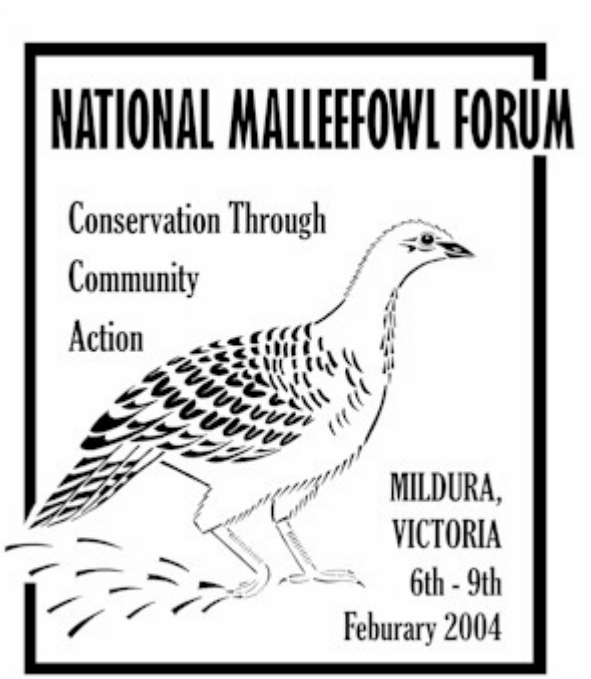

Proceedings of the National Malleefowl Forum

February 2004

Hosted by the Victorian Malleefowl Recovery Group

Parks VICTORIA

Victorian Malleefowl Recovery Group

Murray Mallee Partnership

mallee catchment management authority

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The papers and abstracts compiled in this document were developed for presentation at the National Malleefowl Forum, February 2004. They have not been refereed or edited for inclusion in the Proceedings.

Acknowledgements

The kind and generous contributions of the organisations that provided financial support to the National Malleefowl Forum should be highlighted. The Murray Mallee Partnership, Parks Victoria and the Mallee Catchment Management Authority provided sponsorship equating to the 'gold sponsorship package'. Murray Basin Titanium; Iluka Resources; Mildura Rural City Council and Trust for Nature also provided generous financial contributions. Without the support of all our sponsors we would not have been able to deliver such a successful National Malleefowl Forum.

The Victorian Malleefowl Recovery Group were proud to host the National Malleefowl Forum and wish to thank the contributions made by everyone to ensure the Forum was a success and also well attended and enjoyed by all participants.

The organising committee comprising representatives from various states, government and non-government agencies provided invaluable assistance in developing the programs, organising speakers and assistance throughout the planning and duration of the Forum. Organising committee members included:

Shelley Heron	Conference Facilitator
Andrew Marshall	Parks Victoria
Susanne Dennings	Malleefowl Preservation Group (WA)
Joe Benshemesh	Research Fellow Monash University
Paul Burton	National Parks and Wildlife Service (NSW)
Vicki-Jo Russell	Threatened Species Network (SA)
John Blyth	Catchment and Land Management (WA)
Ross Macfarlane	Victorian Malleefowl Recovery Group
Stuart Pillman	Dept. for Environment and Heritage (SA)
Jason Van Weenan	Dept. for Environment and Heritage (SA)
Karina Mercer	Threatened Species Network (SA)
Raquel Carter	Threatened Species Network (WA)
Peter Copley	Dept. for Environment and Heritage (SA)

Finally, the most important people to thank are the participants of the National Malleefowl Forum.

The proceedings were compiled by Shelley Heron of the Victorian Malleefowl Recovery Group. For comments and copies please contact Shelley Heron:
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Foreword

The National Malleefowl Forum held in Mildura on 6-9 February 2004 was an engaging experience for the one hundred who attended: representatives from each state within the mallee belt of southern Australia. We were exposed to the significance of Malleefowl in Aboriginal mythology as evidenced by the naming of the constellation "Neilloan". There were numerous insights into the effects of fire, loss and fragmentation of habitat, and foxes in influencing long-term outcomes for Malleefowl. The importance of Malleefowl as an indicator for the overall health of mallee habitats became very apparent.

We heard instances of ongoing decline of Malleefowl giving rise to pessimism about the future of this species within isolated remnants. We were also given cause for optimism based on evidence of the species persisting in arid areas of the Centre, in near-coastal areas of S.E. Australia, and points in between. The Malleefowl is clearly a very adaptable animal but one whose long-term survival remains in the balance.

The continuing community passion for the conservation of this "icon" species suggests that no effort is being spared at a local level in order to achieve better outcomes for Malleefowl. It was enlightening and heartening to hear of the work being done by volunteers in each state and region where Malleefowl still occur. There are many spin-offs of community action such as the school education programs, the social interaction, and even employment and investment in small towns.

In some cases, the community effort is obviously well coordinated; such as the Malleefowl Preservation Group in W.A. (MPG) and the Victorian Malleefowl Recovery Group (VMRG). In other cases, local people / groups are working in more isolated circumstances. In every instance, the work of volunteers can contribute towards an improved understanding of the status and risks to Malleefowl. The re-invigorated National Malleefowl Recovery Team can play an important role in developing an Australia-wide picture for Malleefowl based on common standards and practices.

The success of the 2004 National Malleefowl Forum was due largely to the efforts of the VMRG, and the agencies who sponsored the event - Parks Victoria, the Murray-Mallee Partnership, and the Mallee Catchment Management Authority. In particular, Shelley Heron played a crucial role in planning the forum and publishing these proceedings. I believe that the forum and the proceedings represent an important catalyst for the work that lies ahead in the cause of Malleefowl conservation.

Peter Sandell
Chair National Malleefowl Recovery Team

Program
National Malleefowl Forum

Friday 6th February

12.00pm	Poster & Sponsor display setup
4.00pm	Registration Opens
5.00pm	Drinks & nibbles
7.00pm	Close

Saturday 7th February

Session Chair	***Neil Macfarlane, Victorian Malleefowl Recovery Group***	
9.00	Official Conference Opening CMA)	(Joan Burns Chairperson Mallee
9.15	Aboriginal welcome to country	(Brian Hunt)
9.20	Purpose & role of conference	(Denis Saunders)

Role of community groups

9.50	Western Australia	(Raquel Carter, TSN)
10.10	South Australia	(Karina Mercer,TSN)
10.30	*Morning Tea*	
11.00	New South Wales	(Paul Burton, NPWS)
11.20	Victoria	(Neil Macfarlane, VMRG)
11.40	Sum up key issues	(Denis Saunders)
11.50	Questions & discussion	
12.15	*Lunch*	
12.45	Poster presentations	

Threats & Community Action

Session chair	***Peter Copley, Dept for Environment & Heritage, SA***	
1.00	Keynote address	(Joe Benshemesh)
1.40	Foxes	(Jeff Short, CSIRO)
2.00	Fire	(Mike Wouters, Parks Victoria)
2.20	Mallee fires and malleefowl – seeking a balance.	(Paul Seager, NSW NPWS)
2.40	*Afternoon tea*	
Session chair	***Andrew Marshall, Parks Victoria***	
3.00	Fragmentation	(Denis Saunders)
3.30	Mallleefowl chicks in isolated remnants	(Jessica van der Waag, WA)
3.50	Funding & Bureaucratic Impediments	(Julie Kirkwood, TSN)
4.10	"Gnowing is Believing": Understanding Community Group Opportunities and Challenges	(Susanne Dennings, WA, MPG)
4.30	day's wrap-up & discussion	
5.00	close	
5.00	Poster presentations	
7.00	Conference Dinner at Grand Hotel	
	Dinner speaker – Stefano DePieri	

Sunday 8th February

Monitoring methods & protocol

Session chair	***Stuart Pillman, Dept for Environment & Heritage, SA***	
9.00	Why is monitoring important	(John Wright, Parks Victoria)
9.20	Monitoring protocol & procedures	(Joe Benshemesh)
9.40	Malleefowl Conservation on Eyre Peninsula, South Australia	

(Andrew Freeman, Eyre Peninsula, Natural Resource Mgt Group)

10.00 *Morning tea*

10.30 Ordinary People Doing Extraordinary Things - An outline of the processes used by volunteers to collect malleefowl data in northwest Victoria (Ann Stokie, Peter Stokie & Ralph Patford, VMRG)

10.50 Workshop preparation, recap and explanation & purpose

11.30 Workshops – Concurrent workshops leading to recommendations & action

12.30 *Lunch*

1.30 Workshops – concurrent (continue)

3.00 *Afternoon Tea*

3.30 Report back to forum

4.00 Discussion

4.30 Actions & outcomes (Peter Copley, Chair of the Malleefowl Recovery Team)

5.00 Close

Monday 9th February

Up with the birds – Malleefowl Mound Tour

The Victorian Malleefowl Recovery Group will be hosting a field trip to at least one active Malleefowl mound. This trip will be subject to weather conditions. The bus will depart the Grand Hotel at approximately 6.00 am and return prior to lunch (in time for the leisurely luncheon on the Murray trip). Leaving at this early hour is desirable, as it will help avoid the hottest part of the day.

Leisurely luncheon on the Murray River

Cruise on the Murray River to one of Mildura's many wineries, stopping for BBQ lunch and wine tastings.

Details of both of these trips will be available at the Forum.

National Malleefowl Forum 2004 hosted by the Victorian Malleefowl Recovery Group
Proudly sponsored by:

Other sponsors: Murray Basin Titanium; Iluka Resources; Mildura Rural City Council; Trust for Nature

Role of community groups

Conservation through Collaboration

The steps that the WA Malleefowl Network is taking to achieve increased malleefowl conservation

Raquel Carter
TSN Coordinator WA, WWF on behalf of WA Malleefowl Network

Introduction

The Threatened Species Network is a joint program of the Australian Government's Natural Heritage Trust and WWF Australia. WWF works on the conservation of global biodiversity through the development and maintenance of partnerships with government, other NGOs, business and community.

The Threatened Species Network is a program that falls within WWF's global theme of "species conservation" and takes a community-based approach to threatened species conservation on a statewide and national level. In Western Australia, WWF works actively on threatened species conservation in 4 key ecoregions - the Kimberley, Central Deserts, Tropical Marine and South West Australia.

WWF has been committed to malleefowl conservation for over eight years. This has been reflected in various attempts to establish a WA Malleefowl Network, through the work of Threatened Species Network (TSN) coordinators and the provision of TSN Grant funding to community groups including the Malleefowl Preservation Group and North Central Malleefowl Preservation Group. Additionally, malleefowl have been used as a flagship species to engage landholders in remnant conservation through WWF's Woodland Watch Program.

South West Australia – malleefowl in a global biodiversity hotspot

Southwest Australia, ranging from Esperance through to Shark Bay, is globally unique, as it is a 300 million year old landscape. Millions of years of continuous leaching have left the soils of Southwest Australia with typically low nutrient levels. Southwest Australia has particularly rich plant diversity and of 8000 - 9000 plant species, three-quarters are not found anywhere else on earth (*Southwest Australia Ecoregion Initiative*, 2003).

European landuse practices have left much of Southwest Australia, in particular, the wheatbelt, with only scattered remnants of the native vegetation. The conservation of malleefowl and their habitats, much of which is remnant vegetation on private land,

can play a major role in the conservation of native vegetation in this world-class biodiversity hotspot.

