Northern Agriculture Integrated Management Strategy

BIODIVERSITY

Situation Statement

Prepared by Department of Conservation and Land Management

BIODIVERSITY IN THE NORTHERN AGRICULTURAL REGION

CURRENT STATUS

CURRENT MANAGEMENT

REGIONAL OPPORTUNITIES

THREATS TO BIODIVERSITY

BIODIVERSITY IN THE NORTHERN AGRICULTURAL REGION

This section considers the current state of knowledge and management of biodiversity in the Northern Agricultural Region (NAR). Further, it identifies the issues and threats affecting the conservation of biodiversity in the region.

It is important that there is a clear understanding of the term biodiversity:

Biodiversity *- the variety of lifeforms; the different plants ,animals and micro-organisms; the genes they contain; and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecosystem diversity.*

There are many reasons for conserving biological diversity and they can be grouped under two basic principles. The first principle is ethical. This generation has a responsibility to allow future generations at least the same richness of biological resources and opportunities as we now enjoy. The second principle is practical. Biological diversity supports human survival and enjoyment in many ways, notably through food, health and industry, and by providing basic life support systems without which we would not survive.

The NAR is biologically diverse and varies from areas along the central west coast which are still relatively well vegetated with native bush, to areas in the north and east which are extensively cleared and where threats to remaining biological diversity are more readily apparent. Our knowledge of the biodiversity of the region and its values at a local, state and national level is variable with most knowledge linked to centres of known conservation value, such as the Mt Lesueur and Eneabba areas that have been the focus of considerable scientific research. Elsewhere, few systematic studies have been conducted and the information that is available is limited in both quality and quantity. This situation has implications for the way that biodiversity conservation can be achieved and managed in these different areas of the NAR.

CURRENT STATUS

VEGETATION AND FLORA

Vegetation Systems

The NAR displays a complex mosaic of different vegetation types with frequent and continuous changes in structure and floristic composition. This mosaic and complex structure shows a strong relationship to moisture availability as determined by soil type, geology, and rainfall.

The NAR fits entirely into the South-west Botanical Province as defined by Beard, 1979. The South-west Botanical Province is further divided into eight botanical districts, 4 of which occur within the NAR. These include almost all of the Irwin Botanical District and the northern parts of the Avon, Drummond and Dale Botanical Districts. Drummond and Dale are sub-districts of the Darling Botanical District.

The two most extensive botanical Districts in the NAR are the Irwin and Avon. The Avon Botanical District is underlain with rocks of the Yilgarn Block and the Irwin by the geological feature known as the Perth Basin. Both the Irwin and the Avon Botanical

Districts are separated from the Darling Sub-districts (Drummond and Dale) by changes in vegetation due to an increase in rainfall.

The Avon District is described as consisting of gently undulating country with a general catena of Casuarina thickets on residual sandplains of higher ground, woodlands of *E loxophleba* (york gum) and *E salmonopholia* (salmon gum) on red earths of slopes and halophyte communities along the valley bottoms.

Each Botanical District is divided into a number of lesser unit areas of varying size which are defined as Vegetation Systems:

> "A Vegetation System consists of a particular series of plant communities recurring in a catenary sequence and mosaic pattern linked to topography, pedological and/or geological features."

There are approximately 39 such Vegetation systems in the NAR – 18 in the Irwin Botanical District, 11 in the Avon Botanical District, 8 in the Drummond Sub-district and 2 in the Dale Botanical Sub-district (Map2).

Vegetation Communities

The key vegetation formations in the NAR include shrublands, woodlands, granite outcrops and halophyte/saltlake complexes. Before European clearing, the Irwin Botanical District was 81% kwongan shrubland, 14.3% *Acacia* scrub and 2.5% *Eucalyptus* Woodland. The Avon Botanical District was 34% kwongan.

Scrubland (Kwongan)

Kwongan is predominately a shrubland vegetation type (+ 1m tall) occurring on sandplain, either lateritic sands or coastal heath sands. It is floristically rich and fairly uniform in overall structure. Kwongan actually occurs over a wide range of climatic, landform and soil types throughout the NAR and across many of the 39 vegetation systems defined by Beard.

Kwongan in the NAR consists of:

- Low shrubland

Scrub-heath with scattered taller shrubs and a mixed composition of Proteaceae and Myrtaceae that is common in the West Midlands and Greenough sub-regions in the Tathra, Marchagee, Mingenew, Yuna and Northampton vegetation systems

- Tall shrubland

Thicket of acacia, casuarina, and teatree as found in the Yarra Yarra sub-region of the NAR and comprising of the Perenjori, Jibberding and Guangan vegetation systems of the Avon Botanical District.

Woodlands

Woodlands in the NAR are commonly associated with drainage lines, lower slopes and heavier red clay/loam valley floor soils. In general they have been extensively cleared for agriculture due to the fertile soils beneath them. Woodlands in the NAR include:

Sclerophyll woodland

An open tree formation with a woody understorey on red loam valley soils. There are three major species; *Eucalyptus loxophleba* (york gum), *E. salmonophloia* (salmon gum), and *E. salubris* (gimlet).

On heavier soils york gum is joined by salmon gum and to a lesser extent gimlet. These form open stands of trees, with york gum and gimlet to 12m and salmon gum to 20m. In small patches york gum may occur only as a mallee of 3 to 5m (Beard, 1976).

The most widespread woodland species of the NAR is york gum. It is usually associated with herbaceous understorey and occurs throughout the Avon Botanical District, especially in the Perenjori and Jibberding Vegetation Systems. Geographically, york gum woodland is a common plant community of the Yarra Yarra sub-region of the NAR, but is also found in the upper Moore sub-region and the eastern edge of the Greenough sub-region.

Due to the extensive clearing of woodlands in the NAR understorey species are not so well documented. However *Acacia acuminata* (jam) is the principle species associated with york gum. Other woodland plants that usually form an open understorey of shrubs include grevillea, oleoria, cassia, phebalium, and templetonia species. The ground flora is sparse although orchids and other herbs are common in late winter and spring.

