in the Wheatbelt are of value in the conservation of birds. They cited the example of East Yorkrakine Nature Reserve (north of Kellerberrin), which is 81 ha and during their surveys contained four species of passerines of vulnerable status, despite being isolated from other native vegetation for at least 50 years. They (1980b) did not believe that feral cats and foxes would have as severe an impact on native mammals in Wheatbelt remnants as cats have had on offshore islands.

While research over the next decade was to change some of these concepts dramatically, this early work by the WA Museum provided the vital foundation of information and ideas upon which new research developed the next generation of theories. Also, ideas developed by the Museum concerning issues such as the relationships between vegetation types and fauna, and the separation of the bird fauna into various categories depending on their tolerance of disturbance, were of real value to land managers.

This early work had one other important value. During the late 1970s and early 1980s, many people, including some land managers and academics, questioned the value of smaller remnants of vegetation. While predictions in the Museum papers concerning viability of remnants proved optimistic, their work did confirm the nature conservation values of small remnants and provided a counter to those who argued that small areas had no value.

RESEARCH OVER THE PAST DECADE

What has changed since the pioneering work of Darryl Kitchener and his colleagues, and what is the significance of the changes from a management point of view? In the first instance, remnants of native vegetation have had their profile lifted markedly, with a great deal of interest in them from research organisations, management agencies, agricultural advisers, funding agencies, and, most importantly, rural communities, including farmers and landcare groups (see Saunders *et al.* 1987, 1993; Saunders and Hobbs 1991; Hussey and Wallace 1993).

Research into remnants of native vegetation and their ecological role in the landscape over the past decade has indicated that we do not have any cause for optimism. Several irrefutable facts of relevance to management that have come out of research in the recent past are that remnants of native vegetation are degrading at rates that are measurable, and that species are still being lost. Without active management applied over the entire landscape, remnants will continue to degrade until this relaxation phase results in species-poorer animal and plant communities. Without major changes in management, there is no way that the collection of remnants in our conservation system will conserve the remaining native biota of the Wheatbelt over the next 100 years, let alone the 1 000 to 10 000 year timeframe that Kitchener and his colleagues suggested. We cannot afford to treat remnants as islands. If we take that approach, we will ignore the major degrading processes, most of which originate in the surrounding agricultural matrix.

Current State of Remnants

One of the most worrying research reports I have read recently is one written by Robert Lambeck and Jeremy Wallace (1993) on the assessment of the conservation value of remnants of native vegetation in the central Wheatbelt, using Landsat Thematic Mapper (TM) imagery. Their research showed that 70% of remaining native vegetation in the study area is not typical of the

unmodified vegetation types that characterised the central Wheatbelt prior to settlement by Europeans. In many of the remnants they examined, particularly the smaller ones, all of the vegetation within the remnant was spectrally unlike any of the flora regarded as indicative of that found before settlement last century. They concluded that the conservation value of many of the remnants has been seriously jeopardised, and they attributed the degradation to impacts of domestic livestock, clearing, invasion by weeds, harvesting of timber, mining of gravel and the dumping of rubbish (see also Arnold and Weeldenburg 1991). In their summary, they stated that only 3% of the original pre-clearing landscape remains in what could be regarded as good condition. They added the important rider that "The probability of such a small component of the landscape continuing to support the essential ecosystem processes that underpin regional biodiversity [is] extremely remote": I would have said it is impossible.

Representation of Remnants

Typically, remnants are small, and none are large enough to be driven by internal processes. All are now driven mainly by the ecological processes generated by the surrounding agricultural matrix. Remnants do not represent the pre-clearing range of animal and plant associations. The process of selection of land for agriculture and the process of fragmentation were not random. Plant communities were linked strongly to soil types, and because certain soil types were more suitable for agriculture than others, those soil types are poorly represented on remnants in agricultural areas. The Wheatbelt is no exception, and Graham Arnold and John Weeldenburg's (1991) study on the distribution and characteristics of native vegetation in the central Wheatbelt illustrates this point. For example, they found that the Merredin and Belka landforms, which formerly were dominated by salmon gum woodlands, occupied about 16% and 5%, respectively, of the landscape, yet they occupied only 6% and 1% of remnants. On the other hand, rock outcrops occupied only 4% of the area but represented 28% of the remnants. In addition, they found that 77% of remnant vegetation was privately owned. The implications of these results for management are serious and far-reaching. The soils regarded as indicative of good agricultural land, and any associated uncleared biota are poorly represented on conservation reserves. Woodlands are in this category, and if conservation of woodlands is an aim of management, then private land must be managed with that aim in mind. Private land now contains much of what must be regarded as our conservation estate. One of our challenges is to come up with ways to ensure that part of the conservation estate is managed with conservation as the primary function.

