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A review of the focal species approach in Australia

Knowledge for managing Australian landscapes

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InSight Ecology

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Background

Recent attempts to restore fragmented agricultural landscapes in southern Australia have been guided by a taxon-specific scheme termed the focal species approach (*sensu* Lambeck 1997). This approach attempts to identify species considered most sensitive to threats such as the loss of habitat patch size, condition, and connectivity. It also aims to identify management interventions required to maintain these species in their habitat. This information is used to guide the design and implementation of revegetation and vegetation management strategies for biodiversity conservation, often across catchments and whole landscapes. Recently, the focal species approach has been re-termed the threat-response approach (*sensu* Freudenberger 2004) to reflect the use of species occurrence data to model species' responses to threats.

Enhancement planting on a lateritic ridge comprising remnant Salmon Gum and mallees at "Calecono Springs" in Buntine-Marchagee Catchment, WA wheatbelt.

Over the past decade, substantial resources have been invested in a range of focal species-based restoration projects in Western Australia, Victoria, NSW, ACT and Queensland, typically as partnerships between government and community-based organisations. Despite this, there has been no national-scale evaluation of the application and performance of these projects in conserving the biodiversity of fragmented agricultural ecosystems. This is essential to determine the utility and efficacy of the focal species approach as a practical conservation tool, improve knowledge and adoption outcomes, and help inform and guide strategic R&D investment.

The following information outlines the objectives of this review and overviews the focal species approach (FSA) in Australia - its history, key features and current trends, the scientific debate, alternative approaches, and main findings, messages and opportunities for knowledge exchange that have come from FSA projects funded by Land & Water Australia (Land & Water Australia).

References from the national and international scientific literature and unpublished commissioned reports are provided to facilitate further study. A range of NRM practitioners (ie. knowledge brokers, biodiversity coordinators, district extension officers, catchment managers, and community liaison officers), research scientists, science consultants, and some landholders across southern Australia have been consulted during the preparation of this document.

Objectives

This review was commissioned by Land & Water Australia to:

- Review current trends and clarify the FSA scientific debate;
- Summarise and synthesise key findings from Land & Water Australia-funded research based on the focal species approach;
- Identify key messages and opportunities for knowledge exchange, including the need for and targeting of case study analyses;
- Inform future strategic R&D investment in landscape design principles.

The focal species approach

A brief history in Australia

In an era of limited funding, knowledge and time for conservation action, Robert Lambeck proposed an alternative to the traditional single-species approach to conserving native biodiversity in agricultural landscapes. He advocated "a multi-species approach for defining the attributes required to meet the needs of the biota in a landscape and the management regimes that should be applied" (Lambeck 1997, p. 849). This became known as the focal species approach (Lambeck 1997, 1999). To the conservation planner and manager, Lambeck's proposal offered more than what was previously available - general ecological principles - to guide strategic intervention.

The FSA is based on the concept of umbrella species which are those species whose conservation is expected to confer protection to a large number of naturally co-occurring species (Frankel and Soulé 1981; Roberge and Angelstam 2004). This concept has been suggested for use in determining the minimum size for conservation areas, selecting sites for inclusion in these reserves, and setting minimum standards for the structure, function and composition of ecosystem processes (see Ryti 1992; Fleishman et al. 2000, 2001). It has been recently extended to include other attributes such as habitat connectivity, the distribution of scarce resources, and the occurrence of ecosystem processes (Fleury et al. 1998; van Langevelde et al. 2000).

A ten-hectare August 2006 planting of endemic shrubs and trees undertaken to widen an existing remnant at "Calecono Springs" in Buntine-Marchagee Catchment, WA.

The FSA was first applied in Australia at Wallatin Creek Catchment in the central wheatbelt of Western Australia (Lambeck 1999, 2003). This work was followed by eight other CSIRO studies across this zone over the period 1998-2004 (reviewed in Freudenberger and Brooker 2004 and see Huggett et al. 2004). In eastern Australia, several projects have used the FSA to guide conservation and revegetation programs, predominantly in southern NSW (e.g. Freudenberger 1999, 2001; Collard 2000; Watson et al. 2001) and Victoria (e.g. Goulburn-Broken Catchment, see Robinson et al. 2004; North Central CMA region – see Griffioen et al. 2002, and Corangamite and Glenelg-Hopkins CMA regions). There has also been a FSA-related project undertaken in the Condamine Catchment of southeastern Queensland (Ford 2003). Some of these projects are currently being implemented or evaluated for their effectiveness as a conservation tool.

The Malleefowl is a nationally threatened ground-dwelling species that is thought to be sensitive to habitat patch condition and isolation in the northern WA wheatbelt. It prefers mallee woodland with some shrubs and will often venture into adjacent wheat paddocks to forage on spilt grain.

Key features and current trends

The focal species approach involves the identification of a set of species for the management of key threatening processes and habitat restoration. These are the species considered to be most sensitive to processes such as habitat loss, modification and fragmentation, predation, salinity, resource depletion, and inappropriate fire regimes. One or more focal species are identified for each threat or threatening process. Lambeck (1997) defined four types of focal species: area-

Pink Woolly Featherflower *Verticordia monadelpha* in an existing remnant in Buntine-Marchagee Catchment, WA.

limited, dispersal-limited, resource-limited, and ecological process-limited. Brooker (2002) collectively termed these species a "focal community".

The requirements for the persistence of focal species determine the characteristics of a landscape that must exist if the needs of all other biota are to be met (Lambeck 1999). The main landscape attributes are habitat structure, composition, configuration, and condition.

The FSA differs from the umbrella species concept, and flagship and indicator species approaches (see Simberloff 1998) by using threatening processes to select focal species. It also extends the use of single species to multi-species groups that are sensitive to selected threatening processes. Various authors have considered the FSA as a surrogate scheme or measure for biodiversity conservation in agricultural landscapes (e.g. see Andelman and Fagan 2000; Lindenmayer et al. 2002).

Most projects employing the FSA have used resident woodland birds as the 'building blocks' for protecting habitat and restoring landscapes, largely because birds are abundant, easy to survey and people can relate to birds! These projects have been carried out in farming landscapes where much of the native vegetation cover has been removed or substantially altered. In these systems, woodland birds are particularly sensitive to further loss of habitat area, condition and connectivity and thus may be useful indicators of ecosystem health and recovery potential (see Bennett 1999).

White Plume Grevillea, *Grevillea leucopteris*, over smokebush in road verge heath, Buntine-Marchagee Catchment, WA.

A set procedure has evolved using the focal species analysis in Australian agricultural landscapes. This has involved identifying key threats, identifying focal species, ranking these species according to their sensitivity to each threat, defining the ecological requirements of the most sensitive species, developing guidelines to manage these threats, and implementing strategies to meet the requirements of the most sensitive species. This method is detailed in Lambeck (1997), Freudenberger (2001) and Huggett et al. (2004). In the Goldfields region of north-central Victoria, Griffioen et al. (2002) developed key thresholds of habitat patch size, quality, and connectivity to identify focal bird species, using Bird Atlas data. These values were used to plan on-ground habitat management and revegetation activities.