Historical and present distribution of malleefowl

In the past (pre 1900's), malleefowl populations were distributed across most of Southwest Australia, mostly in acacia scrub, mallee and sometimes wandoo vegetation communities (Prof. Stephen Davies, personal communication, 4 February 2004). The former distribution ranged from just south of North West Cape to Augusta in the south, and both north and south of the Nullarbor to the Western Australian border (Benshemesh 2000). Today, there are scattered populations across a vast area with the majority of populations outside the current Conservation (Benshemesh 2000). The key malleefowl populations now exist in the Northern and Eastern Wheatbelt, south coast and central wheatbelt regions and a translocated population has been established at Shark Bay (Benshemesh 2000). The extent of malleefowl occurrence and population status east of the clearing line out towards Balladonia (Rangelands) and north of the wheatbelt between the Northern Agriculture Region and Shark Bay is unknown (Benshemesh 2000)

Malleefowl are a "flagship species" in rural communities and over the past few decades there has been a growing interest in malleefowl among landholders and the community. This has lead to an increase in the formation of community groups and on-ground activities with the objective to conserve malleefowl and the associated habitat of this flagship species in Southwest Australia.

Malleefowl as a Flagship Species

There are number of reasons why the malleefowl is an excellent species to engage the rural and broader communities in conservation and natural resource management in Southwest Australia.

Firstly, its distribution covers most of Southwest Australia. It occurs throughout the majority of the wheatbelt and is an excellent flagship for habitat protection, reconstruction and linkage. It is an iconic species and many landholders are passionate about its protection and conservation (Sally Cail. Personal communication. 28 January 2004). It is also an excellent species to stimulate an interest in sustainable land management practices. The broader benefits of protecting malleefowl can include:

- Indirect salinity management – fencing, rehabilitation and protection of good quality remnants can indirectly lead to salinity management (depending on where habitat falls in the landscape)
- Increased funding opportunities that can include fencing remnants with malleefowl habitat (relates to feral animal control, native vegetation conservation and threatened species regional targets)
- Malleefowl have specific habitat requirements that include intact and good condition habitat for breeding. Protecting breeding habitat also assist the protection of other layers of biodiversity.

- Social benefits – creating a basis for community cooperation that can then be used as a support network during difficult times such as drought (this has occurred in northern and southern wheatbelt communities)
- Cross boundary collaboration – as the distribution of malleefowl crosses over regional and state boundaries, its conservation provides an excellent opportunity to drive natural resource management and strategic planning over and beyond these administrative and catchment boundaries and can encourage people to come together on a national level
- Creating a sense of stewardship and ownership of broader biodiversity values in isolated rural communities – this has occurred in Ongerup and in the Wubin/Dalwallinu area in the northern Wheatbelt

The iconic nature of the malleefowl has led to the formation of a number of groups and many individuals have commenced work to conserve the malleefowl in Western Australia.

In the absence of a coordinated support network, this has meant that work on malleefowl conservation tended to be *ad hoc* and poorly communicated. In an attempt to increase collaboration in Southwest Australia and coordinate action, the many players in malleefowl conservation have come together to form what is known as the Western Australian Malleefowl Network.

The Western Australian Malleefowl Network

The WA Malleefowl Network (WAMN) was formed to undertake a strategic approach to malleefowl conservation in Southwest Australia and link efforts nationally.

Although there have been attempts in the past to establish a WA Malleefowl Network, conflicts between groups, communication barriers and the inconsistency of meetings have led to the virtual collapse of the Network.

The re-formation of the network was driven by the -

- Increasing number of malleefowl-focused community groups
- Growing threats to malleefowl and malleefowl habitat
- Increasing interest in research and scientific studies of the species
- Geographical separation between groups
- Large percentage of malleefowl populations that occur on private or leasehold land
- Limitations to resourcing action (funds, coordination, advice and support)
- Need for a support network for community groups
- Need for a pathway for communication and knowledge exchange

The following groups are members of the WA Malleefowl Network:

- Australian Wildlife Conservancy

- Better Bencubbin Progress Association
- Birds Australia, WA
- CSIRO Sustainable Ecosystems
- Curtin University
- Department of Conservation and Land Management
- Dumbleyung Land Conservation District Committee
- Gnowangerup Shire
- Goldfields Naturalist Club
- Gondwana Link
- Kent Districts Hunting & Conservation Group (KDHCG)
- Kent Land Conservation District Committee
- Koorda Land Conservation District Committee
- Malleefowl Preservation Group Inc.
- Mid-West Biodiversity Network
- Mullewa Land Conservation District Committee
- Narembeen Land Conservation District Committee
- Newdegate Land Conservation District Committee
- North Central Malleefowl Preservation Group
- Nulla Nulla Malleefowl Group
- Trayning Land Conservation District Committee
- University of Western Australia
- WWF/Threatened Species Network
- Yilgarn Land Conservation District Committee
- Yongergnow Malleefowl Interpretive, Environment & Research Centre

In the 6 months since the WA Malleefowl Network has been re-established, the Network has produced the following outcomes:

- Agreed objectives for the Network
- Gap analysis and prioritisation of actions in National Recovery Plan from a WA perspective
- Draft Malleefowl Conservation Strategy for Southwest Australia
- Attraction of new members including the Yongergnow Environment Centre

Objectives of the WA Malleefowl Network

- Encourage a state-wide coordinated approach to the conservation and recovery of malleefowl through the implementation of the National Malleefowl Recovery Plan
- Strengthen partnerships and working relationships between groups working on malleefowl conservation issues in WA
- Increase communication between players and increase state-wide awareness of malleefowl activities and projects
- Take a collaborative approach to resources and funding for malleefowl related activities in WA
- Link to regional NRM planning processes and regional groups and ensure that projects that are developed are strategic and in line with NRM Strategy Objectives
- Establish a central database for malleefowl sightings to evaluate the success and progress of the implementation of National Recovery Plan

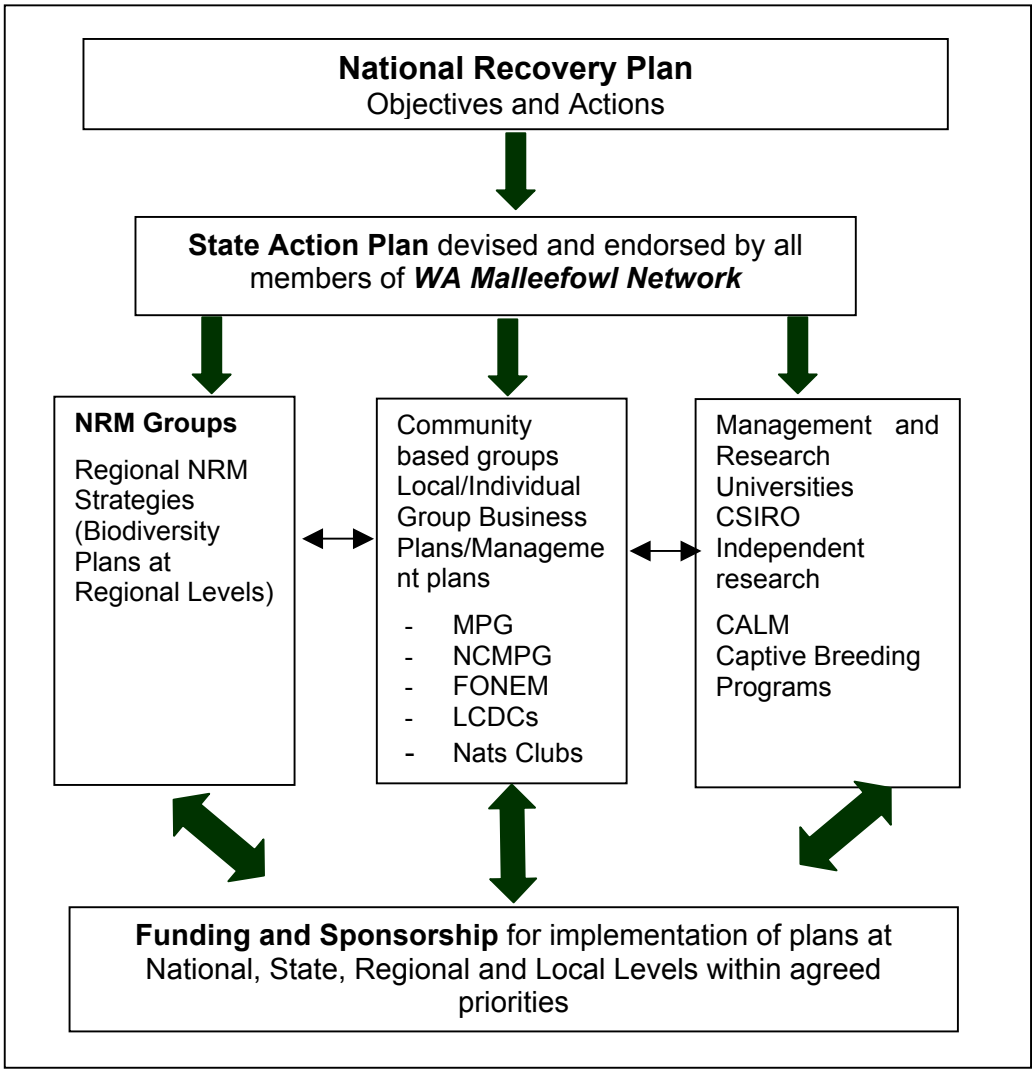
Gap Analysis

During a mini workshop between the Malleefowl Preservation Group, WWF/TSN and the Department of Conservation and Land Management's Threatened Species and Communities Unit with input from other WA Malleefowl Network members, the following actions were identified as priorities in Southwest Australia:

1. Reduce the impact of over grazing in key malleefowl habitat areas across the state
2. Decrease feral animal impacts on malleefowl across the state
3. Include Malleefowl conservation projects in NRM Biodiversity Conservation Investment Strategies
4. Reduce habitat fragmentation through strategic habitat reconstruction in regions
5. Determine survey and monitor distribution and abundance of malleefowl population in WA
6. Develop, maintain and analyse data on a state-wide basis by developing an independent malleefowl database
7. Identify research priorities for application to malleefowl conservation in WA
8. Increase community group and landholder involvement and general public education and awareness for malleefowl and habitat conservation throughout south west Australia
9. Increase state and national communication and partnerships for malleefowl conservation
10. Raise funds for state-wide strategic and collaborative malleefowl conservation and ensure projects are implemented and coordinated adequately

These form the basis of the State Malleefowl Conservation Action Plan.

State Malleefowl Conservation Action Plan



Need for coordinated action (activities in WA)

The development of a State Malleefowl Conservation Action Plan and the WA Malleefowl Network will help to draw groups closer together and ensure that all activities are strategically planned and communicated so that resources and malleefowl recovery can occur in a resource efficient and effective manner. Below are examples of projects that some members of the WA Malleefowl Network are currently undertaking that will impact on the recovery of malleefowl in WA.

WWF Australia

Woodland Watch - A program aimed at improving the conservation status of priority remnants on private land in the WA wheatbelt. To date Woodland Watch has been responsible for a number of covenants and conservation management agreements that include malleefowl habitat. By working with landholders to reduce stocking densities or remove stock completely, in conjunction with assistance in fencing and management planning, Woodland Watch has minimised grazing impacts to malleefowl habitat and/or adjacent areas in the North Eastern Wheatbelt.

Species and Community Program (includes TSN) is responsible for community education events, Acting WA Malleefowl Network Coordinator, grants through TSN community grants, facilitating the development of WA Malleefowl Conservation Action Plan with the WA Malleefowl Network.

Malleefowl Preservation Group (MPG) Inc

Current and past projects include: community education; development of corridor/remnant linkage projects such as Mulga to Mallee link; fox control and other feral animal control programs; community capacity building; malleefowl sighting database, monitoring, hosting/facilitation of research projects, development of partnerships with Gondawana Link project and CSIRO; assistance in the establishment of the Yongergnow Environment Centre are just some examples of the MPG's activities.