Other Eucalyptus woodlands

In the southern parts of the Irwin Botantical District and the North-Eastern part of the Drummond and Dale Sub-districts there are patches of marri-wandoo-powderbark woodland on the heavier soils of valley slopes.

The northern range of *E. rudis* (river gum) and *E. gomphocephala* (tuart) occur in isolated pockets of fringing drainage lines (for example, Hill and Moore River) and in the southern parts of the Irwin Botanical District. Although these woodlands are not extensive in the region they are important as they represent the northern extent of these vegetation types, and provide habitats for nesting species such as Carnaby's cockatoo.

Further north into the Tathra vegetation system *E. rudis* gives way to *E. camaldulensis* (river red gum) where it grows in the Arrowsmith and Irwin Valleys and depressions of the Victoria Plain.

Granite outcrops

Granite outcrops occur throughout south-west of WA on the Yilgarn Block where the ancient underlying rock breaks the surface and is exposed due to erosion. In the NAR they are an important biological resource of the Yarra Yarra Sub-region where the Avon Botanical District extends northwards.

Due to their hard, rocky, upland nature granite outcrops were generally not cleared for agriculture. In fact, many larger granite outcrops were protected as key water reserve areas. Subsequently, in much of the eastern portion of the NAR where clearing has been extensive, granite breakaways represent key vegetated islands in an otherwise cleared landscape.

As well as being key vegetation nodes in the NAR, floristicly granite outcrops usually support a different suite of plants as a result of having different geology and soil types, and additional moisture from run-off. Pincushion (*Borya spp*) is a unique ground cover plant of granite breakaways. Tree and shrub species common include *Casuarina, Acacia, Grevillea, Thryptomene* and *Melaleuca spp*.

Examples of granite outcrops in the NAR include Canna Nature Reserve and surrounding private remnant bushland, Caron Nature Reserve and Bunjil Rocks crown reserve.

Saltlakes

In the Avon Botanical District there are extensive natural salt-lake systems, plus new systems that have appeared over the last century following the clearing of lands for agriculture.

There are two major salt lake systems in the NAR. The Yarra Yarra system heads north from Kalannie towards Morawa, then south to Three Springs and Carnamah, and drains into the Yarra Yarra Lakes. A smaller system exists at the headwaters of the Moore River drainage system leading south-west from Latham, Gunyidi and Marchagee.

The vegetation of natural saline areas is patchy and varied. Samphire (*Halosarcia sp*) is associated with ephemeral salt pans of the broad valley floors of the two saltlake systems in the NAR.

Mostly the vegetation of lake systems is a complex of teatree thickets of *Melaleuca uncinata, M. thyoides*, *Casuarina* and *Acacia spp* over an understorey of samphire, saltbush (*Atriplex spp*) and bluebush (*Maireana spp*). Further away from the salt pan, *E. loxophleba* and *A. acuminata* appear sometimes mixed with teatree and saltbush.

Flora

While vegetation systems have been well documented by Beard and others, detailed floristic knowledge in the NAR is incomplete.

The Mt Lesueur/Eneabba/Badgingarra area is renowned as one of two major areas of species richness in WA and has been the focus of a number of site based botanical studies over the last decade or more. These have recorded almost 2000 plant taxa of which about 20% are either geographically restricted or rare.

Griffin and Hopkins (1990) report 821 plant taxa from the Lesueur National Park, representing about 10% of the States known flora and a third of the taxa in the Irwin Botanical District.

The majority of geographically restricted and endemic taxa in the northern kwongan are concentrated in the Lesueur and Eneabba areas, many yet undescribed. Lesueur National Park contains 111 regionally endemic taxa, nine endemic taxa and 7 declared rare flora.

Threatened Flora

Any plant taxa that is threatened with extinction can be declared by the Minister for the Environment under the Wildlife Conservation Act as "rare flora". This declaration bestows special status on these species and they are gazetted as rare plants and can not be disturbed without Ministerial approval. The list of threatened flora is reviewed annually. These plant taxa are categorised as either "**Declared Rare Flora – Extant Taxa"** or "**Declared Rare Flora – Presumed Extinct Taxa"** (not been collected, or otherwise verified, over the past 50 years despite thorough searching).

Declared Rare Flora are allocated one of three categories depending on the degree of threat to their status:

Critically Endangered:

Taxa that are facing extremely high probability of extinction in the wild in the immediate future and are in need of urgent research and/or management actions.

Endangered:

Taxa that are not critically endangered but are facing a high probability of extinction in the near future and are in need of urgent research and/or management actions.

Vunerable:

Taxa that are not critically endangered or endangered but are facing a high probability of extinction in the wild in the medium-term future and are in need of research and monitoring.

A number of other plant taxa have been designated a priority category as their threatened status is under review, particularly as knowledge of their distribution and threats are poorly known. The priority categories are;

Priority One - few, generally less than 5, populations which are under threat and primarily on lands not managed for conservation;
Priority Two - few, generally less than 5, populations with some that are not under immediate threat and are on conservation reserves;
Priority Three - several populations, with some that are not under immediate threat and are on conservation reserves; and
Priority Four - adequately surveyed and considered not immediately threatened but needs ongoing monitoring.

The NAR contains a large number of Declared Rare Flora and priority flora species (Table 1).

Table 1: Status of Threatened Flora in the Sub-regions of the Northern Agricultural Region.

Species Status	Moore River	Greenough	Yarra Yarra	West Midlands	Total Species in the Northern Agricultural Region
DRF - Presumed extinct	3	2	3	0	8
DRF - extant	36	33	36	46	88
Priority Species	228	277	161	237	513

The large number of threatened flora (particularly extant DRF) in the NAR, as indicated in Table 1, provides an illustration of the pressures on species and vegetation communities across the landscape of the region. Further, the size of the priority flora list illustrates the poor level of knowledge for many species.

FAUNA

Vertebrate Fauna

Australia has the worst record of any country for mammal extinctions. Twenty-three native mammal species have become extinct in Australia since the arrival of the Europeans. Many of these extinctions have occurred in the last 30 to 40 years. This amounts to almost 10 percent of the Australian mammal fauna in existence in 1788, and represents just under one-third of all mammal extinctions that have occurred worldwide in the last 500 years. The situation is even more bleak when it is considered that a further ten mammal species have become extinct on the Australian mainland and now only occur on islands.