Brooker (2002) provided a worked example of her development of the focal species analysis method at Gabbi Quoi Quoi Catchment in the Western Australian wheatbelt. She used bird occurrence (presence-absence) data from this and six other catchments in the WA wheatbelt and statistical models to identify focal species for each landscape variable (ie. remnant size, habitat patch size and isolation, and habitat condition), and the most critical focal species for each threat. From the results of this modelling and using the threshold concept (see Huggett 2005), minimum (typically 10%) probability levels for the predicted occurrence of focal bird species in this catchment were obtained. A computer simulation of bird dispersal between heath/shrub/mallee patches and woodland patches was also employed to assess patch connectivity. The modelled occurrence thresholds and dispersal simulations were then used to help develop a landscape design and management guidelines for the catchment. In Buntine-Marchagee Catchment to the north of Gabbi Quoi Quoi, Huggett et al. (2004) produced a landscape-specific design using a modified version of the Brooker (2002) method (Figures 1 and 2 and Plates 1 to 6).

Figure 1 Predicted probability of occurrence for candidate focal bird species sensitive to heath/shrub/mallee patch size in Buntine-Marchagee Catchment, Western Australia. The Southern Scrub-robin is the focal species for heath/shrub/mallee patch size, requiring approximately 29 ha of habitat to have a 10% chance of occurring, followed by the Redthroat (20 ha) and Crested Bellbird (15 ha) (Huggett et al. 2004).

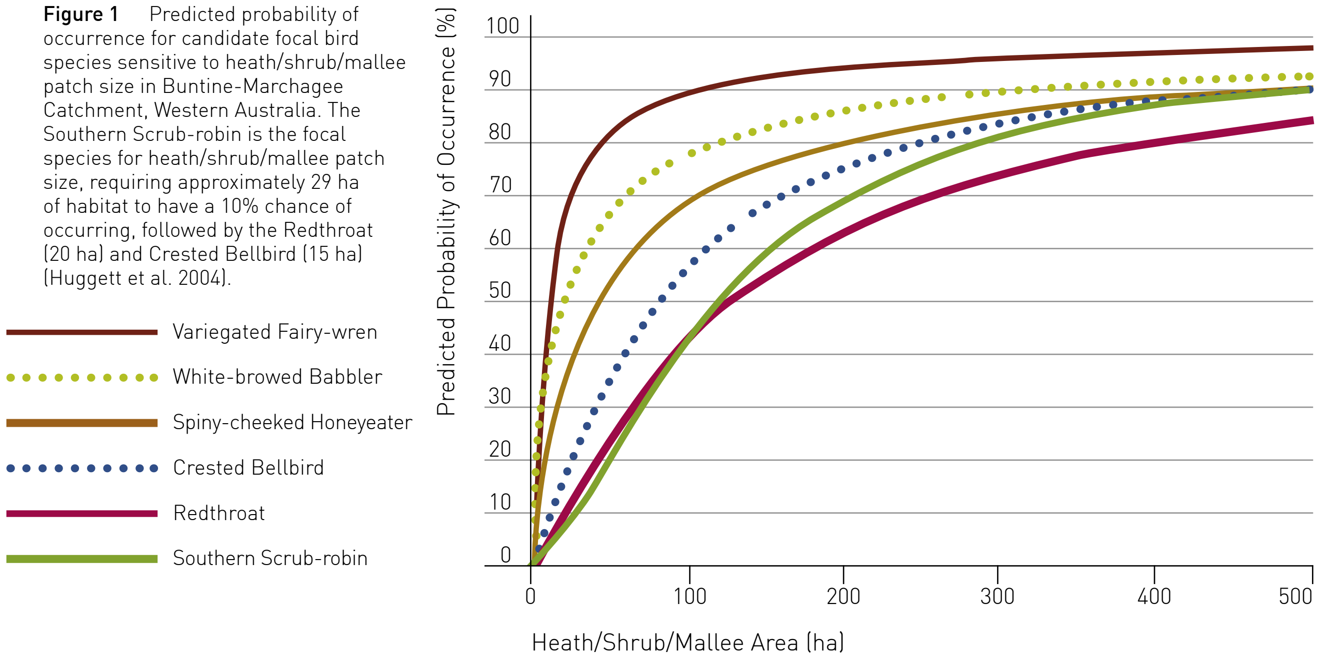


Figure 2 Predicted probability of occurrence for the woodland specialist Brown-headed Honeyeater for habitat patch isolation in Buntine-Marchagee Catchment, Western Australia. To have a 10% chance of occurring, this species required woodland remnants located no more than 1,900 metres apart (Huggett et al. 2004). Confidence intervals of 95% are shown.

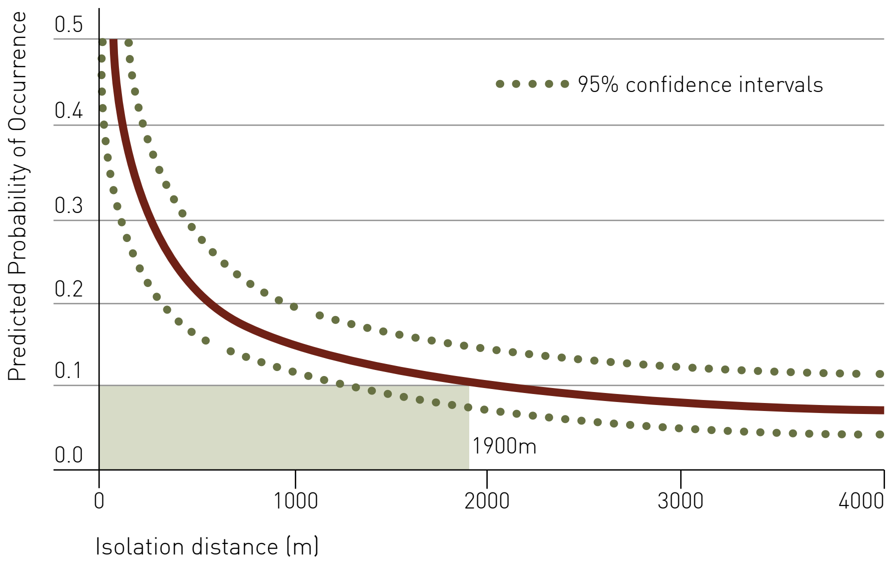


Plate 1 Southern Scrub-robin – the focal species for heath/shrub/mallee patch size and isolation in Buntine-Marchagee Catchment, Western Australia. Photo courtesy Bert & Babs Wells and Department of Environment & Conservation, WA (DEC).

Plate 2 Redthroat – a shrubland specialist sensitive to heath/shrub/mallee patch size in Buntine-Marchagee Catchment, Western Australia. Photo courtesy Bert & Babs Wells and DEC.

Plate 3 Crested Bellbird – an elusive shrubland specialist sensitive to heath/shrub/mallee patch size in Buntine-Marchagee Catchment, Western Australia. Photo courtesy Bert & Babs Wells and DEC.

Plate 4 Western Yellow Robin – the focal species for remnant condition in Buntine-Marchagee Catchment, WA. This is a generalist species requiring woodland and shrubland remnants in good condition. Photo courtesy Bert & Babs Wells and DEC.

Plate 5 Brown-headed Honeyeater – focal species for woodland patch isolation in Buntine-Marchagee Catchment, Western Australia. Photos courtesy Bert & Babs Wells and DEC.

Plate 6 Blue-breasted Fairy-wren – a heath/shrub/mallee specialist in Buntine-Marchagee Catchment. Photo courtesy Bert & Babs Wells and DEC.