North Central Malleefowl Preservation Group

Current and past projects include the fencing of priority remnants that include breeding malleefowl populations, survey and monitoring, community education and awareness (developing interpretative displays) and an annual fox control program. The group has also assisted Project Eden through the provision of 60 eggs to CALM for project Eden (native animal reintroduction program at near Shark Bay) and networking with adjacent Land Conservation District Committees.

CSIRO

CSIRO are working on the Buntine/Marchagee Recovery Catchment project in partnership with Department of Conservation and Land Management. The project is taking a focal species approach to conservation at a landscape scale. This will assist in the conservation of malleefowl through the identification of priority remnants for restoration and enhancement, and corridor and habitat construction to meet the needs of the most sensitive bird species in the catchment.

CSIRO and MPG have plans to work together to develop use the MPG's sightings database and generate a spatial analysis of the distribution and abundance of malleefowl in the southern wheatbelt region with key recommendations for future management.

Birds Australia

BA is currently undertaking annual monitoring of malleefowl populations at Eyre and will be involved in monitoring and survey for malleefowl in northern Wheatbelt with NCMPG

Land Conservation District Committees (e.g. Koorda and Trayning)

LCDCs have commenced annual fox baiting programs, have installed malleefowl signage in conjunction with local authorities and are looking to establish survey and monitoring projects.

Friends of North Eastern Malleefowl (FONEM)

FONEM is a newly formed group that has developed from a past TSN Grant. The group has been responsible for working with local authorities in Bencubbin to erect signs on road verges alerting drivers to "malleefowl crossing" hotspots. This project has stimulated a number of interested landholders and has commenced the collection of sighting information

Gondwana Link

This project is a partnership project between Malleefowl Preservation Group, Greening Australia WA, Fitzgerald Biosphere Group, Wilderness Society, Friends of Fitzgerald River National Park and Australian Bush Heritage Fund. The project aims to restore ecological integrity across Southwest Australia, protect and re-plant native vegetation over 500 km and build a living link that reaches across the continent.

Department of Conservation and Land Management (CALM)

Frankland District of CALM has been completing the following recovery actions for protection of the malleefowl, -
1. Fox baiting
2. Malleefowl mound search work in areas where malleefowl have been historically or recently recorded
3. Researching the effect of threatening processes such as fire regimes, feral animals, weeds, salinity and *Phytophthora* on other threatened species with known distributions for extrapolation to those with lesser known distributions, such as the malleefowl.

At present, the Department's conservation efforts are indirect owing to limited information regarding the occurrence of the malleefowl in the District.

Universities (Curtin University and the University of Western Australia)

Universities are providing the delivery of priority research projects that close the gap in our knowledge of malleefowl biology and their ecological requirements.

Australian Wildlife Conservancy

The AWC is currently de-stocking sheep and goats at Mount Gibson Reserve (138,000ha); the is a major contribution to malleefowl conservation. Malleefowl mounds, fox and cat sightings are being recorded and the AWC are seeking funding for an aerial fox control program. AWC are also keen to establish monitoring programs.

Future Action

During meetings with individual members of the Network, the following actions were highlighted as priority actions in the State Strategy (these priorities are in line with the gap analysis):

- Investigate the impacts of grazing on malleefowl populations on leasehold land
- Projects to minimise the impact of grazing in regions, in particular in the rangelands
- Increased liaison with landholders and leaseholders in key malleefowl breeding areas to increase fencing of priority remnants and reduce stocking densities
- Broad scale fox control program coordinated across regions

- Liaison with landholders to gain increased effort and infill fox haven properties within fox control areas
- Identification of priority research projects
- Continued monitoring and reporting of malleefowl occurrences across the south west
- Capacity building of small groups to become self-sufficient and sustained
- Engaging in the Regional Natural Resource Management Planning and delivery frameworks
- Eliminating communication barriers and creating increased accessibility of information for groups
- Development of a centralised database for the acquisition of malleefowl data to allow for annual reporting against the recovery plan and state strategy
- Ongoing funding for the implementation and coordination of malleefowl activities across Southwest Australia

The next steps for the WA Malleefowl Network?

- Coordination of the development and the delivery of the State Malleefowl Conservation Action Plan
- Strategic use and allocation of funding across the region
- Establishment of a broad scale monitoring program
- Integration of learning's/future directions from National Malleefowl Forum into state, regional and local plans
- Increase two way communication with State and national malleefowl networks (such as the National Recovery Team).

Sourcing funding to employ a State Malleefowl Network Coordinator to continue facilitation of and maintenance of the WA Malleefowl Network

Collaboration is the key to conservation in a world of limited resources and funds.

The need for a Statewide Coordinator has been the highest priority for the Network at the past few meetings. It is clear that the Threatened Species Network Coordinator cannot take on this role effectively in the long-term as the job will require support network for community groups, assistance in the development of strategic project, maintenance good communication flow, responsibility for coordinating monitoring and survey activities and report against the implementation of a state Action Plan in WA and National Recovery Plan. Effectively, the Coordinator will provide the "glue" for collaborative approach to malleefowl conservation in southwest Australia.

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Southwest Australia Ecoregion Initiative. Dir. Sophia Hall. Videocassette. Prod. WWF Australia 2003

Benshemesh. J. (2000). National Recovery Plan for Malleefowl. Department for Environment and Heritage, November 2000.

Community and Conservation: Malleefowl Conservation in SA

Karina Mercer
SA Co-ordinator, Threatened Species Network

Introduction to the Threatened Species Network

The Threatened Species Network (TSN) is a community-based program of WWF Australia and the Australian Government's Natural Heritage Trust. The TSN operates at a national level with co-ordinators across each of the states and territories.

The Threatened Species Network works on threatened species conservation through:

- Providing support and funding opportunities for community organisations to undertake on-ground conservation work for threatened species;
- Empowering the community to participate in research, monitoring, management and education projects for the conservation of threatened species;
- Participating in recovery teams and recovery planning to direct, prioritise and oversee recovery activities; and,
- Working co-operatively with government agencies, scientists, educators, and community groups in achieving species and habitat protection

In SA the TSN is represented on a number of species recovery teams (currently some 20 teams), advisory panels, and other natural resource committees. Recovery teams involve both flora and fauna recovery, and may be either single or multi-species focussed. For example, the TSN works with the Mt Lofty Ranges Southern Emu-wren Recovery Program for conservation of the species and its habitat, both of which are listed at the national level. The TSN is currently represented on the such recovery teams as the Murray-Darling Basin threatened flora (9 species), Kangaroo Island threatened flora (15 species), Mt Lofty Ranges orchids, Arid Recovery project, and the Pygmy Blue-tongue.

Distribution of malleefowl: past & present

Past distribution

Historically, malleefowl were present from the SE corner of the state through the Murray Mallee to north of the Murray River, and westwards into the arid western region of the state. An approximation of the past and present distribution (Cutten 1998) is shown in the Appendix (Figure 1); the National Recovery Plan also provides a similar map (Benshemesh 2000).

Present distribution

While there appears to have been a general contraction in range, it is not the focus of this paper to speculate on this, nor draw conclusions; caution should be applied when making assessments about a species' range and possible population size. When factors such as the degree of monitoring, life history and cryptic nature of malleefowl are considered, it is difficult to determine accurately any changes in habitat area. With

this caveat in mind, regions where a contraction is thought to have occurred are the SE (with no recent records of malleefowl from south of Naracoorte), the Adelaide region, and on the Yorke Peninsula where recent records are confined to the lower region around Innes National Park. Further investigations are required to determine true population trends, and should be approached at a national scale.

Malleefowl are now known from locations across Eyre and Yorke Peninsulas, the South-East, the Murray-Darling Basin, with some records from the Aboriginal Lands and the Rangelands as shown in the Appendix (Figure 2).

Community and malleefowl conservation in South Australia

There are many individuals and/or groups active in malleefowl conservation, a few of which will be discussed. Groups involved include, but are not limited to: Adelaide Zoo, Aboriginal Lands Trust, Conservation Volunteers Australia, Department for Environment and Heritage, Birds Australia, Birds SA (formerly South Australian Ornithological Association), Threatened Species Network, Friends of Parks groups, University of South Australia, and Bookmark Biosphere.

A "snapshot" of malleefowl conservation activities in South Australia

With NRM reform underway in South Australia, there are currently 8 regions that operate within the state. As future funding is tied to each region, this brief overview of current malleefowl conservation activities is presented on a regional basis.

In the Aboriginal Lands, the receipt of funding through the TSN's community grant scheme by the Anangu community on Pitjantjatjara Yankunytjatjara land will continue work aimed at protecting critical habitat for malleefowl populations and to develop appropriate adaptive management methodologies, and to collect ecological data on malleefowl in this area. This project will include monitoring of malleefowl breeding activity, abundance, threat mitigation, habitat use, seasonal activity and dispersal. Computerised mapping (GIS) will be used to assist with the recording, monitoring, evaluation and planning (DEH 2003).

The large park areas on the Eyre Peninsula provide habitat for a number of threatened species including the malleefowl. There has been strong community support for malleefowl through involvement in captive breeding programs. There is monitoring across five grids – Munyaroo, Pinkawillinie and Hincks Conservation Parks, and on Heritage Agreements at Cowell and Lock. These grids were surveyed in 1998, and some resurveyed in 2003, and again in 2004. The Cowell heritage agreement land has been surveyed consistently for nine years (A. Freeman *pers. comm*.).

Monitoring on Yorke Peninsula is restricted to the SE of the Peninsula around Innes National Park.

There is widespread effort in the SA Murray-Darling Basin, with monitoring ongoing in areas such as Danggali, Billiat, and Ngarkat Conservation Parks, and Gluepot Reserve. Community and organisation effort is high in these areas and includes

monitoring by the University of South Australia in Danggali CP, the to-be-formed Friends of Gluepot Reserve and Birds Australia in Gluepot Reserve, and the Nature Conservation Society of South Australia. Previous TSN community grants have assisted such groups as the Lower Mallee Land Management Group to undertake monitoring and feral animal control in keeping with the aim of the objectives in the Local Action Plan for the Murray Mallee region. Since 1999 some 20,000ha has been baited regularly, and monitoring of a Heritage Agreement has been ongoing since 2001. Additional biodiversity benefits are likely as other mallee species benefit from such control programs. It is also likely that some monitoring and activities in other reserves are undertaken by private landholders.

The South-East appears to be experiencing a contraction in range. There have been some opportunistic sightings. Community concern is high, and strong support for malleefowl conservation is evident, for example through the Karoonda Area School adopting the malleefowl as part of its emblem (Appendix - Figure 3). Activities by the Mantung-Maggea Land Management Group have included rabbit and fox control, and fencing off of remnant vegetation as habitat. There appears to have been a reduction in fox and rabbit numbers, which has obvious benefits to both landholders, malleefowl and other associated species. Much of the work is undertaken voluntarily.

In the Mt Lofty Ranges there has been little community-driven activity and sightings of malleefowl are occasional and opportunistic. Records from the Rangelands Integrated Natural Resource Management (INRM) region are few. There are no malleefowl on Kangaroo Island.

Benefits, obstacles, and opportunities for malleefowl conservation in SA

Discussion between the TSN and various individuals and groups involved in malleefowl conservation in SA, and a review of recent correspondence identified a range of issues. The list is indicative of concerns that exist; note that some regions will identify more with some issues than others will, or will have other issues not identified here.

Conservation vs protection – alleviating landholder concerns
There is little doubt that malleefowl are a recognised or "flagship" species. At its most basic level, this recognition is an advantage in promoting awareness not only of malleefowl, but also of the other environmental and species' considerations. In a recent interview with a local media representative, community support was identified as one of the keys to species conservation, and best achieved through ongoing promotion of the particular species or issue. *"Ten years ago, no one in SA knew what a bilby was. Now, through promoting bilby conservation and the issues surrounding it (such as impact of feral species on habitat), the bilby is a well-recognised native species"* (C.Warren, pers. comm.). This applies as equally to the malleefowl as to any other native species.