This picture illustrates that prior to the arrival of Europeans the wheatbelt, including the NAR, had a much richer mammalian fauna. The disappearance of the vertebrate fauna has been linked to the massive clearance of native vegetation, introduction of feral predators (the European red fox and the feral cat), introduction of exotic herbivores that have modified the remnant vegetation, and changes in fire regimes. Feral predators are believed to have had a major role in the disappearance of the "medium – sized" mammals. Programs, such as Western Shield, which target the removal of feral predators have demonstrated recovery of surviving mammal populations.

Though less severely impacted, birds, reptiles, and amphibians have also declined in numbers in the wheatbelt as a result of habitat fragmentation and other post-European impacts. Research has demonstrated that 12 species of non passerines and 29 species of passerines have decreased in range and/or abundance in the wheatbelt as a whole over the last 80 to 90 years, representing 30% of the avifauna of the area. In recent years, there has been evidence that increase in salinisation has reduced the abundance and distribution of some amphibian species.

The fauna of the NAR has not been studied in any detail. Information collected so far for the NAR suggests that despite the considerable extent and diversity of native vegetation present in the West Midlands the vertebrate mammal fauna is considerably less than the recent fossil evidence suggests was present in the area. As indicated by the information presented in Table 2 little systematic survey information is available for the eastern and north- eastern areas of the region.

Studies associated with the State Salinity Action Plan programmed for 1998 and 1999 include the survey of a large number of sites in the NAR east of the 600mm rainfall isohyet. This work will consider vegetation, vertebrate fauna (excluding avifauna), selected invertebrate groups and physical site attributes with the objective of providing quantitative data that can be used to help select catchments with high conservation value and to provided a framework and part of the baseline data for future monitoring. In addition, this work is also designed to have a predictive value in terms of likely occurrence of species.

Table 2: Native Fauna records in selected reserves and area of the Northern Agricultural Region.

	Mammals	Birds	Reptiles	Amphibians	Invertebrates
Lesueur NP (CALM 1998)	15	122 + 30 on coast	48 + 14 additional in nearby areas	9	
Nambung NP, Wanagarren, Nilgen Sth, and Beekeepers NR (CALM 1998)	8	103	15	3	
Coorow Greenhead Road					343
East Yuna Nature Reserve	7	77 (recorded outside reserve)	34	1	
Bindoo Hill Nature Reserve (WAM 1981)	7	55	18	1	
Howathawa Hill Reserve (McFarland 1977)	3	55	12	4	
Inering Bush Management Strategy Study of Remnants (121,000 ha area)	6	73	19	7	
Morawa	3	42	21	6	
Latham	6	49	13	4	

Invertebrate fauna

Little attention has been paid to invertebrate fauna in the region. Two brief surveys along the Coorow-Greenhead Road (Foulds and McMillan 1982) recorded 463 species of invertebrates. Many close associations exist between the large numbers of endemic plants of the northern kwongan and insects and other invertebrates. Many invertebrate species are likely to be unique to the area.

Threatened Fauna

Under the Wildlife Conservation Act, fauna taxa that are rare or likely to become extinct can be declared as "threatened fauna". As for threatened flora, threatened fauna are categorised as critically endangered (CE), endangered (EN), or vulnerable (V). In addition, there are a number of fauna taxa that require special conservation management, and these are declared as "specially protected fauna".

In addition, as for flora a number of other fauna taxa have been designated a priority category as their threatened status is under review, particularly as knowledge of their distribution and threats are poorly known.

The NAR contains a large number of threatened fauna, specially protected fauna, and priority fauna (Table 3).

Table 3. Fauna of the NAR which are threatened, in need of special protection, or a priority species.

Taxa	Threatened Fauna	Specially Protected Fauna	Priority Fauna
Mammals			
Dibbler	EN		
Chuditch	V		
Black-footed Rock-wallaby	V		
Tammar Wallaby			4
Birds			
Western Long-billed Corella	EN		
Carnaby's Cockatoo	EN		
Grey Honey Eater	V		
Malleefowl	V		
Peregrine Falcon		#	
Major Mitchell's Cockatoo		#	
Painted Snipe			3
Freckled Duck			4
Little Bittern			4
Square-tailed Kite			4
Grey Falcon			4
Eastern Curlew			4
Hooded Plover			4
Bush Stone-curlew			4
Reptiles			
Lancelin Island Skink	CE		
Western spiny-tailed Skink	EN		
Woma Python		#	
Carpet Python		#	
Several additional species			#
Invertebrates			
Mogumber Bush Cricket	CE		
Aganippe castellum (a species of trapdoor spider)	EN		
Several additional species			#

The distribution of threatened fauna species in the NAR is not well known. It is possible that further surveys will improve knowledge about their conservation status, and provide a basis for better protection.

Threatened fauna can be utilised as flagship species to promote awareness and protection of biodiversity. To date, there are examples of 2 bird species being utilised as flagships in the NAR.

- Malleefowl (*Leipoa ocellata*). Habitat fragmentation and predation by foxes is believed to be responsible for the disappearance of malleefowl from much of the wheatbelt. Less than 1% of chicks are believed to survive. Foxes, feral cats, and birds of prey take a heavy toll on young birds, and to a lesser extent, adult birds. It has been shown that up to 80% of young birds are taken by foxes within two weeks of hatching. A number of community groups have been active in promoting Mallefowl conseravation and the protection of Malleefowl habitats in WA and there are 2 active groups in the NAR - the North Central Malleefowl Preservation Group and Morawa Malleefowl Preservation Group. Activities have included coordinated fox baiting programs to coincide with chick hatchings.