Australian applications of the FSA have used one of three different models or frameworks. The first model, employed by CSIRO in the Western Australian and southern NSW wheatbelts and outlined above, utilises a strong quantitative approach based on some core principles of landscape ecology – increased habitat area and connectivity and improved habitat condition. The second – Biodiversity Action Planning (BAP) – uses these principles together with a multi-step landscape conservation and targeted survey and assessment procedure to determine areas for focusing conservation action at bioregional and landscape scales (Platt and Lowe 2002). This model, developed by the Victorian Department of Sustainability and Environment (then Department of Natural Resources and Environment), is being applied in the Goulburn-Broken and North Central Catchment Management Authority (CMA) regions (see Robinson et al. 2004). In contrast, the third framework - the Living Landscapes Program - uses an experiential learning process (see Frost et al. 1999) to provide catchment groups with the skills needed to produce their own management plans. It was developed in the Western Australian wheatbelt by Greening Australia (Dilworth et al. 2000) but has been adopted by rural Victorian CMAs in the Corangamite and Glenelg-Hopkins regions. North Central and Corangamite CMAs use a combination of the Living Landscapes and BAP models to drive their biodiversity conservation planning process.

The scientific debate

The conceptual, theoretical and practical foundations of the focal species approach have been vigorously debated in the scientific literature. The reasons put forward to support criticism levelled at these foundations are presented below in an attempt to clarify the nature and context of the debate.

The primary criticism of the FSA concerns its assumption of 'umbrella' protection afforded to all biota by meeting the needs of the most sensitive species to particular threats in a landscape. Several authors have cited this assumption in arguing that the approach is conceptually flawed (e.g. Lindenmayer et al. 2002; Lindenmayer and Fischer 2003; Short and Parsons 2004). They have contended that, given the often complex and poorly understood biological and ecological requirements of individual species occurring within heterogeneous landscapes, this is an impossible or unrealistic goal (e.g. Simberloff 1998; Andelman and Fagan 2000; Lindenmayer et al. 2002). This is the "surrogacy dilemma" in which action to conserve one particular taxon (e.g. woodland birds) identified as the focal species for a given threat does not mean that other taxa (e.g. reptiles, amphibians, plants) with different habitat requirements, dispersal capabilities, and sensitivity to disturbance will also be conserved. Even closely related species of the same guild may not respond in similar ways to habitat loss, fragmentation or alteration (see Landres et al. 1988; Huggett 2000). Westphal and Possingham (2003) caution that selecting focal species with different ecological requirements may lead to the provision of conflicting management advice.

A second key criticism concerns the difficulty of determining what are the most sensitive species to each threatening process in any given landscape. This requires substantial and costly survey effort and the need to target, in the general absence of data on the most dispersal-limited or resource-limited species in a landscape, the most area-limited taxa (Lindenmayer et al. 2002). However, this is problematic because funding is limited and other factors such as predation, fire or disease may contribute to species decline or influence their distribution patterns. Also, threatening processes can interact to create, as Watson et al. (2001) found in isolated woodland patches near Canberra ACT, more than one factor (e.g. habitat patch isolation *and* structural complexity) responsible for influencing the sensitivity of a species to habitat area. Variation in the spatial and temporal scales of threatening processes and the lack of transferability of focal species selected in one catchment to another are other challenges faced in selecting focal species for specific threats (see Lambeck 1999; Lindenmayer 2000; Brooker 2002; Fischer et al. 2004a).

A third criticism is the FSA's claimed assumption of nestedness in patterns of bird species occurrence across highly fragmented agricultural landscapes (Lindenmayer et al. 2002). Nested subset theory implies that small species-poor remnants should contain assemblages that are subsets of larger species-rich remnants

Scarlet Featherflower, *Verticordia grandis*, on sandplain heath in Buntine-Marchagee Catchment, WA.

(Patterson 1987; Doak and Mills 1994). Lindenmayer et al. (2002) argue that the FSA (Lambeck 1997) is theoretically limited because it does not supply evidence of nested occurrences or responses to threatening processes and, even if demonstrated for one taxon (e.g. birds), cannot be assumed for another (e.g. plants) (but see Lambeck 2002, p. 549). However, strong evidence has been found for the presence of nestedness in bird species assemblages in the WA (see Brooker and Lefroy 2004; Huggett et al. 2004; Short and Parsons 2004) and NSW (see Freudenberger et al. 2004) wheatbelts.

Practical issues raised include the approach's heavy emphasis on birds, the amount of farmland required for revegetation based on FSA landscape designs and guidelines, and the lack of scientific testing of the approach. Almost all projects utilising the FSA in Australia have been based on resident land birds. This has created the potential for over-emphasis on the development of management advice centred around one group of biota (land birds) with specific conservation needs and responses to habitat disturbance. Studies using other taxa are clearly needed.

Encouraging farmers to revegetate their properties to the level recommended by earlier FSA-based designs has been impractical and cost-prohibitive (e.g. Lambeck 1998, Brooker et al. 2001). Later applications have, however, refined this step to target a more achievable set of priority remnants and planned interventions (see Huggett et al. 2004; Robinson et al. 2004). Griffioen et al. (2002)'s use of thresholds to identify focal bird species and plan restoration works in north-central Victoria also refined this process, despite caveats associated with the use of thresholds (see Huggett 2005; Lindenmayer et al. 2005).

There is also a need for rigorous testing of the approach which, as Lindenmayer et al. (2002) point out, must be based on conventional scientific method and subjected to peer scrutiny. Short and Parsons (2004) tested the utility of the FSA for mammals and reptiles using existing and new data from the WA wheatbelt. They found that remnant area significantly influenced the probability of occurrence of these species and that the minimum size of remnants recommended for birds would be insufficient to accommodate these taxa (and see below).

Hooded Robins (male on right, female on left) are a focal species for patch size and isolation. They require larger patches, old trees, fallen timber and can only tolerate moderate grazing pressure.
Photo: Graeme Chapman.

Alternative approaches

There are a number of alternative approaches and tools to planning the restoration of degraded agricultural landscapes. Collectively they provide a broader range of options for biodiversity conservation than perhaps have been previously considered in the focal species debate. These are reviewed below.

Several authors have emphasised the importance of the matrix as habitat for many plants and animals in fragmented agricultural systems around the world – including isolated paddock trees, vegetated paddock/road verges, and crops or pastures (e.g. see Boutin et al. 1999; Kirk et al. 2000; Daily et al. 2001; Fischer et al. 2005). The Countryside Biogeography Approach (CBA) was developed in Costa Rica to predict and understand the impacts of habitat alteration on birds and mammals in both forest remnants and non-forested agricultural land (Daily et al. 2001, 2003; Luck and Daily 2003). The CBA used a model based on life-history factors to predict the minimum amount of native habitat that a species would need to persist (Pereira et al. 2004). The level of threat posed to each species was estimated using minimum predicted patch sizes. There is potential to incorporate into this approach a population viability analysis and thus address one of Lindenmayer and Fischer's (2003) major criticisms of the FSA.

The Speckled Warbler is a declining ground-dwelling species which occurs in larger patches, requires regenerating shrubs, fallen timber, native grassland and can only tolerate moderate grazing pressure. Photo: Graeme Chapman.