Additionally, interest in malleefowl has led to further interest in the environment in which it lives. While mallee habitats and ecosystems are already of interest to many people, the malleefowl has been influential in increasing appreciation not just of these ecosystems, but of the diversity of species both floral and faunal that such systems support as well.

have a great respect and affinity for malleefowl, particularly in the rural areas of Australia where the difficulties faced in working the land are perceived to be similar to those faced by malleefowl - both are dependent upon rain and both prosper when it arrives. This affinity and a resulting protectiveness of the birds, is reflected in discussions and landholder

surveys in which farmers express a reluctance to divulge bird and nest locations (Cutten 1998), with anecdotal reports of nests being raided once locations were disclosed to individuals. Feedback from landholder surveys conducted in the SE (NCSSA) and on Eyre Peninsula & Yorke Peninsula (Greencorps) support these concerns. Concerns include people disturbing birds and nests, fear of losing land through compulsory purchases, and fear of de-valuing of land should areas be conserved through fencing, or a heritage agreement or other covenant.

ɔncerns are valid, the value of landholder information (sightings, breeding success, habitat types etc) is important in presenting as complete a picture as possible of malleefowl, where they live (or are absent) and what factors may affect their survival. For example, a patch of a scrub – such as a park – shared by both agency and a landholder with a strong population of malleefowl would be ideal choice to protect from large-scale events such as fire. While the affinity that farmers have with malleefowl is admirable, this protectiveness may present difficulties in assessing malleefowl distribution and numbers accurately. Developing strong relationships between the rural community and individuals in government (whether local or state) or other agencies is essential to securing reliable information and protecting the privacy of both landholder and malleefowl while gathering accurate information about the species' distribution on private land. This information might relate to seasonal resources such as an abundance of lerps, information on the presence of foxes or rabbits, or an opportunity to record other species (such as the Black-eared Miner).

Communicating information

A report by the Land & Water Resources Research and Development Corporation into remnant vegetation in the rural landscape (Lambert 1993) identified some key recommendations in relation to data accessibility and co-ordination, which apply equally in relation to malleefowl conservation. Briefly, these recommendations and their relationship to malleefowl are:

- *The results of scientific research and development into remnant vegetation need to be communicated more effectively to end-users*. Information on the value of remnant vegetation, not just for malleefowl, but for ecosystem benefits such as soil stabilisation, wind-breaks, microclimate creation, a seed source for revegetation, groundwater table maintenance, or simply the inherent value of the system's plants and animals to exist, needs to be communicated.
- *Lack of accessibility to data, need for greater communication – face to face, rather than production of leaflets, brochures and other written information, a central repository for information on scientists carrying out research.* Often, more productive discussions are achieved face-to-face with individuals who are passionate about their subject and can convey that verbally, rather than relying on "yet another brochure" to convey a message. Information needs to be exchanged in an appropriate form and at a level targeted to the audience.
- *Social research into factors influencing landholder attitudes, including the role of incentives and regulations*. Some landholders express an interest in undertaking conservation works on their property but may be limited by external factors such as whether the recent season was good or poor. Funding sources and incentives may not be known, may be poorly understood, or it may be a matter of pride for some individuals that assistance is not needed. There has also been a significant shift in our understanding of ecosystems. For example of the value of remnant vegetation as opposed to policies in the past that advocated the clearing of "scrub" to "improve" the landscape, or the planting of local native vegetation rather than species from other regions or states.
- *Incentives are under-utilised or incorrectly utilised including tax incentives*. There are very real concerns by landholders that their properties may be devalued as a result of obtaining Heritage Agreements or other conservation covenants. There are also concerns that by placing land under conservation covenant it is somehow "lost" to them. Adequate, accurate information to landholders on this and other conservation covenants is necessary to reassure landholders.

Creating and expanding networks, and sharing information

National, state and/or regional networks are valuable on a number of levels. For malleefowl conservation it allows for strategic direction of activities at a landscape level, updates on progress towards the species recovery, progress on activities in relation to the National Recovery Plan, and a forum in which information, successes and failures can be discussed. Consistency also needs consideration at the state and regional level - a national co-ordinating body, a national repository of data (though regions, states or groups could still maintain their own databases), and the ability to seek funding across a broader region, would all present national co-

ordinated recovery actions.

The formation of personal networks is important in contributing to the long-term value that a community may place on a particular species or ecosystem. The social benefits from developing and strengthening these networks cannot be underestimated. Invitations and opportunities to visit other groups in other regions are extended and seized upon, forums can be launched at which similar issues can be discussed and information can be exchanged.

Basic information exchange, such as what's worked/what hasn't is very valuable, and highlights that despite distances between groups some problems and solutions are the same. Training weekends, information exchange, and "hints & tips"-style factsheets are all viable ways in which to train volunteers up to standard methodologies while acknowledging that the engagement of volunteers in malleefowl conservation activities is extremely valuable. Working within the capabilities and "comfort zone" of volunteers is important; technological methods such as palm pilots can be daunting to people more familiar with paper methods. Groups can work in the knowledge that their method is the best for the situation, or at least work with an awareness of some of the issues and solutions which others may have worked through similarly.

A strong social network binds communities, all with the common aim - despite their backgrounds - of malleefowl conservation. Such networks can be the catalyst for continued conservation actions, and encourage involvement from within or between communities. This is evidenced by such active groups and networks that already exist, not just for malleefowl, but for other species also.

Landscape conservation through Heritage Agreements and private land purchases

The landscape changes resulting from agriculture and urban development means that malleefowl exist in a now-fragmented system. Each remnant is significant, and there is a need to augment the existing reserve system with additional reserves or protected areas, to safeguard against events such as fire, disease, etc. Conservation efforts by landholders need to be supported. Private land purchases such as the acquisition of Gluepot Reserve by Birds Australia provide opportunity for the conservation of both species and habitat.

There needs to be greater dissemination of incentives and funding opportunities, to alleviate concerns that exist in this area. Funding opportunities for landholders, individuals, agency and non-government agencies (NGO's) should be noted and distributed. The circulation of information such as avenues from which financial assistance for land management activities – such as fencing or feral animal / plant control which can be costly - can be sought could be distributed via a social or malleefowl network. Personal experiences by individuals, information from NGO's or agency staff, latest developments in conservation covenants etc are all examples that would benefit from distribution to a wider audience.

Landholders undertaking land conservation through Heritage Agreements (HA) or other similar private land conservation schemes are important in augmenting this protection of required habitats. While some landholders may be involved in private land conservation without undertaking a HA or other covenant, there are financial incentives to participate in such schemes. There are also examples of landholders working with agency staff to enable off-site conservation on land that adjoins existing reserves, thus managing the area as a continuous habitat; such co-ordinated strategic efforts are extremely valuable. Fencing of remnant vegetation is primarily used to prevent stock access into remnant vegetation but may also be used to limit vehicular or pedestrian access to important areas.

Concluding remarks in the context of malleefowl conservation in SA

Malleefowl are a well recognised species that people wish to see remain

Simply, people like malleefowl, and it is well recognised as a "flagship" or "iconic" species. Regardless of the use of such catchwords, there can be little doubt that malleefowl – for a portion of the community – represent mallee habitats, working

within environmental conditions, "battlers" through harsh conditions. These are all images with which people can identify in some way. This identification or empathy is a good stepping stone from which greater interest can grow.

There is a need to harness and maintain interest of "the community"
Committed and very active groups involved in malleefowl conservation exist – whether they be landholders, specific malleefowl-oriented groups, broader focus groups like birding organisations, government and non-government organisations. Maintaining the interest of those is important, as is generating interest amongst people who perhaps had not given much thought to malleefowl before. Feedback, support, sharing of information, social activities such as monitoring – all help to maintain that enthusiasm for malleefowl conservation.

There is a need for a co-ordinated scientific approach
While each group, region or state may be involved in malleefowl conservation works, this does not necessarily mean each are at the same level. To address what is a national species, a national co-ordinated scientific approach is required. Scientific research or an approach to management is required; it will be sought by decision-makers, particularly with funding organisations, and it is essential in determining species' survival and recovery.

Community, however defined, can be a strong driving force in malleefowl conservation. Only through community support can conservation, monitoring, and research programs succeed. Only if malleefowl are seen as a national priority can we ensure and personnel required exist to achieve this across a region, state, and country.

Acknowledgements

Images courtesy of VJ Russell, D McKenzie, P Paton, J Bradley, K Mercer & J VanLaarhoven.
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Acronyms

CVA	Conservation Volunteers Australia
DEH	Department of the Environment and Heritage (Australian Government Department)
HA	Heritage Agreement
INRM	Integrated Natural Resource Management
LAP	Local Action Plan
LWRRDC	Land and Water Resources Research and Development Corporation
NGO	Non-government organisation
NCSSA	Nature Conservation Society of South Australia
TSN	Threatened Species Network

Appendix

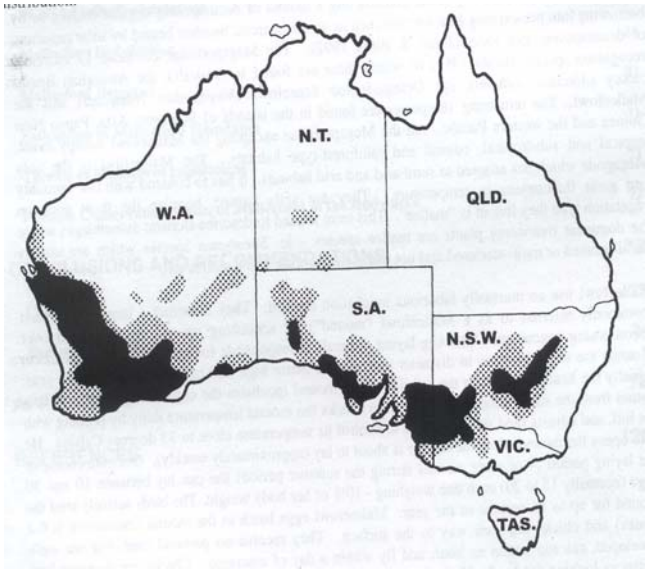

Figure 1. Past and present distribution (Cutten 1998 from Priddel 1989). The solid area represents present fragmented distribution, and the stippled area approximate former known distribution.

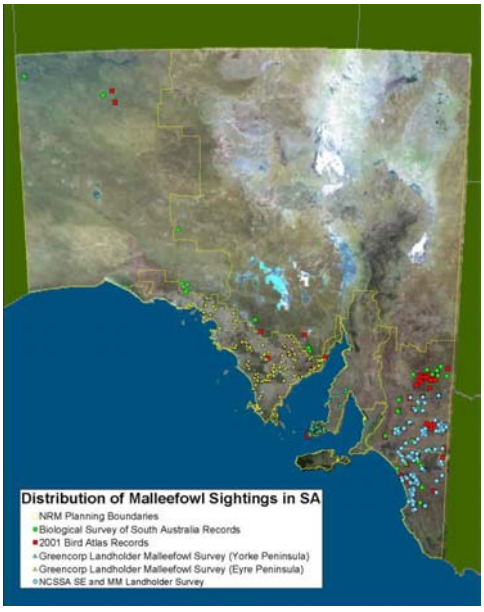

Figure 2. Distribution of Malleefowl sightings in SA. Image courtesy DEH.
Note: the records for landholder surveys on Eyre and Yorke Peninsula are indicative of properties on which sightings have occurred, not individual birds. Image courtesy of DEH.