- Carnaby's cockatoo (*Calyptorhynchus latirostris*). Carnaby's cockatoo has been on a steady decline over the last 50 years, and has disappeared from much of its breeding range over the last 20 years. This has been partially attributed to an increase in Galah populations as a result of the increased availability of grain and water. The two species compete for nesting hollows, with the Galah often displacing the nesting attempt of the Carnaby's cockatoo. The invasion of feral bees has also reduced the number of nesting hollows available. In addition, feral cats are known to take a significant number of nestlings. The Coorow community has promoted the Carnaby's cockatoo to achieve a number of biodiversity plantings in the Shire that have included species that will produce nest hollows and also food species of the cockatoo.

SPECIAL HABITATS

Wetlands

Wetlands present particular management problems for a number of reasons. They are almost always low in the landscape and are, therefore, affected by hydrological processes and land use in their catchments. There are few wetlands in the conservation reserve system. For those wetlands that are, much of the catchment is managed by private landholders and for purposes other than nature conservation.

There are a number of significant wetlands in the NAR. Some fresh water systems are being impacted by threats such as salinisation of inflow, eutrophication, excessive inundation, water diversion, vegetation clearing, and grazing.

Currently there is only limited biological and ecological information on wetlands, lakes, estuaries, rivers and vegetated springs in the NAR.

The "Directory of Important Wetlands in Australia" produced by the Australian Nature Conservation Agency (ANCA) identifies the following wetlands in the NAR as being of significant biodiversity value:

- Hutt Lagoon System, as an example of a coastal brine lake.
- Lake Logue-Indoon System, as an example of a suite of linked seasonal freshwater/brackish basins that occur in the bioregion.
- Lower reaches of the Murchison River, as an example of permanent river pools set in a long, narrow, steep-sided gorge.
- Lake Thetis, as an unusual wetland type and one of few lakes where both submerged benthic microbial mats and developing microbial structures occur.

A report, "Ecological Assessment of Wetlands in the System 5 Region" by the Semeniuk Research Group for the Conservation Council of WA identified 19 suites of ecologically important wetlands in the northern sandplains. The ten wetlands areas of highest biodiversity value were the Hill River Estuary, Irwin River Estuary, Jurien area, Minyulo area, Arrowsmith area, Leaman area, Lake Garaga, Minyulo area, Nambung area, and Indoon area.

Since 1994 a "Monitoring of River Health" project has been in progress in WA. This project incorporates sites within the NAR. The initial phase of this work focused on the development of bioassessment models and has now extended to the applied use of these models.

The NAR appears to be a transition zone between a richer northern aquatic fauna and a more depauperate, patchy southern aquatic fauna. From work completed, river health in the NAR is below reference quality due to the accumulated impacts of grazing, erosion and in some areas, salinity. These impacts are severe in some locations. Areas that have been identified as particularly worthy of protection for remaining conservation values include the downstream portions of the Hill and Hutt Rivers.

Wetland studies associated with the State Salinity Action Plan will be conducted in the NAR in1999. This work will focus on wetlands of highest conservation value in the area east of the 600mm rainfall isohyet and will consider vegetation, aquatic invertebrates, waterbirds and water chemistry. Salinised wetlands will also be included to determine what fauna and flora is likely to persist in areas that become affected by salinity in the future.

Threatened Ecological Communities

Threatened ecological communities are those communities which have been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution. Further, the community is in danger of significant modification or destruction over its range, or is already severely degraded throughout its range. These communities would face threats such as general pollution, changes induced as a result of introduced animals, competition and displacement of native plants by introduced species, hydrological changes, inappropriate fire regimes, diseases resulting form introduced micro-organisms, and direct human exploitation and disturbance.

No ecological communities in the NAR have yet been identified as threatened. However, it is likely that following adequate surveying that several threatened communities will be identified. CALM is currently undertaking investigations of possible threatened communities in the NAR.

Other Habitats of Significance

Up-land areas

Up-land areas in the NAR such as the Billeranga Hills, Inering System, Moonagin System, Moresby Range, Koolanooka/Bowgada Hills and the Yandanooka Hills are all key vegetation systems that require coordinated management and protection.

These up-land areas often represent old relic vegetation associations that have not been exposed to the same extensive soil erosion as surrounding lower slopes and valley floor plant communities. As a result, they often contain high numbers of threatened flora, and in many cases are the only remaining examples of particular vegetation associations.

Most remnants of these vegetation systems are not in conservation reserves and are exposed to stock grazing, competition from weeds, feral animals, and other degrading factors.

Salmon gum woodlands

Due to the fertile soils beneath salmon gum and gimlet woodlands in the NAR they were selectively cleared when the region was first developed for agriculture. There are now few good quality large salmon gum remnants remaining in the NAR either in conservation reserves or on private property.

Salmon gum and gimlet woodlands that do persist are small, isolated from other bushland, and usually suffer from a large boundary to area ratio (edge effect). In addition, they are commonly weed infested, exposed to grazing from stock and other feral animals, exposed to altered fire regimes, have a limited natural understorey, and are not naturally regenerating. Of great significance to the integrity of biodiversity in salmon gum woodlands is their topographic location in clay/loam valley floor soils where they are most at risk from rising saline water tables.

There is a major opportunity for the NAR community to recognise the sense of place and biodiversity value that salmon gum and gimlet woodlands provide, and to undertake conservation actions.

COMMERCIAL ACTIVITIES

Wildflower Industry

Some 80 wildflower species are commercially exploited by the wildflower industry in the NAR and this includes flowering stems, fruit, branches, leaves and seeds.

The wildflower industry in the NAR is based primarily on vacant crown land and operates all year round. The NAR includes two primary areas of commercial wildflower activity. First, the northern sandplain that extends from Cervantes in the south to the northern boundary of the NAR and up to approximately 100km inland from the coast. Second, the pastoral/wheatbelt area that commences some 100km from the coast and includes the remainder of the NAR.

Figures from 1997 details 87 licensed crown land pickers and 69 licensed private property pickers working in the NAR. However, there are other crown land pickers currently licensed elsewhere in the state who also pick seasonally in the NAR. Traditionally the northern sandplain has been heavily exploited by the wildflower industry. For example, one of the key species taken is *Banksia hookeriana* of which at least 1.4 million flowering stems were taken from crown land in 1996.