Margules and Pressey (2000) used reserve-selection approaches to plan the prioritisation and protection of existing habitat remnants in fragmented Australian landscapes. These use algorithm software to select minimum sets of protected areas that represent biodiversity surrogates at specific targets. This tool considers the matrix in terms of habitat corridors that may be used by organisms but is constrained by its focus on the size and configuration of habitats at the expense of other attributes such as condition and population viability (Sarkar et al. 2005). It also favours larger patches over smaller patches, an outcome that under-estimates the contribution of small remnants to biodiversity conservation in highly fragmented farming landscapes where small patches are often all that remains (see Gibbons and Boak 2002). However, reserve-selection algorithms can be used to prioritise areas for conservation and so may have some value in planning restoration programs in agricultural systems.

Sanderson et al. (2002) put forward the landscape species approach which selects species with large area requirements for conservation action. This includes some elements from the umbrella and FSA models using selection criteria of area, habitat heterogeneity, vulnerability to human threats, economic functionality, and socio-economic significance. A scoring system based on these criteria is used to rank candidate landscape species and the species satisfying all five criteria is joined by species ranked next with the process concluding when the spatial requirements of all candidates species are met.

Other alternative approaches, tools and models have been proposed. These include a decision-theory framework to landscape planning (Westphal and Possingham 2003; and see Wilson et al. 2005 and Nicholson and Possingham 2006), multiple species targeting approach for grassland bird species in the UK (see Bayliss et al. 2005); suggestions for a "new" conceptual framework for landscape designs in the Australian wheatbelt (Short and Parsons 2004), noting, however, that many of these suggestions have been previously put forward or included in the recommendations of other landscape designs; multispecies multivariate techniques to predict preferred landscapes for whole species assemblages using statistical modelling (see Gottfried et al. 1999; Titeux et al. 2004); habitat contours as a conceptual landscape model (Fischer et al. 2004b); and several other statistical models (e.g. generalised additive models, resource selection functions, genetic algorithms, and population viability analysis). Information criteria (e.g. Akaike's and Bayesian) have been recommended for selecting the most appropriate of these models for a given application (see Burnham and Anderson 2002).

Revegetation adjacent to existing remnants, Paradise (Upper Avon Richardson catchment, North Central CMA Victoria) Photo: Geoff Park.

Key findings

The main focal species-related project funded by Land & Water Australia - *Testing Approaches to Landscape Design in Cropping Lands* (CSE9 project) - was undertaken by CSIRO Sustainable Ecosystems from 2001-2004. It investigated some of the assumptions of the focal species approach, provided several refinements to the method, and made a suite of recommendations for further work. Specifically, it provided an improved method for determining where to revegetate for bird conservation (Component 1 – Huggett et al. 2004), determined how much revegetation is needed by identifying fragmentation thresholds (Component 2 – Brooker and Lefroy 2004), and explored whether a bird-based FSA could also be used for other taxa in western (Component 3a - Short and Parsons 2004) and eastern (Component 3b - Freudenberger et al. 2004) Australia.

For more information on the CSE9 project: *Testing Approaches to Landscape Design in Cropping Lands*, please visit

www.lwa.gov.au/nativevegetation

Utilising a refined landscape design procedure that included assessment of vegetation condition, Huggett et al. (2004) determined that 1,361 hectares of new native vegetation, comprising habitat linkages and 'stepping stones', would be needed to connect core habitat neighbourhoods for focal bird species in Buntine-Marchagee Catchment in the northern wheatbelt of WA. To have a 10% chance of the most sensitive bird species occurring, habitat patches of 30-40 hectares would be required. In addition, 4,568 ha of existing remnant native vegetation was recommended for protection and management to retain focal bird communities. Priority locations for doing this work were identified, through a process of innovative 'road-testing' of the draft landscape design directly with the local community using GIS modelling and an electronic whiteboard (Figures 3 to 5).

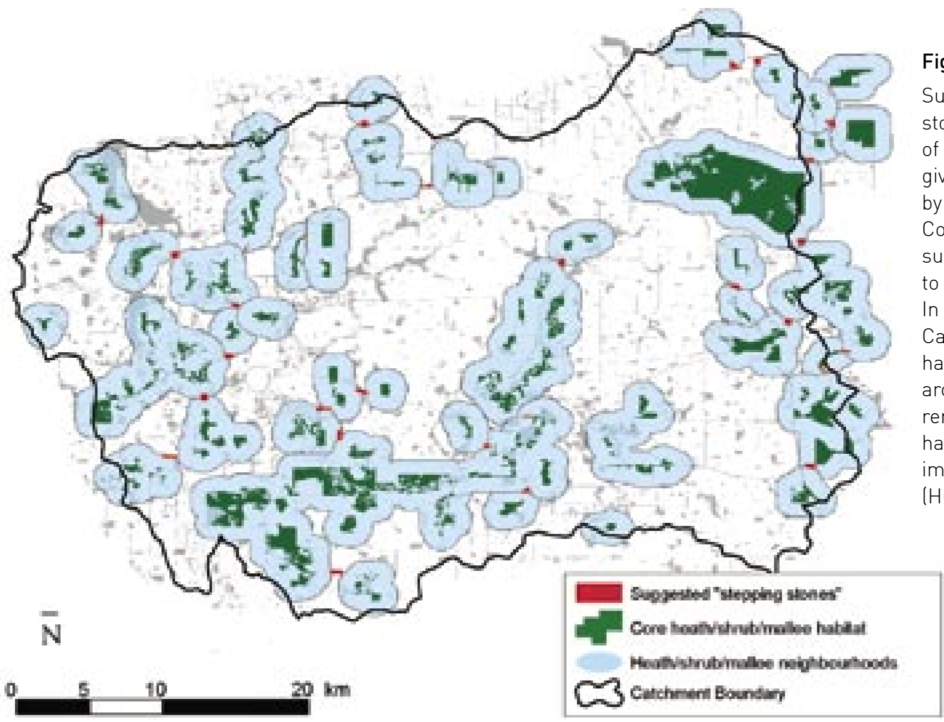


Figure 3

Suggested heath/shrub/mallee 'stepping stones' to link neighbourhoods or sets of habitat patches occurring within a given radius of core habitat, as defined by the requirements of the focal species. Core habitat is native vegetation of sufficient size for a focal bird species to have a 10% chance of occurrence. In this example in Buntine-Marchagee Catchment, Western Australia, new habitat is recommended for planting around existing heath/shrub/mallee remnants to increase the amount of habitat available for fauna use and improve connectivity between patches (Huggett et al. 2004).