Figure 3. The Karoonda Area School emblem. Image at www.karoondaas.sa.edu.au.

Excerpt from Land & Water Resources Research and Development Corporation report into remnant vegetation in the rural landscape (Lambert 1993)

It found that national co-ordination between government departments, research groups, conservation groups and landholders was virtually non-existent. It found little evidence of co-ordination at a state level, little between researchers, and almost negligible levels of landholders able to access research bodies though some contact with individual scientists was made.

In relation to funding for remnant vegetation research and development, it found that the levels for this, and ecological research, is low and consistently outranked by funding for research into the productive aspects of agriculture.

The report made several recommendations, which apply equally in relation to malleefowl conservation:

- *The results of scientific research and development into remnant vegetation need to be communicated more effectively to end-users*. The value of remnant vegetation, not just for malleefowl, but for values such as soil stabilisation, wind-breaks, microclimate creation, revegetation seed source, groundwater table maintenance, or simply the inherent value of the system's plants and animals to exist.
- *Lack of accessibility to data, need for greater communication – face to face, rather than production of leaflets, brochures and other written information, a central repository for information on scientists carrying out research.* Often, more productive discussions are achieved face-to-face with individuals who are passionate about their subject and can convey that verbally, rather than relying on "yet another brochure" to convey a message. Information needs to be exchanged, in an appropriate form and at a level targeted to the audience.
- *Social research into factors influencing landholder attitudes, including the role of incentives and regulations*. Some landholders express an interest in undertaking conservation works on their property but may be limited by the season that they have had. Funding sources and incentives may not be known, may be poorly understood, or it may be a matter of pride for some individuals that assistance is not needed. There has also been a significant shift in our understanding of ecosystems, for example of the value of remnant vegetation as opposed to policies in the past that advocated the clearing of "scrub" to "improve" the landscape.
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NSW Malleefowl

Paul Burton
NSW Parks and Wildlife Service

The National Parks and Wildlife Service (NPWS) carry out most Malleefowl research and monitoring in NSW.

While addressing facets or the National Recovery Plan the NSW department has a State Action Plan to aid Malleefowl recovery.

Three main areas in NSW have populations of Malleefowl. The South West Mallee belt North East and North West of Buronga, the Central Mallee region South of Cobar and sections of State Forest near Dubbo.

The NPWS has injected funds during the last few years into a Fox Threat Abatement Plan (Foxtap) and Malleefowl have benefited from theses monies. Monitoring of populations is conducted by air and numbers of breeding malleefowl are determined in annual surveys.

An example is the extensive work carried out by staff at the Buronga office who have been ground and aerial surveying for many years. When the Foxtap program started more nests were mapped to add to the pool but the monitoring of historical populations continued in Mallee Cliffs National Park and Tarawi Nature Reserve.

Although Malleefowl research is conducted by NPWS a number of pastoralists in the South West have instigated surveys in conserved areas of their Stations.

Though controversial to some the Southern Mallee Plain has added to the Reserve system vast areas of Malleefowl habitat with known populations within them. This has been a project coordinated by the Department of Infrastructure, Planning and Natural Reserves NSW.

Several pastoralists have mapped and undertaken private surveys in their reserves and have adopted the birds as their own. Many of the reserves cross over lease boundaries and this has meant a conservation partnership between lessees.

The reserves are fenced, require feral pest control and most importantly are ungrazed by introduced stock. My experiences have shown that these community people are exceptionally proud of their efforts and fiercely defend the birds and nests. Often to the point where the entire family has become passionately involved. The benefits to the environment are significant due to the indicator species we know as the Malleefowl being saved which of course leads to other species survival such as the endangered Pygmy Possums and Mallee Worm Lizards.

Throughout NSW many volunteers carry out work on their land and in areas of the State Forest for Malleefowl.

While we do not have the community network established in several other States in Australia, this is more than offset by the substantial commitment of the NPWS to the Malleefowl and its survival in NSW. This will continue as many staff implement own passion and commitment – a recipe for a substantially bright future for Malleefowl in NSW.

The Role of Community Groups: *Victoria*

Neil Macfarlane
President, Victorian Malleefowl Recovery Group

The subject of this morning's session is The Role Of Community Groups, and we might summarise that by saying that:

- *They get things done, in an organised way, that wouldn't otherwise get done;*
- *They draw attention to, and involve people in, issues that might otherwise be overlooked.*

There has been a long history of community interest in Malleefowl in Victoria, including, from early on the RAOU, and later Sunraysia Naturalists Research Trust at Mildura, the Mid-Murray Field Naturalists in the eastern Mallee, the Friends of Wyperfeld, the Friends of The Little Desert, and other local groups.

Private individuals who have made important contributions to studying Malleefowl and promoting their conservation have included Les Chandler, Keith Hately, Angus Torpey and Wimpey Reichelt.

The evolution of this group, the VMRG, began at the third International Megapode Symposium at Little Desert Lodge, Nhill, in December 1997. Researchers Joe Benshemesh and Paul Burton contacted attendees, and small local groups at Nhill, Ouyen and Mildura, who with the backing of Parks Victoria, Birds Australia and the Threatened Species Network formed a working group to train volunteers to take on the annual monitoring of breeding activity in the 24 research grids located in the Mallee and Little Desert.

The group was formalised and incorporated in 2001 as the Victorian Malleefowl Recovery Group Inc., whose purposes include:

- Monitoring and associated data collection;
- Media and general education; and
- Preparing project proposals and seeking funding.

The group meets 2 or 3 times yearly, including a training weekend prior to monitoring. A committee handles business between times, and ad hoc sub committees handle e.g. safety, planning, newsletter, and this conference.

We have had the indispensable assistance of a part-time co-ordinator since mid 2001, though in this respect we will soon be on our own.

We have a register of 51 paid-up members, including people resident in Melbourne, Geelong and southern centres, as well as those resident in the homeland of the Malleefowl.

VMRG operates with the close co-operation and support of Parks Victoria and the Department of Sustainability and Environment.

Malleefowl

The historical range of the Malleefowl in Victoria included the entire Mallee region, and the northern and western Wimmera to the southern fringes of the Little Desert. More surprisingly, it included much of the North-Central region, almost to Echuca, and through the Central Goldfields to southern outliers in dry mallee woodlands east of Melbourne and as far south as the Brisbane Ranges.

More recently, the Victorian range of the Malleefowl in both Atlases of Australian Birds has remained the same in gross terms – the number of 1-degree grids – as has the breeding range. The Historical Atlas (pre 1901) shows it breeding in 3 grids where it no longer exists.

Today it is largely confined to the non-agricultural parts of the Mallee –Sunset – Hattah – Annuello in the north, Big Desert – Wyperfeld in the west, and Little Desert in the south. Several small reserves harbour populations in the northeastern Mallee, with larger ones in the central Mallee at Wathe and Bronzewing.

For the rest of its range in Victoria, only a tiny relict population remains at Wychitella in the Goldfields of central Victoria.

The most southerly populations had gone by 1880, and almost nothing is known of the habitat that sustained these populations, or connected them to others through central Victoria and the Wimmera to the Mallee (perhaps they were only relicts of earlier dry times). Indeed most populations in the Wimmera and North-Central regions were also likely gone before 1900, though malleefowl hung on till the 1950s at the Whipstick Scrub north of Bendigo, and in the Mallee areas around Wedderburn until the present.

Much of this range may have contained prime Malleefowl habitat. For example, I was shown a site between Quambatook and Kerang, where Malleefowl were present till around 1900. Here mallee sands met pine / buloke and gum woodlands, and riverine woodlands.

Such areas were among the earliest mallee cleared for cropping.

And clearing for cropping has been the principal reason for the contraction of the Malleefowl's range, in northwestern Victoria at least.

Settlement of the Mallee

From the mid-1840s, grazing had taken place, along watercourses, on lakebeds, saltbush plains and wooded grasslands fringing or scattered through the Mallee, though subject to lack of water, drought, and the first scourge of rabbits through the region in the 1870s.

About 1890, it was realised that clearing and cropping was viable in the Mallee, and closer settlement progressed rapidly from Hopetoun and south of Swan Hill. This could only happen with the advent of the railways, and water provided by the Wimmera-Mallee Stock And Domestic Water Supply Channels.

So successful and rapid was this closer settlement that by 1940 (i.e. in 50 years), almost all the sustainable agricultural land in the Mallee was cleared or well on the way to it. This in spite of terrible droughts in 1902 and 1914, the First World War, and the Great Depression of the 1930s.

The last major public allocations were the Soldier Settlement Schemes after the First World War, at Annuello-Kooloonong (close to 100 square km), and the Millewa south and west from Mildura.

I grew up in one of these areas in the 1940s and 50s, and would like to make some observations about how these developments may have affected the Malleefowl, and in fact how the experience there may reflect what happened earlier in other areas.

The first settlers at Kooloonong decided the easiest way to clear the scrub was to burn it – so they started fires which reputedly burned uncontrolled between Kooloonong, Annuello and Robinvale for up to 2 years. Certainly they burnt very extensive areas, to the detriment of Malleefowl (and the chagrin of later arrivals, who had to deal with the dead sticks).

However even with clearing by mallee-roller, fire was involved. No fire brigade, no heavy equipment to make firebreaks, no water, and the best time to burn was a hot day in February when you would get a clean burn that would kill shoots and stumps as well. Obviously many of these fires got out of control too, until there was sufficient clear land around to stop them.

Early photographs attest that this happened because there is hardly a tree to be seen in cleared land and the roadside vegetation has also been burnt to ground level, with only regrowth to be seen.

Within 4 or 5 years, only pockets of unburnt Malleefowl harbour would be left, and the birds themselves were hunted. Hardly surprising that the species disappeared from so many areas.

In the 1930s Depression, drought, economics and changed government policy forced most of the occupiers off these more recent settlements, though their prodigious efforts had already radically changed vast areas of once prime Malleefowl habitat.

Much of the land reverted to the Crown, channel water supply ceased in some areas, properties were leased for annual grazing, and cropping was opportunistic. The terrible drought of the early 40s, and wartime, crippled farming communities.

However, with better years in the late 40s and 50s there was much regrowth of mallee and scrubs in abandoned areas, with Malleefowl recolonising many properties and becoming relatively abundant.

The birds came back!

They then occurred almost continuously from the Murray River floodplain, close to the Wakool junction, to the South Australian border and beyond. We fairly much took them for granted. A big mistake – and from a conservation point of view, an opportunity lost.

With excellent seasons and a booming wheat industry through the late 40s and 50s, land clearing was renewed in a big way in the early 60s.

The Malleefowl were again on the retreat, with the remaining habitat fragmented and increasingly isolated, to the alarm of some landholders and local naturalists.

The Hoare family had purchased a 5000-hectare property at Wandown, between Annuello and Kooloonong. They were so concerned at the effects of clearing that they approached the Swan Hill Shire and Mid-Murray Field Naturalists Club with a view to having 1700 hectares of prime Malleefowl habitat reserved.

The Shire took up the issue with the Fisheries and Wildlife Department, and the field naturalists undertook what may have been the first grid survey of a Malleefowl population. In June 1969 volunteers walked the proposed reserve area, locating, numbering and tagging all mounds encountered. By modern standards it was primitive, but it revealed the quality of the area for Malleefowl, with upwards of 100 mounds identified. This along with bird, plant and reptile lists compiled for the area, led to the purchase of what is now the Wandown Flora and Fauna Reserve by the private M.A. Ingram Trust, and its conversion to Crown Land.

This reserve has now been added to, and there are smaller reserves nearby. All continue to have remarkably healthy Malleefowl populations, though now isolated within vast areas of cleared agricultural land.