Collection of flora from the wild has obvious implications for biodiversity in that species may be threatened by overpicking or associated impacts such as disease introduction. Licensing and sustainable management of the industry is the responsibility of CALM. The illegal taking of wildflowers from conservation reserves and other areas excluded by license conditions is a key management concern. Unmanaged, this activity can lead to the severe decline of species and their loss from the trade (at least from crown land), as has been the case already for many species in the south of the state.

The seed industry is quite active particularly in the eastern areas of the NAR. There is currently very little information on the value or quantity of seed that is exported as export license are not required from Environment Australia to export seeds overseas.

Apiary Industry

The northern sandplain from Lancelin to Dongarra is the largest annual source of honey for the WA apiary industry. The combination of a mild climate and good pollen and nectar producing plants (particularly *Dryandra sessilis* and *Hakea trifurcata*) makes the area one of the best for beekeeping in the state. Annual honey production accounts for some 52% of the States honey production. Much of the beekeeping activity occurs on vacant crown land or conservation reserves through this area. In particular the Beekeepers Nature Reserve is a key resource.

Beekeeping operations on crown land are managed by CALM. This includes the allocation of sites and the establishment of standards for access and site management.

Access for beekeeping activities, especially during winter months, has the associated risk of introduction of *Phytophthora* disease from other areas where apiarists have been operating.

Some research has been conducted into the impacts that honey bees have on native flora and fauna. No conclusive results are available. This area of research requires further investigation given the scale of the industry on vacant crown land and conservation reserves in the west midlands, and the significant biodiversity values of this area.

CURRENT MANAGEMENT

CONSERVATION

Conservation Reserve System

Protection of biodiversity through the establishment of reserves is the strategic approach to nature conservation in Western Australia. This is achieved through an integrated system of conservation reserves appropriately managed and broadly representative of the landforms, marine and aquatic systems, biogeographic districts and biota of Western

Australia. A reserve system must also include special areas to encompass rare species and ecosystems, and unique or spectacular landforms. This approach aims to maintain habitat, evolutionary processes and ecological support systems that will maximise the long-term persistence of species and communities.

The establishment of a comprehensive, adequate, and representative (CAR) conservation reserve system in the NAR is incomplete. Bioregions, as recognised in the Interim Biogeographic Regionalisation of Australia (IBRA), are utilised nationally to assess representativeness of the reserve system (Map 1). Information on the representativeness in the reserve system of each vegetation type in the IBRA Regions is available.

The majority of the bioregions in the NAR are poorly represented in conservation reserves (Table 4). In many areas of the NAR there are few conservation reserves, and those that exist are very small (less than 500 hectares) which impacts on their ecological integrity. The inadequacies in the reserve system are particularly apparent in the eastern section of the NAR (Map 2).

Table 4 Representativeness of vegetation types in the conservation reserve system for each IBRA Region in the Northern Agricultural Region.

IBRA Region		Number of Vegetation Types that are <10% reserved	Number of Vegetation Types that do not occur in reserves	Total of Vegetation Types under-represented in reserves	% of Vegetation Types in IBRA Region under-represented	Total of Types in IBRA Region within NAR
Avon Wheatbelt	AW	90	38	128	84	152
Murchison	MUR	36	73	109	93	117
Carnarvon	CAR	44	52	96	86	112
Yalgoo	YAL	26	31	57	89	64
Geraldton Sandplains	GS	36	19	55	65	85
Jarrah Forest	JF	Data incomplete				
Swan Coastal Plain	SWA	25	14	39	68	57
TOTAL FOR NAR		**62**	**33**	**95**	**57**	**166**

Terrestrial conservation reserves in WA are vested in the National Parks and Nature Conservation Authority (NPNCA) and managed by CALM. Categories of conservation reserves in the NAR are:

National Parks

National Parks are for wildlife and landscape conservation, scientific study, preservation of archaeological, historical or scientific interest and enjoyment by the public. They have national or international significance for scenic, cultural or biological values.

Conservation Parks

Conservation Parks have the same purposes as national parks, but they do not have the same national or international significance. They have significant local or regional value for conservation and recreation.

Nature Reserves

Nature reserves are for wildlife and landscape conservation, scientific study and preservation of archaeological historical or scientific interest. Recreation which does not harm natural ecosystems is allowed.

There are currently 8 national parks, 1 conservation park, and 175 nature reserves in the NAR (Table 5). The distribution of these conservation areas is inconsistent across the landscape of the NAR (Map 2). For example, in the West Midlands the conservation estate is the most comprehensive with the Shire of Dandaragan containing some 30 nature reserves (49,211 ha) and 5 national parks (65,507 ha), or 17.6% of the shire area. On comparison, only 0.2% of the Shire of Perenjori is conserved in 8 small nature reserves, five being less that 200 ha in size. Table 5 illustrates the disparity in distribution of conservation reserves across the NAR.

Table 5 Conservation estate in the Northern Agricultural Region

Shire (Area, hectares)	Reserve Type	Reserve Name	Area (hectares)	Total Area and % of conservation estate in the Shire
Carnamah	National Park	Tathra	4 312	
(286 940 ha)	Nature Reserve	Beekeepers	30 000	
		Lake Logue	5 037	
		Other	12 084	
	Other	Stockyard Gully	1 385	52 818 (18.4%)
Chapman Valley	Nature Reserve	Wandana	54 821	
(396 565 ha)		Other	2 913	57 734 (14.6%)
Coorow	National Park	Watheroo	13 312	
(424 583 ha)		Lesueur	13 494	
		Alexander Morrison	8 501	
	Nature Reserve	Pinjarrega	18 221	
		Beekeepers	10 000	
		South Eneabba	5 082	
		Other	4 310	72 920 (17.2%)
Dalwallinu	Nature Reserve	Other	7 735	
(723 681 ha)				7 735 (1.1%)
Dandaragan	National Park	Watheroo	17 850	
(668 507 ha)		Nambung	18 362	
		Lesueur	13 493	
		Drovers Cave	2 681	