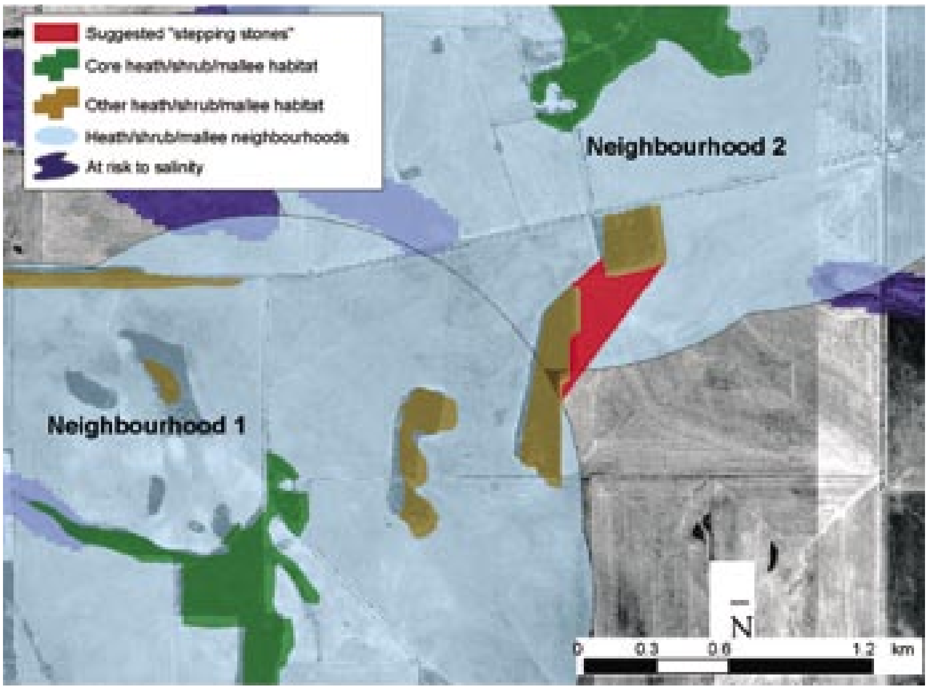


Figure 4

An example of a suggested heath/shrub/mallee 'stepping stone' for linking two neighbourhoods in Buntine-Marchagee Catchment (Huggett et al. 2004). Here the 'stepping stone' (red) is positioned to link existing habitat and avoid sites of high salinity risk (purple). This helps target the revegetation effort in the catchment.

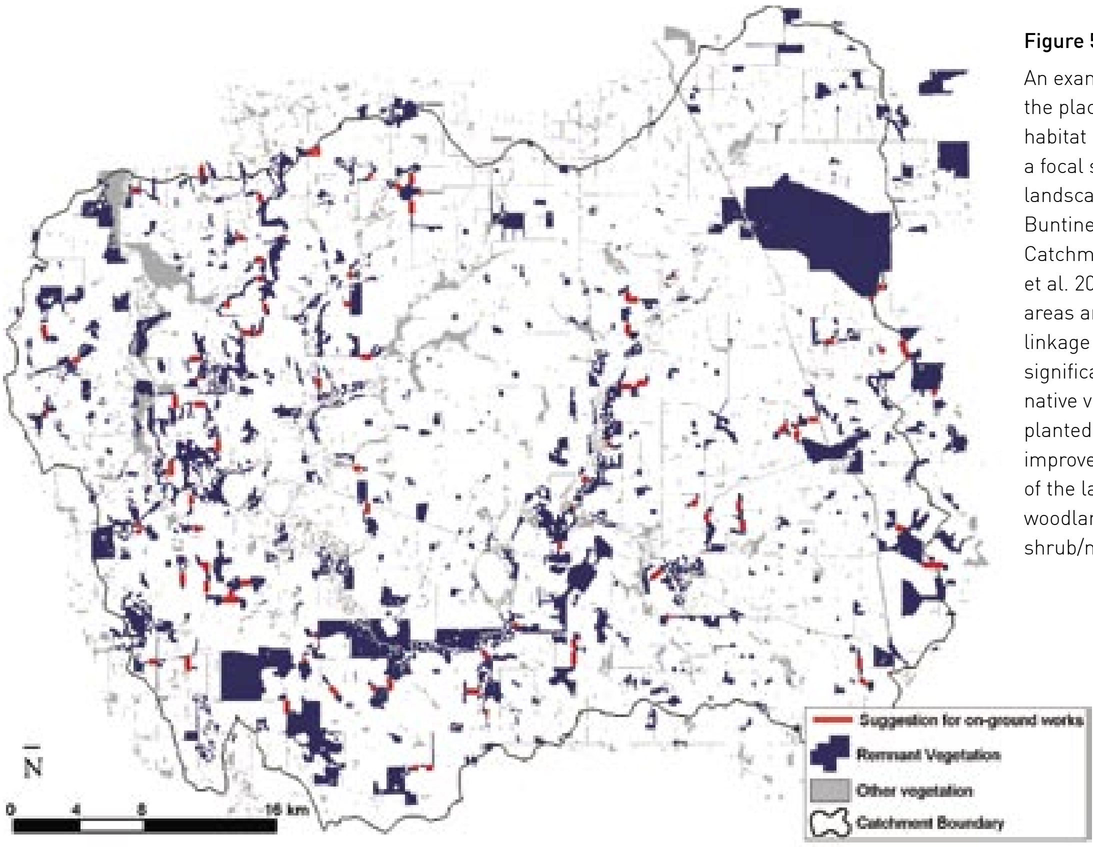


Figure 5

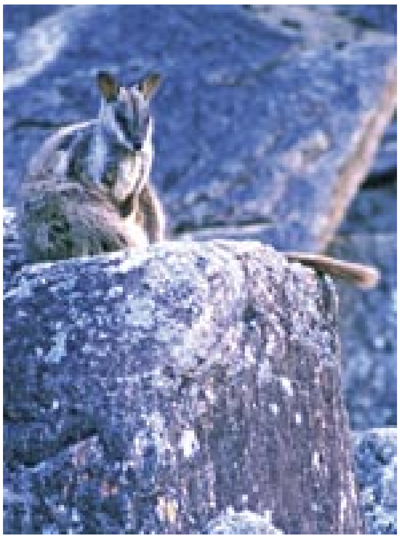
An example of targeting the placement of new habitat linkages using a focal species-based landscape design in Buntine-Marchagee Catchment (Huggett et al. 2004). The red areas are recommended linkage sites between significant remnants of native vegetation that if planted, will significantly improve the connectivity of the landscape for focal woodland and heath/shrub/mallee bird species.

In the central WA wheatbelt, Lesley Brooker used GIS-based modelling of bird survey and vegetation data to rank and map the relative conservation value of 54,000 remnants (Brooker and Lefroy 2004). This identified priority areas for targeting conservation action and allowed regional priorities to be made for investing in the protection and enhancement of existing remnants. Brooker and Lefroy (2004) also identified thresholds of fragmentation beyond which the persistence of bird populations was compromised. From this work they were able to indicate how much revegetation would be needed to maintain declining bird species in this region.

The Lace Monitor may be a focal species for habitat patch size, condition, and connectivity. It utilises hollow trees and logs and appears to be sensitive to predation of its young by foxes. Photo: Rob Ashdown

To test whether area thresholds derived from Brooker and Lefroy's (2004) work would cater for the habitat requirements of reptiles and mammals, Short and Parsons (2004) reviewed existing data and collected new data from six remnants in the WA wheatbelt. They found that the mammal and reptile species they studied had substantially more demanding area requirements than birds, although the number, location and duration of surveys they conducted were limited. For instance, hopping mice had a 10% probability of occurrence at 320 hectares while the lizard *Delma australis* required 140 hectares. These findings should be viewed as preliminary only, awaiting more rigorous surveys replicated in other parts of the WA wheatbelt.

In the extensively cropped and grazed NSW Riverina Plain, Freudenberger et al. (2004) found that the most sensitive birds captured the area and condition requirements of many other organisms, from plants and fungi to mammals, reptiles, frogs and ants. However, birds were insensitive to isolation and so did not effectively capture the connectivity requirement of other biota. Again, minimal survey effort and, in this case, a lack of replication in other landscapes means that these findings should be treated with caution. Protocols for FSA survey design are needed to increase the chance of detecting rare or cryptic species and so be able to design landscapes based on the species most sensitive to given threats.



The Brush-tailed Rock-wallaby is threatened by habitat loss, fragmentation, and predation by foxes and wild dogs. The focal species approach for candidate mammal species may require the use of different habitat characteristics than for bird species. Photo: Rob Ashdown.