But can they last?

The VMRG in its long-term program is monitoring such areas, and others in the much larger natural blocks running from Hattah and the Sunset Country, from Wathe and Bronzewing through Wyperfeld and the Big Desert.

Building on the research of Joe Benshemesh and Paul Burton, and the work of groups such as Greencorps in establishing the grids, our ongoing study gathers data to assess the trends in breeding activity, and therefore population stability and viability. Currently we are monitoring 26 grids and close to 900 mounds annually. Speakers in later sessions will enlarge on this program.

Trends

This monitoring on any scale only goes back to about 1990, which is not a long time in Malleefowl terms. However it seems that populations are relatively stable, though there is concern about the drier Sunset areas, where monitored breeding populations show a continuing decline.

Overall the last 2 seasons have been an intriguing contrast. Season 2002 was a severe drought, with only 8 mounds active out of 878 visited. All of the active mounds were in a narrow strip through three grids, which may have indicated a crucial episode of rainfall in a limited area.

Season 2003 started with widespread general rain, and continued favourably most of the season. How would the previous year's drought have affected populations?

Monitoring in October-December 2003 revealed 108 active mounds out of about 900. That is: in 2002, less than 1% of mounds monitored were active. In 2003, 12% of mounds monitored were active – which is probably as high a rate of breeding activity as we have yet recorded.

That looks good. The breeding population has survived and bounced back. But a closer look reveals something quite startling, in my view.

Of the 108 active mounds, around 80% were found in five grids, with an active to inactive ratio in those grids averaging 30%+, and in one case approaching 50% of monitored mounds.

The story gets curiouser.

The five grids – Wandown, Menzies, Bronzewing and Wathe 1 and 2 – were all surveyed and allocated for closer settlement in the 1920s and 30s, and they were all cleared and farmed to varying extents – that is, cropped and grazed.

Further, they are all adjacent to, or completely surrounded by, farmland, and four are in tiny to relatively small reserves. In fact, they are the isolated reserves, away from the huge public land blocks, but part of the agricultural Mallee.

Menzies block, which was purchased by Trust For Nature, is only about 325 hectares. It was cleared and farmed in the 20s and 30s, again rolled and burnt in the 1960s, is completely surrounded by farmland – and this season has 12 active mounds out of 26!

It is certainly drawing a long bow to read too much into the results of one year's monitoring, but these grids have consistently had a good level of breeding activity, and they are located in areas that are agriculturally productive – that is, better soils. Might they provide some insights into what was prime Malleefowl habitat?

That is, not continuous blocks of dense mallee, however variable, but a mosaic of mallee areas for refuge and breeding, interspersed with woodlands, shrub lands and open areas able to provide a wider range of seasonal foraging and dispersal. We know that was the case in mallee areas with better soils. We know Malleefowl are travellers and survivors, and widespread disjunct populations would be a great insurance against fire, which as we often see destroys populations in dense continuous mallee.

All this suggests we need to think carefully about maintaining the integrity of these small isolated reserves. They may in fact be crucial for understanding and conserving malleefowl.

- Perhaps that is where priority should be given to establishing corridors;
- Where priority should be given to working with landholders;
- Where because of their breeding capacity, and the population's obvious resilience, we should look when restocking other areas.
- Perhaps, in the wider scheme of things, the "inevitable" decline of these smaller areas matters more than most.

Threatened?

Another general issue I would like to comment on is that of how threatened Malleefowl are.

- Nationally the Malleefowl is listed as Vulnerable (National Malleefowl Recovery Plan).
- In Victoria it is listed as Vulnerable (Victorian Flora And Fauna Guarantee Act).
- The fact is that we really do not know. Although they are widely dispersed over much of their original range, they remain an enigmatic species.

It is argued that there are many other more endangered species, or more urgent issues demanding attention and resources. The VMRG argues that if we can sustain viable Malleefowl populations, we are necessarily providing viable habitat for the full range of mallee species, plant and animal.

The Malleefowl is also a truly unique species – large enough, and interesting enough, to be a "feel-good" species which the wider community can get excited about, and which can be used to "sell" mallee conservation as a whole. The Western Australian groups such as the Malleefowl Preservation Group have clearly recognised and acted on this.

Here in Victoria we know that local farmers and communities are proud of and sympathetic towards this symbol. Its wellbeing can be used to promote wider conservation and management initiatives.

Climate Change

Further to this is the issue of climate change. If in fact we are entering a period of rapid climate change, we have even less reason for complacency. Certainly Malleefowl have adapted to a wide range of temperature and rainfall before. But the crucial factors in the posited changes in the near future are:

- Rate of change;
- Seasonality of rainfall; and
- The clearing of former habitat and corridors.

In this context, a 1995 paper by Brereton, Bennett and Mansergh[1] postulated 1 possible scenario, whereby a 3-degree Celsius average temperature increase, a 10% fall in winter rain and a 10% increase in summer rain over several decades would drive suitable bioclimatic conditions for Victorian Malleefowl to the cleared areas of

[1] Brereton, Bennett, & Mansergh. "Enhanced Greenhouse climate change, and its potential effect on selected fauna of south-eastern Australia". In Biological Conservation 72 (1995).

central Victoria. Here, ironically, the only mallee left is in the Wychitella area, where the species is now almost extinct.

Hopefully this speculative analysis will not be realised, or both we, and the Malleefowl, will be in serious bother by then – through no fault of the unfortunate Malleefowl.

Malleefowl Management Issues for Victoria

- Fragmentation of habitat
    - Wildlife corridors – creation and extension
    - Salinity
    - Fire – impacts and management
    - Clearing (including illegal and incremental)
- Climate change
    - Temperature
    - Rainfall (totals, and seasonality)
    - Rate of change
    - Implications and responses
- New monitoring grids
    - In burnt areas of Big Desert Wilderness
    - Wychitella
    - Little Desert
- Private property - relationship with landholders
    - With Malleefowl on their land
    - Adjacent to reserves
    - Possible purchase of further small reserves as available.

VMRG Responses to Action Plans

- Victorian Flora And Fauna Guarantee Act 1988: Action Statement 59. Malleefowl. November 1994, updated January 2000.2
    - Vic. listing – "Vulnerable".
    - Major objective: to increase breeding populations in Victoria to over 2000 pairs over next 20 years.
    - Related VMRG actions
        - Monitoring of grids;
        - Extension of grid system;
        - Liase with DSE and Parks Victoria;
        - Collect Malleefowl genetic material (feathers, scat);

[2] Flora And Fauna Guarantee Act 1988: Action Statement 59. Malleefowl. November 1994, updated January 2000

- Work with other conservation and community groups.

- National Malleefowl Recovery Plan (October 2000)[i]3
  - VMRG, within its limits, is contributing to:
    - Objective 1 – Reducing permanent habitat loss;
    - Objective 4 – Reducing predation - by monitoring and reporting fox activity, and collecting scats for analysis;
    - Objective 5 – Reducing isolation of fragmented populations - by advocacy and supporting local groups;
    - Objective 7 – Reducing road loss – by advocating use of warning signs;
    - Objective 8 – Providing information for regional planning – through our monitoring and advocacy;
    - Objective 9 – Monitoring trends in Malleefowl
    - Objective 10 – Detailing the distribution of Malleefowl in settled areas.

Conclusion

In conclusion, may I say that while "monitoring" may sound "as dry as dust", it is in fact an involving, stimulating activity, and we have no trouble at all engaging enthusiastic volunteers to take up on an ongoing basis.

It is a great reason to go out into the Mallee, to see and learn much, and to do something constructive in a scientific and disciplined way.

References

Brereton, Bennett, & Mansergh. "Enhanced Greenhouse climate change, and its potential effect on selected fauna of south-eastern Australia". In Biological Conservation 72 (1995).

Flora And Fauna Guarantee Act 1988: Action Statement 59. Malleefowl. November 1994, updated January 2000

National Malleefowl Recovery Plan (October 2000)

[3] National Malleefowl Recovery Plan (October 2000)

Threats & Community Action

Community involvement and the National Recovery Plan for Malleefowl

Dr Joe Benshemesh

The National Recovery Plan for Malleefowl (Benshemesh 2000) was commissioned and guided by the by the National Malleefowl Recovery Team with the view of providing a framework for directing conservation of the species over the subsequent decade or so. The plan was funded by the four main public zoos in southern Australia (Perth Zoo, Royal Zoological Society of SA, Zoological Parks and Gardens Board of Victoria, and the Zoological Parks Board of NSW). The recovery plan has two main objectives:

- Secure existing populations, and
- Downlist Malleefowl from Vulnerable to a lower risk category using IUCN criteria

Achieving these objectives requires a range of actions that address the need for both improved management and better information on Malleefowl ecology and threats. The most important of these actions are discussed below. While the ultimate aim is to remove Malleefowl from threatened categories (such as vulnerable and endangered), to do this we will have to demonstrate that the distribution and breeding densities of the species is at least stable across its range over a suitably long period of three generations. While we do not yet know the average generation length for Malleefowl (ie. the average age at which breeding birds are replaced) this may be 10-15 years or even more. Thus, to downlist the species we shall probably have to show its populations are stable for the next 30 years or so.

Community groups and individuals have an important role in the recovery of Malleefowl. Community involvement can substantially reduce the cost of many actions, and thus increase the benefits to Malleefowl that can be achieved from scant funds. Perhaps just as critically, community programs can provide a degree of continuity in field work that is often difficult for agencies to equal. And finally, community groups across Australia have clearly shown that they are capable and willing to undertake conservation works for Malleefowl; in fact the achievement of community groups in recent times in regard to monitoring, education and awareness, and predator control has been remarkable.

Why do we need a Recovery Plan?

A recovery plan was needed for Malleefowl primarily to provide a national perspective for management and research. This national perspective is particularly important for Malleefowl because the species has a wide, scattered and fragmented distribution across Australia. This presents numerous challenges because issues and priorities change across this vast landscape, but it also highlights the need for a national approach so that important issues are identified and addressed within a planned and logical framework.

The other function of the recovery plan is to provide a concise background briefing of Malleefowl conservation issues. As such, the plan is hopefully a useful resource for managers, researchers and community groups, especially in regard to planning work and completing funding applications.

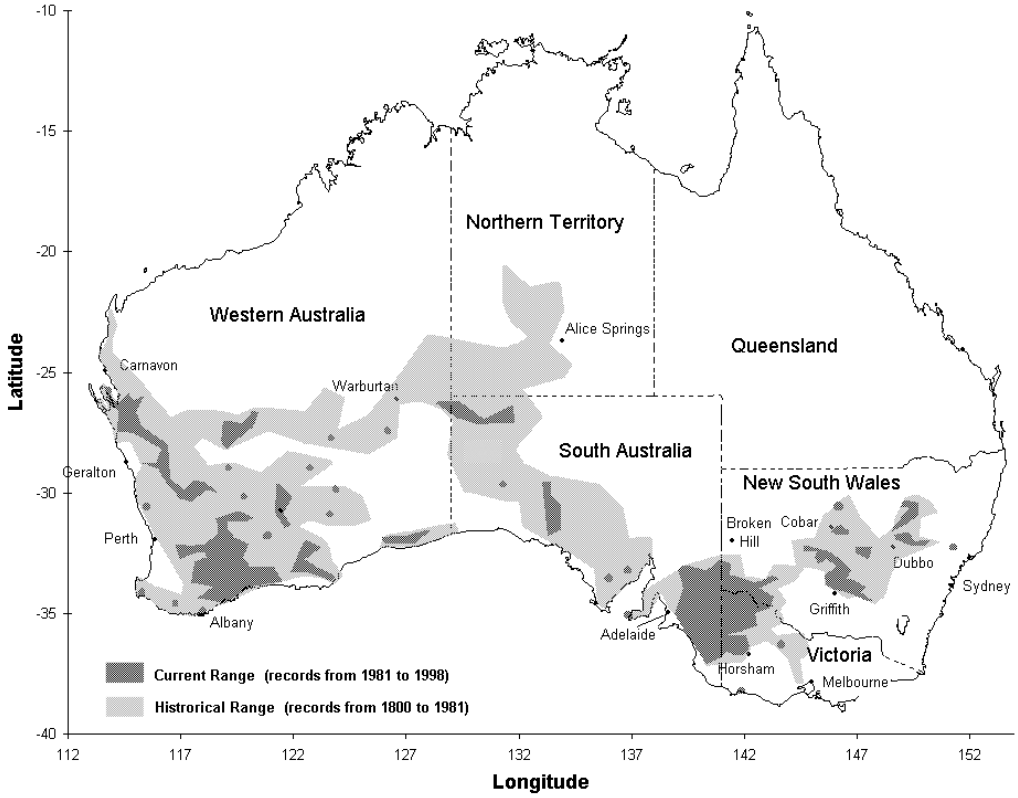

Figure 1. Historical (light grey) and current (dark grey; 1981-1998) distribution of Malleefowl across Australia.