Native Vegetation Is Resistant

Research has shown that native vegetation is resistant to invasion by exotic vegetation, provided that the remnant vegetation is not disturbed or enriched with nutrients (Hobbs and Atkins 1988). Unfortunately, the agricultural matrix surrounding most remnant vegetation results in a wide range of disturbances and considerable nutrient enrichment. Ignoring the obvious and major disturbance of grazing by domestic livestock, and enrichment by fertiliser drift, how many times do we see dead sheep disposed of by throwing the carcases into the bush? As the carcases decompose, nutrients are released and scavenging animals scraping around the carcases disturb the area. Any seeds of weed species caught in the wool have an ideal bed on which to establish themselves. Similarly, the vegetation scraped from the edges of roads or firebreaks is usually piled in the bush and left. These piles, like the rotting carcases, are major foci of weed invasion along road verges and through many other remnants of native vegetation.

Remnants Are Influenced by the Surrounding Matrix and Have an Effect on the Surrounding Matrix

It is well known that the extensive clearing of native vegetation in the Wheatbelt has resulted in major changes in the hydrological balance, leading to widespread salination of susceptible areas. Nearly 20% of all cleared agricultural land may be useless for cereal cropping within the next 30 years because of increases in salt levels in the soil (Nulsen 1993). Ecological processes do not stop at legal boundaries, and remnants of native vegetation are being affected by increasing soil salinity. Position in the landscape does not necessarily guarantee immunity from degradation. For example, Durokoppin Nature Reserve is 1 100 ha and located in the highest point of the landscape at the top of two catchments. Because of the higher water use by remnant vegetation than by agricultural vegetation, watertables are up to 7 m lower under the reserve than under nearby agricultural land (McFarlane *et al.* 1993). Nonetheless, watertables are rising under the reserve as

water flows into the "hydrological shadow" and, if this continues, will probably reach the root level of the salmon gum woodland in the lower part of the reserve, with further loss of an already severely restricted vegetation type. At present, we do not know how many other remnants are threatened in this way. However, George and McFarlane (this volume) believe that a significant area of our conservation estate is under threat.

Remnants Are Still Degrading and Losing Species

The losses of native mammals from the Wheatbelt are well known (Burbidge and McKenzie 1989) and still continuing (Hobbs. *et al.* 1993a). Birds are demonstrating the same trends as the mammals. For example, of 192 species of birds recorded from the Wheatbelt since 1900, 96 species (50%) have decreased in range and/or abundance, and only nine (5%) have increased (Saunders 1993). Species are still being lost from the region, from districts and individual remnants (Saunders 1989). Kitchener *et al.* (1982) cited East Yorkrakine Nature Reserve as an example of the conservation value of small remnants for species dependent on native vegetation. In the period between these researchers' surveys in 1974 and the surveys by the CSIRO in 1988, three of the four species the former noted the reserve was of value for became extinct. In the Wheatbelt, a number of species dependent on native vegetation are located on remnants of native vegetation in populations which are too small to be viable. In addition, those populations are isolated from other such populations, and they are gradually becoming extinct because of a range of stochastic events. In this situation, the effects of the fox and cat on these isolated populations are much more severe than Kitchener and his colleagues predicted. The work of Jack Kinnear *et al.* (1988) and Tony Friend (1990) on relict populations of endangered marsupials are good examples of what we stand to lose if we fail to control foxes and cats throughout the Wheatbelt.

Remnants Must Be Managed in a Total Landscape Context

The take-home message regarding the management of remnants of native vegetation in the Wheatbelt must be that they cannot be managed in isolation. Any management which concentrates only on individual remnants, particularly those designated as conservation reserves, and ignores the surrounding agricultural matrix is doomed to failure and will continue the degrading processes which are leading to the loss of our unique biota. We need to get away from the single species–single remnant approach to management and concentrate on developing an integrated landscape approach which involves all of the people and groups engaged in management of elements of the Wheatbelt landscape (Hobbs and Saunders 1991, 1993; Hobbs *et al.*1993b). We need to work with all of these individuals and groups, to integrate our knowledge and use it to construct management models which aim to protect our remaining biological heritage within production-oriented agricultural landscapes. The aim of this workshop should be to come up with ways to assist us achieve that goal.

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