A Land & Water Australia funded project undertaken by CSIRO and Greening Australia - *Improved vegetation planning for rural landscapes* (CTC27 project) – compared the focal species and 'principles and thresholds' approaches to landscape design (McIntyre et al. 2003). The latter approach incorporates all major threats and aims to maintain or return most native species in a landscape rather than conserving the most sensitive species to given threats. It uses existing information and principles to develop a generic approach to landscape design. The authors suggested that these approaches be applied differentially – the FSA in highly fragmented landscapes (e.g. WA wheatbelt) and the thresholds approach in the variegated landscapes of eastern Australia (e.g. grassy eucalypt woodlands). They also recommended that the FSA use the full suite of threats present in a landscape.

From these findings emerge some important insights on how the FSA method might be refined and applied to conserving degraded agricultural landscapes. First, the Lambeckian expectation (Lambeck

Mixed mallee eucalypts and shrubs planted in July 2004 as a potential corridor linking two key remnants on the "Nulands" property, Buntine-Marchagee Catchment, WA.

1997, p. 850) that conservation of focal bird species will also protect all other species in a landscape is flawed – it is simply not possible to make this claim given the diversity and complexity of life on earth. However, it is possible to say that a scheme able to quantify the habitat requirements of species that are most sensitive to a given threat or threatening process in a landscape can provide spatially explicit guidelines for the recovery of these biota and possibly other ecologically similar or similarly threatened species. The focal species or threat-response approach is therefore a valuable conservation planning tool, providing a useful framework to design and implement strategic revegetation works based on analysing key threatening processes in degraded agricultural landscapes. It should be viewed, however, as one of several options for helping to achieve this goal. These options may need to be used in a blended or integrated way, depending on the landscape in question, threats present, and the nature of interactions within and between its ecological and social processes.

Second, there is a pressing need to review the way in which the focal species approach is being applied in Australia. Currently, it is being haphazardly applied in some Victorian CMAs without adequate understanding of the scientific principles that inform the selection of focal species, identification of threats, design of landscapes, and implementation of priority actions (Geoff Park, pers comm). Also, some Victorian catchment groups are using the Living Landscapes model that was developed for relictual WA wheatbelt landscapes in variegated (see McIntyre and Barrett 1992) eastern Australian farmed landscapes. This has created the potential for misapplication of the focal species analysis method to landscapes quite different to those for which the method was originally designed. There are also issues of sampling design, including special provisions for the detection of rare or cryptic species, a need for improved knowledge of the autecology of target species and their response to disturbance (Huggett et al. 2004, p. 73), and consideration of other threats such as predation, competition, salinity, livestock grazing pressure, and inappropriate fire regimes. In effect, an on-ground evaluation of current approaches and methods being used in Australian focal species work is urgently required, with view to developing guidelines for implementing the FSA and other landscape design tools and assessing their performance across different landscapes.

Third, consideration should be given to the use of taxa other than sedentary land birds as potential focal species in landscape designs and plans. Potential exists for using bats, other mammals (e.g. echidnas, wallabies, phascogales), large flying insects (including butterflies), and some reptiles such as monitor lizards. Nocturnal and possibly migratory birds should also be considered, though with the need for habitat and life history data from different landscapes across the geographical range of the latter group. Aspects such as dispersal ability, population viability, landscape type and matrix characteristics, detection and monitoring protocols, and availability and suitability of data (historical and current) to allow rigorous and quantitative analysis would need to be addressed. Recent work overseas has demonstrated that other taxa can be used in FSA-based landscape management planning. For instance, large carnivorous mammals (e.g. cougar, wolf and Atlantic salmon in Nova Scotia, Canada and Maine USA – Beazley and Cardinal (2004) and European badger, weasel and stone marten in Lombardy, northern Italy – Bani et al. 2002), and butterflies in Californian coastal shrubland (Fleishman et al. 2001) and British mountain ranges (Betrus et al. 2005) have been used as focal species in managing these forested, urbanised and farmed landscapes.

A fourth insight relates to the practical value of the FSA in communicating goals for strategic local conservation action by landholders, NRM groups and government agencies. Freudenberger (2004) highlighted this effectively in his discussion on the ability of the FSA to provide farmers with quantitative targets for revegetation to conserve declining bird species (see also Freudenberger and Brooker 2004). This attribute of the FSA is also enabling the WA Department of Environment and Conservation to implement a FSA-based landscape design for bird conservation in the Buntine-Marchagee Natural Diversity Recovery Catchment. In this way, the FSA is indeed a mechanism for engaging with landholders that goes well beyond providing general principles for habitat protection and restoration. There is also scope for further analysis of the degree of social engagement offered by the FSA relative to alternative approaches.

Finally, there is emerging consensus among conservation biologists and NRM practitioners around the world on the need to be flexible and adaptive in the development of surrogate schemes to conserve our remaining biodiversity. The focal species scheme like its predecessors offers no 'magic bullet' (Lambeck 2002) for arresting the slide of many native plant and animal species to extirpation in agricultural landscapes. However, the FSA does have the potential to direct conservation effort, together with a range of other tools, toward actions that manage specific threats in a landscape.

The Echidna is sensitive to habitat loss and fragmentation, and loss of patch connectivity. Photo: Bruce Thomson

Key messages and ways forward

There are a number of important messages and potential future directions that have emerged from Land & Water Australia-funded focal species projects. These have the potential to inform and guide the strategic restoration of fragmented agricultural landscapes. Investigation of ways to incorporate these messages into landscape planning models is recommended.

Vegetation connectivity and pattern in the landscape is important for species sensitive to habitat loss and fragmentation. Corridor linkages near Holbrook, New South Wales. Photo: Jim Donaldson

A fundamental message of the CSE9 project is that the focal species approach should not be considered as the sole mechanism for obtaining biodiversity benefits from the restoration of degraded farming land. It is a tool not a panacea and perhaps too much emphasis or hope has been placed on its ability to restore landscapes *per se*. This has been understandable since many landscapes have had for many years only general ecological principles to guide their restoration or rehabilitation. The real value of the focal species approach lies in its ability to inform and prioritise the recovery effort through application of the scientific principles of landscape ecology and to mobilise and guide community action. Component 1 of the CSE9 project used the concept of 'stepping stones' and added a 'road-testing' step that allowed landholders to have direct input to the draft design. While these innovations improved the operational flexibility of the FSA in Buntine-Marchagee Catchment, there is plenty of room for further refinement of the approach across a range of landscape types and matrix conditions. Central to this is the need to fully develop a toolkit of options available for landscape restoration (see Alternative approaches above). These should go beyond the general principles, much of which do not significantly add to our existing knowledge of actions needed, or options, available to help restore degraded agricultural ecosystems. Pursuit of Freudenberger's (2004) point on selecting different approaches for different objectives may be a useful way forward.

A second message concerns the influence of scale and ecological factors on the identification of focal species and the development of effective landscape designs. Threatening processes operate at different temporal and spatial scales meaning that landscape designs prepared for farms and catchments may not properly conserve species undergoing regional population decline and range contraction. Effective landscape design also requires an understanding of how organisms and ecological processes function and interact in fragmented landscapes. Knowledge is specifically required of their patterns of distribution, abundance and habitat use, reproductive success, population viability, dispersal/movement, and response to disturbance. Given the absence or poor availability of much of this data for so many species affected by habitat loss, fragmentation and modification, future work should investigate, as a priority, the population viability, movement, habitat use and disturbance response of threatened and declining taxa (see Akçakaya 2004; Huggett et al. 2004). Understanding the value of regional scale focal species analysis would assist this work (see Brooker and Lefroy 2004).