Malleefowl distribution

Malleefowl once occupied a huge range across Australia (Figure 1). In the settled regions, where recent distribution data is most accurate, its range has since contracted mostly due to clearing for agriculture. In this regard, Malleefowl have actually persisted remarkably well despite huge changes since European settlement that have included introduced predators and competitors, changed fire regimes, and landscape fragmentation. This pattern is markedly different from that shown by other similar sized ground dwelling animals, such as the medium sized mammals that all disappeared in these habitats within a few years of settlement. This persistence demonstrates a resilience of Malleefowl that augurs well for conserving them with appropriate management.

In the more remote regions of central Australia the past and current range of this elusive species is less well known, and contractions of range are most easily explained by habitat changes (eg. changed fire regimes, grazing, etc) and predation by introduced foxes and cats.

In both settled and remote areas a range of actions are needed to mitigate threats to the species, improve our knowledge and coordinate our approach. In the following discussion I will overview some of the most important actions that are detailed in the recovery plan, and provide an indication of the potential role of community involvement in these actions.

Mitigating Threats

1. Clearing & Fragmentation

Effects

Clearing for agriculture has had catastrophic effects for Malleefowl as much of their habitat, and most of the prime habitat, was removed. The after-effects of this clearing are just as detrimental as the initial clearing because the remaining habitats have been left fragmented and in many areas Malleefowl persist only in small, isolated remnants (Figure 2). A large body of theoretical and empirical work indicates that the outlook for small isolated populations is grim even if the remnant habitats are pristine. However, fragmented habitats cannot remain pristine when surrounded by agricultural land and become degraded at their edges due to a variety of effects.

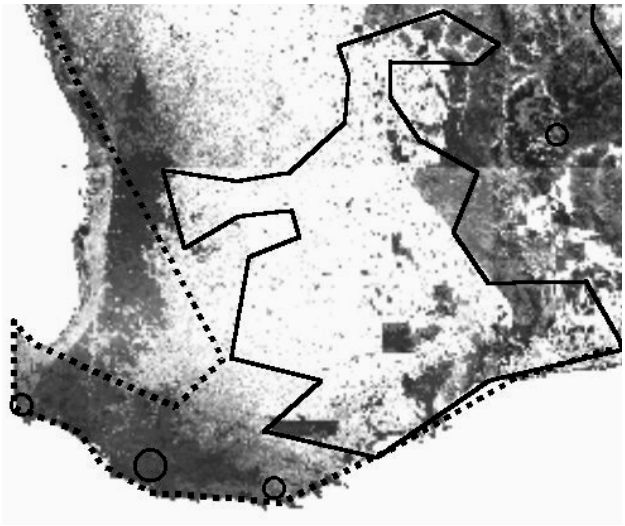

Figure 2. SW Western Australia showing the likely original distribution of Malleefowl (dotted line) and distribution since 1981 (solid line). Most of the area in which Malleefowl still occur is in fact cleared (pale) and the species persists in numerous small and isolated remnants. This degree of fragmentation will inevitably lead to local extinctions unless management intervenes.

What can be done?

Many of the detrimental effects of small, isolated populations can be overcome by linking habitat patches with habitat corridors that allow Malleefowl to move into/out of habitat patches. These need to be carefully planned to achieve the desired result. Where dispersal corridors are not feasible, maintaining Malleefowl in isolated patches will eventually require translocations.
Intensive habitat management will probably be required to maintain habitat condition and to control predators and competitors.

Potential for community involvement

High: community groups are already actively involved in revegetating links between isolated remnants.

2. Fire

Effects

The initial effects of large fires are similar to clearing in that habitat is removed. However, habitat recovers from fire over several decades and many food plants used by Malleefowl require fire to regenerate. The threat to Malleefowl is due to BIG fires that suddenly kill or displace birds over vast areas, and may even eliminate the species from large reserves. Small, patchy fires are beneficial to Malleefowl both because they reduce the chance of a subsequent big fire, and allow regeneration to occur without disturbing too many birds.

What can be done?

Identifying and preferentially protecting the key areas where Malleefowl are most abundant would provide insurance against big fires. In general, any actions that prevent or disrupt big fires and encourage patchiness in habitats would probably benefit Malleefowl.

Community contribution

Community groups could help identify the most important areas for Malleefowl breeding in large reserves. Fire management is not an option for community involvement. Fire is a risk for people working in the mallee and safety issue for volunteers wh should have good communication systems in place.

3. Foxes

Effects

Foxes are known to eat Malleefowl eggs, chicks and adults, but their effects on Malleefowl populations are still unclear. Captive reared chicks that are released in the wild benefit from fox control, and accordingly such release programs should always be accompanied by fox control. But whether wild Malleefowl populations require reduction or removal of foxes in order to maintain themselves is still uncertain, though much discussed. There has simply not been a clear demonstration of a positive effect of fox reduction on Malleefowl populations, partly because fox control is usually undertaken at the same time as habitat is improved (by removing goats/sheep, maturing habitat after fire, etc). Clarity in this issue is important because fox control is costly and might have undesirable effects in some areas (eg. benefiting cats, rabbits and other herbivores, poisoning wildlife). Most likely, the effect of foxes on Malleefowl is greatest in small reserves.

What can be done

Baiting with 1080 is the most effective method of fox control within Malleefowl reserves. However, effective control of foxes requires careful planning, collaboration and execution and usually needs to occur at a large enough scale to prevent immediate reinvasion. There is clearly a need to document the effect of foxes on Malleefowl populations, and the benefits of fox control for conserving Malleefowl.

Community contribution

Groups can make a major contribution to both reducing fox abundance and clarifying the effect of foxes on Malleefowl populations. In particular, community groups have already shown themselves to be especially good at coordinating landholders for large scale baiting campaigns. Community groups would also be well suited to monitoring the effects of control measures on foxes (have they actually been reduced?), and on Malleefowl (have breeding densities increased?).

4. Grazing by sheep and goats

Effects

Grazing by sheep is known to reduce Malleefowl abundance enormously. Sheep, goats and other herbivores probably compete with Malleefowl for food, but an even greater threat may be in causing long term habitat changes. It's for this reason that grazing by sheep in mallee communities has been called "de facto clearing".

What can be done?

Remove stock and goats from Malleefowl sites, and close/fence unnatural water sources.

Community contribution

Landholders can make major contribution by reducing grazing pressure on Malleefowl habitat under their control.

Information for Management

1. Monitoring

Why?

Knowing the trends of Malleefowl populations is fundamental for conservation, and is a key criteria for assessing their status. Monitoring also provides a means of gauging effectiveness of management (eg. measuring the benefits of fox control).

How?

Breeding density is the best measure of Malleefowl population trends.

Community contribution

Community groups can and have made a major contribution to Malleefowl conservation by undertaking monitoring programs. In fact, community involvement is essential for on-ground survey of monitoring sites, and the continuity provided by community involvement is a great benefit for on-going monitoring programs.

2. Distribution

Why?

The distribution of Malleefowl is poorly known in many areas, especially the more remote areas. This is because Malleefowl are actually rather elusive birds and rarely show up in general animal surveys unless they are very common in an area.

How?

Postal surveys are useful in settled areas, and have been used to great effect, although it is also true that without follow-up checking the results can be misleading. In drier, remote areas, searching for Malleefowl footprints ("tracking") is the most effective means of detecting their presence in suitable habitat, especially in combination with local knowledge (if any exists). Incidental sightings can be very useful too, particularly if these are of breeding mounds or pairs of birds.

Community contribution

Community groups make a very important contribution to obtaining distributional information, both by collecting information in the field, and by passing on information they hear from locals. Groups and remote communities can also plan and conduct surveys with little supervision or instruction because the techniques are easily learnt.

3. Population Dynamics

Why?

Understanding population turnover, recruitment of young and longevity of adults is crucial, and this is perhaps the biggest gap in our knowledge of Malleefowl conservation ecology.

How?

This project involves capturing and marking adults and perhaps chicks and then identifying these birds at mounds in subsequent years. Some recent work (Priddel and Wheeler 2003xx) achieved this for a population of adults in NSW by visually identifying birds with colour bands, but this is enormously labour intensive and can only be done on adults. New technology used in zoos and on livestock and pets allows animals to be identified much more efficiently and automatically on both adults and chicks. A closed (isolated) population of birds is required for this study, and after catching and marking the birds the routine work would involve moving equipment from mound to mound during the breeding season. This is a long-term project and should run for at least ten years to provide useful data.

Community contribution

Community involvement would be of great assistance in setting up this project as catching adults and chicks is labour intensive. Once the birds are marked, community groups could run this project with little more supervision than regular monitoring of breeding densities.

4. Habitat requirements

Why?

Describing what Malleefowl habitat requirements are would enable us manage habitat better and to identify sites that would be suitable for re-introductions. Understanding Malleefowl habitat requirements is especially important now that global climate appears to be changing as habitats will change substantially in the future.

How?

The existing monitoring sites across Australia provide a invaluable resource showing breeding densities and trends of Malleefowl in a range of different habitats. What

needs to be done now is to measure a range of habitat variables and find which of these best explain differences in Malleefowl densities.

Community contribution

Volunteers could help measure habitats. This would require careful planning to ensure that these measures were repeatable.

5. Genetics

Why?

Understanding the genetic variability of Malleefowl across their range is important in order to determine appropriate management units. If there are distinct genetic populations, then these should be managed separately. There is also the possibility of identifying individual birds from moult feathers which could be useful in determining how long individuals live and how strongly monogamous the pairs are.

How?

Samples of tissue and feathers have already been collected from around Australia, and some genetic work has been completed. However, further genetic markers need o be developed before the conclusions can be drawn or new techniques developed.

Community contribution

Volunteers in some areas routinely collect feather samples, but further development in this area is dependent on detailed genetic studies.

National Coordination

1. Community Involvement

Why?

Community volunteers have shown to be instrumental, effective and enthusiastic agents in Malleefowl conservation. They have already taken lead role in surveys, monitoring, education/awareness, revegetation, and predator control, and their involvement is essential for many projects in the recovery plan.

How?

Newsletters and webpages are already in effect and these should be supported to maintain a degree of communication across Australia and raise public awareness. Community groups have developed some excellent websites (see www.malleefowl.com.au and www.malleefowlvictoria.org.au). Forums, such as this meeting, are of great value in bringing people together and foster collaboration and national perspective.

2. National Recovery Team

Why?