		Badgingarra	13 121	(9.8%)
	Nature Reserve	Beekeepers	5 063	
		South Beekeepers	10 841	
		Wanagarren	10 994	
		Coomallo	8 815	
		Namming	5 432	
		Other	8 066	(7.4%)
	Conservation Park		2 369	
	Other		348	117 435 (17.6%)

Gingin	National Park	Moore River	17 540	
(315 560 ha)	Nature Reserve	Yeal	10 962	
		Boonanarring	9 250	
		Nilgen	5 508	
		Moore River	4 722	
		Other	1 293	
	Other		114	49 389 (15.7%)

Greenough	Nature Reserve	Burma Road	6 889	
(177 404 ha)		Other	284	7 173 (4.0%)

Irwin	Nature Reserve	Beekeepers	23 000	
(238 186 ha)		Yardanogo	6 591	
		Other	194	29 785 (12.5%)

Mingenew	Conservation Park	Coalseam	754	
(194 452 ha)	Nature Reserve	Other	350	1 104 (0.6%)

Moora	National Park	Watheroo	13 312	
(373 148 ha)	Nature Reserve	Other	1 097	14 404 (3.9%)

Morawa	Nature Reserve	Other	2 101	
(341 836 ha)	Timber Reserve	Kadji Kadji	26 338	28 439 (8.3%)
	(Pastoral)			

Mullewa	Nature Reserve	Urawa	8 784	
(1 076 999 ha)		Other	5 608	14 391 (1.3%)

Northampton	National Park	Kalbarri	183 004	
(1 354 323 ha)	Nature Reserve	Other	900	183 904 (13.6%)

Perenjori	Nature Reserve	Other	1 513	1 513 (0.2%)
(833 452 ha)				

Three Springs	Nature Reserve	Other	7 207	7 207 (2.8%)
(258 882 ha)				

Victoria Plains	Nature Reserve	Other	1 042	1 042 (0.4%)
(255 291 ha)				

Management of Conservation Reserves

Management of conservation lands by CALM is undertaken according to government policies, relevant legislation and as specified in management plans of the particular land approved by the NPNCA. CALM also manages land in the absence of Management Plans under section 23 of the CALM Act 1984. Interim Management Guidelines (IMG's) for the protection of flora and fauna and other values provide the basis for ongoing operations in such areas. Current management plans and IMG's in the NAR are:

- Nambung National Park, and Wanagarren, Nilgen, and South Beekeeper Nature Reserves Management Plan 1998-2007.
- Lesueur National Park and Coomallo Nature Reserve Management Plan 1995-2002.
- Watheroo National Park IMG's
- Kalbarri National Park IMG's
- Burma Rd Nature Reserve IMG's
- Lancelin and Edward Island Nature Reserves IMG's

An action of the Salinity Action Plan is to "ensure better retention and better management of remnant vegetation on crown land including conservation reserves. CALM has commenced a program to rehabilitate disturbed and degraded sections of all conservation reserves and crown remnants in the NAR.

Wildlife Conservation and Protection

Under the provisions of the CALM Act 1984 and the Wildlife Conservation Act 1950, CALM is responsible for the conservation and protection of flora and fauna in Western Australia.

Though the protection and conservation of wildlife is a key element in any area management plan, specific wildlife management programs and species recovery plans are written for critically endangered and specially protected flora and fauna. In the NAR there are two significant wildlife management programs in operation:

- Moora District Rare Flora Management Plan.
- Geraldton District Rare Flora Management Plan

In addition, interim recovery plans addressing threatening processes that require urgent attention have been prepared for 4 critically endangered plant taxa in the NAR and a number of others are in preparation.

Interim recovery plans are operative for two fauna species that are only known from island nature reserves in the NAR. These are the Lancelin Island Skink and the Dibbler, known from Whitlock and Boullanger Islands off Jurien.

CONSERVATION OUTSIDE THE RESERVE SYSTEM

Role of Remnant Vegetation

There are many areas of land outside of the conservation reserve system that can make a substantial contribution to nature conservation. These include Crown reserves that are

managed for other purposes, unmanaged reserves, farm remnants and other undeveloped private land.

Remnant vegetation refers to patches of natural bushland that remain in the landscape after clearing occurs. These patches can be small or large, they may be present as narrow strips or only as scattered trees and they can be healthy or degraded. In some areas road reserves can be significant remnants in an otherwise cleared landscape. Remnant vegetation provides habitat for surviving populations of both plants and animals and depending on how it is managed can provide for the ongoing survival of plant and animal communities.
Remnant vegetation on farms has an extremely important part to play in the conservation of biodiversity across the landscape. This is particularly so in landscapes where clearing has left little of the native vegetation cover and where the conservation reserve system can not adequately represent the diversity present prior to clearing.

Many of the Declared Rare Flora (DRF) species occur on private land or on crown land not vested for the purpose of conservation. Sixteen percent of the known populations of DRF species in WA occur on freehold land. Efforts to protect farm remnants by landholders are important for biodiversity conservation.

Remnant vegetation on road verges provide a wildlife refuge and corridor that can be extended or enlarged to link isolated patches of farm bushland. The value of roadside vegetation for birds has been well documented, however, information about its value for other fauna requires further examination. The value of any roadside vegetation as a refuge and corridor depends on its width, length, location, habitat value, floristic diversity and condition.

Remnant vegetation has a significant role in achieving sustainable agricultural development. Remnant bushland can provide hydrological stability, wind erosion control and habitat for natural pest control species.

Remnant bushland is also valued for the "sense of place" and aesthetic benefits that it brings to individual properties and the region as a whole.

Distribution of Remnant Vegetation

As a result of extensive land clearing and the scarcity of remnants in the NAR, all quality remnants are potential sites for biodiversity conservation. Remnant vegetation on freehold land comprises 7% of the region (Table 5). Substantial areas of remnant vegetation remain in the west midlands, but little remains in eastern areas. For example, Peronjori, Mingenew, and Northampton shires have less than 5% remnant vegetation remaining, and those with less than 10% include Chapman Valley, Greenough, Mullewa, Morawa, Dalwallinu, Moora, and Victoria Plains. Further, these shires have little land reserved in the conservation estate so these small percentages of remnant vegetation on freehold land could be extremely significant and of great biological value. At present few of these remnants have been surveyed and their condition and integrity is not known.