Third, focal species studies need to recognise that other threats to the survival and persistence of declining species and populations exist in highly fragmented landscapes. These include, for example, salinity, predation, competition, inappropriate fire regimes, livestock grazing pressure, and invasive species. The development of landscape designs based on a multi-threat analysis, given data availability, is a potential way forward.

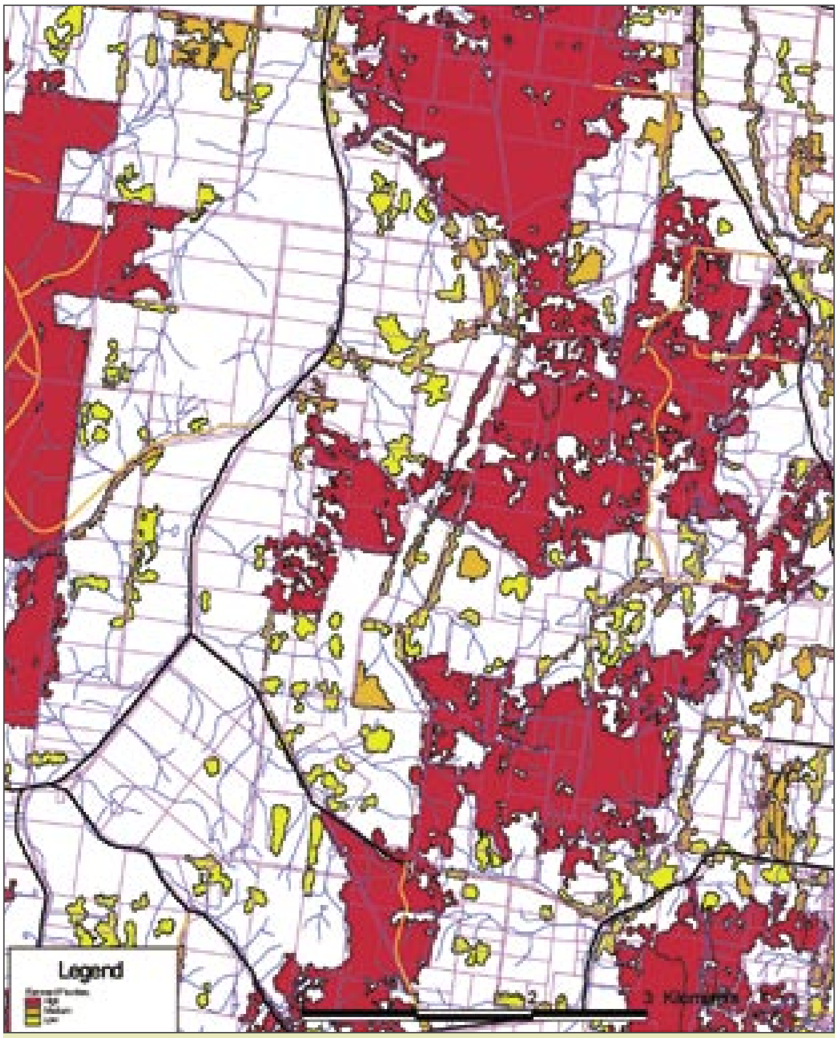
A new habitat linkage planted in July 2004 on "Nulands", Buntine-Marchagee Catchment, WA. This is a heath/shrub/ mallee 'corridor' planting that links two important remnants supporting several focal bird species.

Fourth, care needs to be exercised in the application of the FSA method to landscape restoration projects. Key issues for consideration include objectives and desired outcomes of the project, nature of the subject landscape and its matrix (ie. degree of fragmentation, size, connectivity, condition, species composition and configuration of remnant vegetation), identifying species most sensitive to given threats and their habitat requirements, types and scale of threats present, and species at risk of further decline and extinction (these may be 'candidate' focal species). Caro and O'Doherty (1999) suggest that criteria be used to select surrogate species and a pilot study be conducted to confirm whether this choice was appropriate before addressing the conservation problem at hand. This could be extended to assess the utility of the FSA in different landscapes (including urban/peri-urban) and for a range of different species. A framework for developing and implementing the FSA method could be designed to improve the rigour of focal species analysis and its use in landscape design and restoration planning. Ideally, this could be in the form of a draft national standard of practice (or guidelines) trialled in a small number of catchments across Australia.

The fifth message emphasises an ongoing need for monitoring and evaluation of the performance of landscape designs informed by focal species analyses. Key considerations here include the extent of and barriers to on-ground implementation of these designs, costs and benefits of implementation, areas for improvement, and whether the designs achieved their stated objectives. Also, to be of most value in landscape restoration, the FSA needs to be part of a monitoring and evaluation loop contained within a long-term adaptive management system (Freudenberger, pers comm).

Finally, a suite of priority actions from the Component 1 (see page 10) study deliver some core principles for landscape design in fragmented agricultural systems. These focus on (in order of priority) protecting and retaining existing habitat and species of conservation value, prioritising habitat protection and management activities, creating habitat 'stepping stones' to link ecological neighbourhoods, and establishing linkages or potential corridors to improve habitat connectivity within neighbourhoods (see Huggett et al. 2004, pp. 79-83). Also, recommendations for monitoring, review, and future research are provided in this report (Huggett et al. 2004, pp. 83-86). These could help inform further work to develop a national FSA standard of practice or set of guidelines.

Extract from Providence Gully Local Biodiversity Plan (Newstead area, North Central CMA Victoria) - this plan was devised by extension staff and the local community with focal species data from bird surveys in the area and across the Goldfields Bioregion.



Priority Remnants

Priorities for protection and enhancement of remnant vegetation in the Providence Gully area were determined primarily on the basis of:

- Remnant size
- EVC Conservation Status (Depleted, Vulnerable, Endangered)

Additional remnant shape / spatial distribution criteria were then taken into consideration:

- Shape: Linear or other elongate remnants were given a lower priority, with the exception that creekline vegetation was considered a high priority
- Isolation: Remnant patches adjacent to large core areas were given a higher priority
- Clusters of remnants were given a high priority
- Remnants that made valuable linkages were given a higher priority

Focal Species expected to benefit: Hooded Robin, Sacred Kingfisher, Speckled Warbler, Diamond Firetail and White Browed Babbler

* The remnant priorities shown here are to be considered as guidelines only, since the quality or condition of remnants was generally not known. Assessment of habitat condition would be required before recommending works, and may alter the priority of some remnants.

Opportunities for knowledge exchange

Substantial potential exists for the exchange of knowledge gained from focal species studies amongst the broader NRM community. Key areas are in the focal species analysis method, landscape design procedure, priority actions, monitoring and evaluation framework, and development of key communication networks. These opportunities are identified below.

Advances in the application of the focal species analysis method, as presented in the CSE9 project, should be extended to the FSA practitioner community, both in Australia and overseas. The introduction of new steps in field surveys and analysis procedures such as the sampling of relative abundance of bird species, comprehensive vegetation sampling, assessment of remnant condition, and GIS-aided mapping of vegetation associations, salinity risk, and bird species occurrence could be shared with other practitioners in Victoria, NSW and Queensland. There is a specific need for a more scientifically rigorous and local-based survey and analysis method in several Victorian (Geoff Park, Doug Robinson, Chris Pitfield and John Rees, pers comms) and Queensland (Greg Ford, pers comm) FSA-based projects.

Knowledge accrued through the development and implementation of the Buntine-Marchagee Catchment landscape design procedure also has potential to be shared among FSA practitioner and manager audiences. Uptake of two innovative elements of the 10-step landscape design employed in this project - the 'stepping stone' concept and GIS-based 'road-testing' of the draft design with the catchment community – could make designs more workable and thus more likely to be adopted by those implementing them (ie. landholders, NRM groups and their facilitators, government agencies).

The suite of priority actions identified from the landscape design for Buntine-Marchagee Catchment provides another opportunity for knowledge exchange with and extension to practitioner, manager, and landholder audiences in other catchments. The approach used to develop and prioritise these actions included focal species analysis, landscape design, and assessment of the local, regional and State conservation significance of declining woodland and shrubland birds. This could be readily adapted for use in other catchments, together with the priority actions themselves – protection and enhancement of existing habitat and high conservation value species using a threat management approach, prioritised protection and management of core remnants, establish 'stepping stones' to link ecological neighbourhoods, and establish new habitat linkages to increase the degree of habitat connectedness within neighbourhoods.

An opportunity also exists for sharing and extending knowledge accrued through monitoring and evaluation frameworks developed in eastern and western Australian focal species work to the broader NRM community. Specific areas here include reviewing the biodiversity contribution of past ecological research and revegetation programs (including methods and monitoring protocols used), assessing the performance of landscape designs, researching the role and function of existing and planted 'corridors' for fauna movement, dispersal and habitat use, and developing new approaches to nature conservation in agricultural landscapes.


The focal species approach provides a planning mechanism to facilitate exchange of knowledge between researchers and landholders. Here workshop participants gather to assess the habitat condition of a remnant near Wodonga (Victoria).
Photo: Nadeem Samnakay

On the south-western slopes of NSW near Holbrook, the BioAssess Project has been monitoring and assessing the performance of revegetation in conserving declining woodland birds (Freudenberger, pers comm and see Collard 2000). The experimental design and monitoring framework used in this focal species-based project, together with the bird survey results, could provide valuable insights for the design and management of other revegetation programs in agricultural landscapes. Recently, other projects have examined the role and effectiveness of revegetation in providing habitat for biodiversity, e.g. bats in planted eucalypts on farms (Law and Chidel 2006) and birds and arboreal mammals in the wheat-sheep belt of southern Australia (Vesk and Mac Nally 2006). The results of these projects may help inform the development and implementation of other revegetation initiatives in southern farming zones.

There is also potential for valuable learnings to accrue from current projects examining the contribution of revegetation to biodiversity conservation in the western Australian wheatbelt. These include work underway in Buntine-Marchagee Catchment and in the central (native vegetation and commercial crops planted in Wallatin Creek and O'Brien's Creek Catchments) and southern (Narrogin district oil mallees) wheatbelt zones (Smith 2006 and pers comm). Although the latter projects are not evaluations of the landscape designs derived from the current FSA model (see Huggett et al. 2004), their methods, analyses and results may assist revegetation work in other agricultural systems.

Finally, the focal species projects funded by Land & Water Australia have provided an opportunity for the creation and further development of key communication networks among the NRM, scientific research, land resource manager, producer group, and landholder communities. To capitalise on this, there is a need to improve formal links and contact and support structures between regional, State, national and international researchers, NRM facilitators, and industry and catchment groups. This will promote the effective communication, transfer, and uptake of knowledge in other landscapes that flows from the results of focal species and related studies (see Land & Water Australia 2005; Campbell 2006).

Concluding views

No singular conservation tool or scheme will offer the 'perfect' solution - security of tenure for and protection of all our declining native biodiversity. In agricultural ecosystems, the conservation imperative has never been more pressing with the compounding effects of salinity and climate change on remnant habitat yet to be fully felt. The search for a 'cure-all' solution or 'magic bullet' has therefore been a frantic one as scientists, managers and farmers alike race against time to hang on to (and try to increase) what is left.

The latest addition to the restoration toolkit in these landscapes – the focal species or threat-response approach - is not without its caveats and critics. Among the for-and-against arguments are some important points that warrant a recap. The focal species approach can provide quantitative and spatial advice for strategically restoring landscapes for the most sensitive species to given threats or threatening processes. This goes beyond what was previously available to managers and farmers, that is, general principles and expert opinion. However, because threats often interact and there is usually limited data available on the more sensitive species, care, knowledge and forethought are needed when using the approach as a conservation tool which after all, is but one of the several available for this purpose.

What is really needed is constructive discussion on the development of guiding rules and principles, including risk-spreading elements, to standardise and increase the scientific rigour of using the focal species approach across catchments, landscapes and even continents. Questions need to be asked (and answered) about the purpose of revegetation programs, what are the desired outcomes, particularly over timeframes of greater than three years (ie. the typical funding cycle), and what are the alternatives available. Practitioners also need to be aware of the approach's limitations, particularly those relating to assumptions of 'catch-all' protection and nestedness, the challenge of obtaining data of sufficient quantity and quality (beyond just presence-absence), and identifying the species most sensitive to given threats. But, at the same time, landscape renovators should recognise the strengths of the approach - its use of the principles of landscape ecological science to build new habitat for the targeted taxa, the should-be-studied 'social hook' value, and its practical contribution to the suite of tools now available to help restore the ecological structure and function of our degraded farmscapes.

Now is the time to work on evaluating how landscape designs based on the focal species approach and other schemes are performing to conserve their targeted biodiversity. To this end, a case study approach is recommended to target, initially at least, three catchments in southern Australian agricultural landscapes which have implemented focal species-based revegetation plans. There is also a need to explore the implications of using the focal species approach inappropriately – that is, what might be the likely outcomes for biodiversity conservation if, for example, not enough revegetation occurs or landscape designs are not properly implemented or the approach is used to define clearing levels (Freudenberger, pers comm). In the latter and hopefully unlikely case, the risks of 'getting it wrong' would be substantial.

There may also be merit in, as David Freudenberger has suggested, widening the frame of reference beyond focal species to ways of targeting priorities for vegetation management that accrue biodiversity benefits (Freudenberger 2004). As outlined above, this is already underway in parts of southern Australia.

Finally, the results of focal species research funded by Land & Water Australia have provided valuable new data (e.g. bird species presence-absence in 785 WA wheatbelt remnants – a significant achievement in itself), regional-scale conservation priorities for remnant native vegetation, innovations in landscape design, and testing of the utility of the approach for other taxa. These outcomes alone have more than justified the investment. However, the biggest return is perhaps yet to be realised – demonstrating that these designs and the science driving them are achieving their principal goal – creating the basis for the recovery of some of the biodiversity of our fractured agricultural ecosystems. That, in a nutshell, is the challenge that lies ahead.

A road and rail corridor of remnant heath/shrub/mallee along the Wubin – Dalwallinu road, Western Australian wheatbelt.

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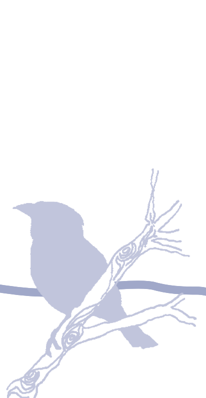

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Visit the Native Vegetation and Biodiversity R&D Program website for more information on the focal species approach and other related topics.

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