It should be noted that in general shires that incorporate a section of the West Midlands sub-region have a high percentage of remnant vegetation remaining, however, the true area of remnant vegetation remaining in the eastern section of these shires reflects the situation for shires with less than 10% remnant vegetation.

Table 5 **Area of remnant vegetation in all shires of the NAR, excluding vegetation on crown lands and pastoral components of the shires.**

Shire	% Remnant Vegetation
Carnamah	15.19
Chapman Valley	8.15
Coorow	12.91
Dalwallinu	7.39
Dandaragan	22.34
Gingin	26.80
Greenough	8.04
Irwin	20.74
Mingenew	4.92
Moora	5.55
Morawa	7.72
Mullewa	8.99
Northampton	4.97
Perenjori	3.41
Three Springs	11.83
Victoria Plains	7.82

REGIONAL OPPORTUNITIES

Management mechanisms for remnant vegetation

Key management mechanisms for remnant vegetation outside the conservation reserve system available to land managers include:

- Land for Wildlife
- Bushcare and other programs under the Natural Heritage Trust
- State Revegetation Scheme
- State Remnant Vegetation Protection Scheme (RVPS)
- Private conservation covenants
- Land acquisition – purchase for inclusion in the conservation reserve system

There has been an increasing interest in the Land for Wildlife scheme in the NAR since its launch in February 1997. As at September 1998, there is 16 properties registered in the NAR, with approximately 5270 hectares of remnant vegetation covered by the scheme.

From a statewide perspective, the Remnant Vegetation Protection Scheme has been poorly subscribed to by landholders in the NAR. In the period between 1990 and 1997 there were a total of 818 application to the RVPS in WA. Only 95 (11.6%) of these applications have come from the NAR.

Re-establishment of native vegetation

Re-establishing native vegetation does have the potential to greatly assist in biodiversity protection. Re-establishment of native vegetation refers to revegetation that:

- Utilises a suite of local provenance species preferably sourced from seed collected close to the site to be revegetated.
- Re-establishes original structure by planting different layers of tree, shrub and understorey plants.
- Protects, buffers and increases the overall size of, or links with, existing areas of native bush.

There is currently limited re-establishment of native vegetation in the NAR. Incentive schemes should ensure that re-establishment of native vegetation increases throughout the region.

Revegetation with commercial species

Currently there are four species that provide commercial options for revegetation in the NAR. These are maritime pine *(Pinus pinaster)*, oil mallees, Broombush *(Melaleuca uncinata)*, and sandalwood *(Santalum spicatum)*. As well as the value of the final product, all three species have an integral role to play in controlling ground water recharge and, hence, in the protection of biodiversity values.

A commercial maritime pine program is being developed in the west midlands based on the sandy soils on the Dandaragan plateau. Maritime pine is an economically viable option for farmers in this area. Maritime pine is also commercial option that could be developed in the Moore River and Greenough subregions, in the >400mm rainfall sandplain areas.

In the <400mm rainfall sections of the Yarra Yarra, Greenough, and Moore River subregions the oil mallee industry is being developed as a potential commercial revegetation option. Another potential species option for this low rainfall area is Broombush *(Melaleuca uncinata)* for fencing materials and oil production. There has also been some interest in the enhancement of sandalwood on rocky hilltops in the Northampton block.

To ensure long-term on-ground change, revegetation with commercial species needs to be integrated with other on-farm revegetation and nature conservation activities. For example, a combination of commercial revegetation and re-establishing native vegetation can be utilised to protect remnant vegetation at risk from salinity and to create strategic wildlife corridors.

THREATS TO BIODIVERSITY

Size of Reserves

The size, distribution, isolation and small number of conservation reserves in the eastern section of the NAR has significant implications for biodiversity conservation compared to the west midlands where there is substantial areas of conservation reserve and contiguous crown land. Biological diversity is, therefore, highly fragmented across the landscape in the eastern section of the NAR with enormous gaps that can only be filled by remnant vegetation, much of which is not protected from grazing or other threats.

In addition, factors such as the particular size and shape of reserves can make them more vulnerable to disturbance.

Salinity and Waterlogging

The Salinity Action Plan identifies that up to 80% of susceptible remnants on farms and up to 50% on public lands including nature reserves in the Agricultural Region could eventually be lost to salinity. This is a major threat to the biodiversity of the wheatbelt and presents a particular risk to small nature reserves and remnants in the NAR that are low in the landscape.

Many remnants located in valley floors and along drainage lines are under threat from salinity and waterlogging. In the west midlands rising water tables are relatively fresh but can seriously affect existing plant communities by enhancing the spread of dieback disease and drowning the habitats of species found in lower lying areas.

Implementation of the State Salinity Action Plan is occurring through a number of CALM managed programs that have a specific biodiversity outcome. These include specific management activities on crown remnants, the establishment of the Land for Wildlife program, wetland monitoring and a comprehensive biological survey of the wheatbelt to identify catchments of high conservation value, and the implementation of protection actions for nominated recovery catchments.

Clearing

Information quantifying the historic rate of clearing for the NAR is not readily available.

The review of state government clearing guidelines in 1997 has resulted in it being more difficult for landowners to clear land. The new guidelines include consideration of the impact of clearing on biological diversity, landscape value, water resources including waterways and wet lands, and land degradation. As a general principle, landholders will not receive approval from the Commissioner for Soil and Land Conservation to clear land where the shire has less than 20% remnant vegetation. For the NAR, the shires that currently have greater than 20% remnant vegetation are Irwin, Carnamah, Coorow, Dandaragan, and Gingin.

Notice of intent to clear figures available from AGWA indicate that during 1995, 715ha were approved for clearing in the northern half of the NAR with 3250ha disallowed. Further, in 1996, 70ha were approved with 5240 ha disallowed, and up to September 1997 applications for 835ha had been disallowed, with no approvals for clearing given.

Dieback

Dieback is a plant disease caused by a group of introduced fungi (*Phytophthora sp).* The fungus lives in the soil and attacks the root systems of susceptible plant species. Many of our native plants are vulnerable, particularly the families of Proteaceae, Myrtaceae and Epacridaceae. The main cause for the spreading of the disease is the movement of infected soil, most often associated with human activity. Once introduced the fungus spreads downstream through drains, swamps and streams. There are many suitable habitats in the higher rainfall parts of the NAR, and off road activities readily have the potential to spread the disease.

The disease is currently limited in the NAR north of the Moore River, however, it is capable of causing significant localised impact at sites which provide conditions suitable to survival and activity of the fungus.

CALM's Moora District Dieback Protection Plan (1990-1994) outlines policies and guidelines for dieback management. The Northern Sandplains Dieback Working Party (representation from mining companies, local authorities and government agencies) co-ordinates efforts to restrict the spread of the disease. To date, little attention has been paid to farming activities that could spread the disease.

Fire

Frequency and intensity of wildfires in natural vegetation can have consequences for the long-term structure and composition of the vegetation. Maintenance of biodiversity is dependent on the management of fire, including addressing issues associated with natural vegetation becoming fragmented and influenced by other land uses such that natural fire regimes have been replaced. Fire management should incorporate consideration of all available information on conservation values likely to be affected and should be addressed on both a local and regional planning context.

Feral Animals

Feral animals such as rabbits, goats, cats and foxes can have a significant effect on biodiversity at both a local and landscape level.

Grazing pressure from goats and rabbits has been documented elsewhere in WA as being responsible for decline in natural vegetation through reduction in plant cover and prevention of regeneration.

Research has shown the devastating role that predation has played in the decline of native fauna throughout WA. In recent years, CALM has demonstrated that control of feral animals can provide the opportunity for the reintroduction of locally extinct fauna. There has been little work to date on coordinated feral animal control programs in the NAR. Fox control occurs in Kalbarri National Park as a part of Western Shield, specifically targeting the protection and recovery of the Black-footed rock-wallaby. The opportunity exists for the extension of the Western Shield program, potentially in collaboration with community catchment baiting program, north of Perth to include sections of the west midlands.

Weeds

About 10% of the scientifically described and named plants in WA have been introduced from outside the state. When these exotic plants become an environmental problem they are called weeds. Weed species are generally opportunistic colonisers that respond and establish successfully in sites disturbed by activities such as stock grazing, fire, vehicle access, and gravel extraction. There are numerous weed species in the NAR.

Weeds species compete with the regeneration of native species. Weeds frequently choke out the understorey and herbaceous ground cover plants, increase fire risk, and replace diverse native plant communities with more uniform weed communities. Once established in remnant bushland it is an expensive and time-consuming operation to remove weeds.

Both environmental and agricultural weeds are a serious threat to the integrity and sustainability of remnant vegetation and the conservation estate in the NAR. Road and rail reserves, and waterways are areas where weeds establish easily and can spread further afield. Currently there is limited weed control activity undertaken by land managers to control weeds in remnant bushland. The region requires a coordinated approach to weed control research and management.

REGIONAL NATURAL RESOURCE MANAGEMENT STRATEGIES

TARGET: BIODIVERSITY

OBJECTIVES

Maintain, and where possible enhance, the diversity of flora, fauna and ecological community values of the Northern Agricultural Region.

Enhance regional community understanding of the biodiversity values of the Northern Agricultural Region, and foster support for the protection of these values.

PROTECTION STRATEGIES

Identify reserves whose integrity and biological values are at risk from recognised threats.

Develop and implement management actions to address threats to biodiversity values in conservation reserves.

Identify key environmental weed species in the region, and document the distribution of these species.

Foster a coordinated approach by all stakeholders to feral animal and weed control according to nature conservation objectives.

Review the current nature conservation reserve system against the criteria for a "comprehensive, adequate and representative" reserve system (CARRS) and seek to address gaps identified.

Ensure that the risk of introduction and/or spread of dieback is a consideration in land use and management planning in susceptible areas of the region by promoting awareness of this issue.

Undertake regional fire management planning with relevant authorities and agencies. Ensure that strategies reflect nature conservation outcomes based on scientific advice balanced by the need to provide community and asset protection.

Determine methods to promote the protection of remnant vegetation, including the use of incentives.

CONSERVATION STRATEGIES

Maintain best practice management for conservation reserves in the region.

Identify high value remnant vegetation for its contribution to biodiversity and encourage protection and appropriate management.

Identify wetlands and ecological communities of significance in the region and facilitate action to protect them from known threats.

Identify key corridors that will establish and maintain links between conservation reserves and other significant areas of native vegetation.

Seek to establish the ongoing protection and enhancement of key native vegetation corridors.

Identify key areas for the re-establishment of native vegetation to complement, protect and enhance the conservation reserve system.

Integrate farm and catchment planning with existing nature conservation reserves and corridor linkages.

Implement management activities that improve the conservation of threatened fauna and flora in the NAR.

Continue to develop the concept of flagship species to foster sound management of remnant vegetation.

EDUCATION STRATEGIES

Enhance awareness and understanding in the rural community of the values and management requirements of remnant vegetation.

Maintain a community education program on the biodiversity values of the region.

Facilitate the ownership of biodiversity by landholders, in particular with on-farm vegetation.

Promote biodiversity values to community groups to encourage incorporation of the management of these values in catchment planning.

Promote and demonstrate "best practice remnant vegetation management" techniques to catchment groups.

Foster community involvement in the development and implementation of policies and plans for biodiversity conservation.

RESEARCH STRATEGIES

Facilitate research and activities that contribute to our knowledge and understanding of biodiversity in the region.

Facilitate biological surveys of remnant vegetation on crown land and private property, in areas where limited scientific information is available.

Collate and assess knowledge of the distribution of species and ecological communities that will assist with the identification of lands that have high conservation value in the region.

Complete mapping of remnant vegetation and wetlands in the region, including documentation of their condition and threats.

Investigate and document information on "best practice management" for conservation management of remnant vegetation in the region.