A national recovery team is needed to coordinate and manage the recovery plan, provide national perspective and priorities, and to foster collaboration between community groups, agencies and other interested parties. Fragmentation and isolation threatens the recovery effort as much as it does the species, and a lot more can be achieved by working together than separately.

How?

A national Malleefowl recovery team needs both community and government representation from across the range of the species. The original team that was in place during the preparation of the recovery plan has not met for some years, although there is a clear need for its resurrection in some form. The recovery team has to decide for itself the fine details of its composition, meeting schedule, and agenda.

Actions Summary

The foregoing discussion on the community involvement in Malleefowl recovery is summarised in Table 1 which shows the actions that would benefit most from community involvement.

Table 1. Summary of likely community contributions to different actions in the Malleefowl recovery plan. Actions in which community groups could potentially contribute the most are given more Malleefowl symbols.

Category	Action	Community Contribution
Mitigate Threats	Fragmentation	
	Fire	
	Foxes	
	Grazing	
Information for Management	Monitoring	
	Distribution	
	Population dynamics	
	Habitat requirements	
	Genetics	
National Coordination	Community involvement	
	Recovery Team	

Where to from here?

1. Malleefowl need the support and efforts of the community

While government agencies have made and continue to make enormous contributions to improving the conservation of Malleefowl, often without due acknowledgment, resources are thinly spread and it is clear that community groups have an important role in benefiting Malleefowl. This community effort would be optimised by groups sharing the solutions they have found to various problems and challenges. For example, different community groups have developed a range of projects involving

education kits, coordinated fox baiting processes, sightings databases, and monitoring systems to name a few. Sharing the experiences, processes and knowledge that have been gained amongst all groups would strengthen the national effort and prevent time being wasted in 're-inventing the wheel'.

2. The community needs direction and support from a National Recovery Team

Community groups provide an energetic and capable work force, but need help and expertise to design, standardise and synthesise projects. The recovery plan provides a framework and direction, but this is not a substitution for a dedicated team that would foster collaboration and oversee implementation of projects outlined in the plan. Many of these projects can (and should) be divided up across continent, and one role of the recovery team is to ensure that necessary standards are met. Another important role of the recovery team is to review and if necessary modify the recovery plan as new information comes to light.

3. Greatest resource is community, but some funding and support is necessary

Community groups can achieve a great deal with relatively few funds, but nevertheless require some funds to operate and cover necessary costs involved in administration and coordination, travel and materials. State and federal governments may not always be able to meet these costs, and groups should consider alternative sources such as corporate sponsorship and local councils and businesses to ensure their survival. Another possibility is for community groups to enter into contractual agreements with government agencies for the provision of information (such as monitoring data) over several years.

Concluding remark

The importance of community involvement in the conservation of Malleefowl can hardly be overstated. Community groups provide a work force for mitigating threats and for obtaining crucial information for management. They also represent a powerful lobby group for improving land management generally under the banner of Malleefowl conservation. The achievements of groups across Australia have already been considerable and would be even greater with increased coordination and collaboration at a national level.

Conservation of the Malleefowl: are there lessons from the successful conservation of native mammals by intensive fox control?

Jeff Short
CSIRO Sustainable Ecosystems, Perth

Malleefowl and other ground-nesting birds have shown substantial contractions in range over the 200 years of European settlement and are believed to be at ongoing risk of further declines. One factor implicated in the decline of ground-nesting birds in general, and Malleefowl in particular, is predation by the introduced fox (Saunders *et al*. 1995: 126; Benshemesh 2000). However, these declines, as worrying as they may be, are dwarfed by the extent of decline among native mammals (Woinarski and Braithwaite 1990). At least eighteen species of mammal are extinct, many species that were formerly widespread now survive only on offshore islands, and many others persist only in small remnant populations. Recent management action to conserve mammals has been highly successful leading to substantial recoveries of local populations and the establishment of new populations by reintroduction. It may be that lessons learned in the conservation of mammals may be transferable to the conservation of the Malleefowl and other ground-nesting birds. This paper explores the historical parallels in the diagnosis of threatening factors in the decline of mammals and the decline of the Malleefowl, highlights recent successes in the conservation of mammals, and examines the evidence for and against a prominent role of foxes in the decline of Malleefowl.

Declines in ground-nesting birds and of mammals show many parallels. Declines in mammals, like declines in ground-nesting birds, have been particularly pronounced in the arid zone (Reid and Fleming 1992, Smith *et al*. 1994, Short and Smith 1994). Like mammals, ground nesting birds that occur on mainland Australia are often more abundant on offshore islands to which foxes have not gained entry (e.g. Bush Stone Curlews on Kangaroo Island: Ford 1979). There is also a similar tendency in species with a former extensive north-south range across continental Australia to contract northwards to areas where foxes are absent or rare (e.g. Australian Bustard: Grice *et al*. 1986; and the Nailtail Wallabies: Strahan 1995).

Benshemesh (2000) documented a contraction in the range of Malleefowl of about 50% within the past century, being most pronounced in arid areas and at the mesic peripheries of its former range. Habitat loss due to land clearing was a major factor in declines, particularly on the mesic margins of their former range, and grazing by sheep, goats and rabbits have played a significant part (Frith 1962a , b). The role of foxes was regarded as more controversial: “while some authors believe that fox predation is the main threat to Malleefowl populations and a major cause of their decline, others have considered Malleefowl populations resilient to high predation rates due to their life history and high fecundity.” (Benshemesh 1997: 25). The basis of this perceived resilience appears to be the stable breeding densities recorded on two

monitoring grids over a 30 year period in Victoria in the absence of fox control (Benshemesh 2000).

Fox – a brief profile

The European Red Fox occurs naturally throughout the continents of the Northern Hemisphere – Eurasia, North Africa and North America. It was introduced to Victoria in 1871, spreading to South Australia by 1888, New South Wales by 1893, and Western Australia by 1912. Foxes colonised much of the southern part of mainland Australia but did not become established in parts of northern Australia and many offshore islands. Their spread from their initial release point was almost certainly facilitated by the prior spread of the European Rabbit. Foxes have a catholic diet ranging from insects, fruits, small to medium sized mammals, birds, reptiles and amphibian, carrion, and human rubbish (Saunders *et al*. 1995). Rabbits are a mainstay of their diet in many areas, typically followed in importance by house mice and sheep carrion. Foxes may surplus kill their prey (Short *et al*. 2002), often cache food for later consumption, typically occupy discrete territories, and are most active at night and at dawn and dusk. An important consequence of their catholic diet is that their numbers are not regulated by any one prey species; this factor makes them particularly effective at driving prey numbers of any particular species to low numbers or to extinction.

Foxes weigh up to 8 kg, with males slightly larger than females. Foxes breed once per year, with vixens typically coming into heat in mid-winter. Litter size varies from 4 to 10 cubs. Survival of cubs is often high and young become sexually mature from 10 months of age. Fox densities in rural areas vary from 0.2 to 7 per km^2 (Saunders *et al*. 1995), and tend to be abundant in the fragmented habitats of agricultural landscapes. High numbers (estimated at 2.5 per km^2) have been recorded in semi-arid environments (Algar and Smith 1998) occupied by Malleefowl. Dispersal distances of cubs averaged 11 km in south-east Australia, with some movements up to 30 km (Coman *et al*. 1991). Dispersal distances in arid Western Australia averaged 43 km for males and 15 km for females (Saunders *et al*. 1995).

History of changing ideas regarding the status of mammals and ground-nesting birds

Table 1 provides a chronology of changing ideas about the primary cause or causes of loss of medium-sized mammals. Typically, native mammals were perceived to be an unlimited resource to be intensively harvested as food or for skins or for their bounty as agricultural pests (Jarman and Johnson 1977, Short and Milkovits 1990, Short 1998). By 1910, concerns were being expressed about the rate of harvest of many species and some legislation was introduced or strengthened to protect many species (Ovington 1978). Marshall (1966) described an early contraction in the range of Malleefowl from the Bendigo area in Victoria at this time that he attributed to hunting.

By 1920, predation by foxes was considered a major factor in the decline of many species of medium-sized mammals, many of which had declined so precipitously that naturalists attempted to gather up the remnants to put on fox-free islands (Finlayson 1927, Wood Jones 1923-25, Short *et al*. 1992, Copley 1994). Foxes were considered a primary cause of loss of Malleefowl during this same period. North (1917)

described the fate of the species at Coolabah on the northern slopes of New South Wales: "the introduced foxes were rapidly getting rid of Malleefowl in that district, and one was now rarely seen, where formerly they were numerous." Similarly, Craig (1926) viewed the fox as a great destroyer of ground birds. Malleefowl, along with many species of mammal, were introduced to fox-free Kangaroo Island at this time with releases in 1911, 1923, 1924, and 1936 (Copley 1994). Over 20 birds were released but the population did not persist.

The 1950s – 1970s were the heyday of CSIRO Wildlife Research and the studies carried out by the scientists of this division were extremely influential in the debate on the reasons for the ongoing decline of Australia's fauna. Key scientists were Basil Marlow (who documented the loss of mammals from New South Wales, which was greatest from inland areas where sheep and rabbits had had greatest impact: Marlow 1958), John Calaby (the decline of the numbat in Western Australia attributed largely to habitat loss: Calaby 1960), Harry Frith (the decline of the Malleefowl due to habitat loss and the impact of grazing in remaining areas of natural habitats: Frith 1962a and b), and Alan Newsome (the decline of the desert mammals attributed to the impact of the pastoral industry: Newsome 1971).

All these scientists considered the role of foxes in the decline of native fauna and rejected them as a key factor. A typical quote for mammals comes from Calaby (1960): "It is the author's belief that the role of the predators in the Numbat's decline has been much over-rated. …the fox is probably not important as it hunts mostly at night when the Numbat is not active and is confined to its hollow-log shelters. Foxes and cats are abundant in all areas where the Numbat is still fairly common."

Similarly, Harry Frith believed that the role of the fox was overstated: "It is concluded that the fox is not the main cause of the decline of Malleefowl in uncleared areas. It is more probable that sheep, and perhaps rabbits, enter into direct competition with the birds for food." (Frith 1962a: 33). "… the majority of mallee-fowl chicks are doomed to die young. … foxes ... harvest only the surplus, and their depredations on eggs have no effect on the ultimate numbers of mallee-fowl." (Frith 1962b: 114).

They favoured the impact of grazing by domestic stock and rabbits and the effect of land clearing. They ushered in a major and important period of land acquisition for nature conservation (sites where grazing would be excluded and that were protected from clearing). However, it has become increasingly clear that this was a necessary, but insufficient step to conserve the biota (Short and Smith 1994).

The late 1980s and 1990s saw an increasing emphasis on management of the conservation estate, prompted by the dramatic decline or loss of fauna from many nature reserves and the failure of reintroductions of mammals to others. Examples of the former include losses from Tutanning Nature Reserve (Southern Brown Bandicoot and Numbat: Friend and Thomas 1994; Kinnear *et al*. 2002), loss of rock-wallabies from isolated granite outcrops in the central wheatbelt of Western Australia (Querekin Rock: Kinnear *et al*. 2002); and the dramatic reduction in the sightings of Numbats at Dryandra Forest in the late 1970s and early 1980s (Friend and Thomas 1994). These losses were believed to coincide with a period of high fox numbers resulting from the phasing out of use of 'one-shot' oats to control rabbits following the introduction of the European rabbit flea to Western Australia in 1969 (Christensen 1980, King *et al*.

1985). The flea provided a vector additional to the mosquito to transmit myxomatosis and led to a widespread reduction in rabbit numbers.

Examples of management interventions to conserve native species included the manipulation of habitat by the creation of fire mosaics in the Gibson Desert (Christensen and Burrows 1994) and the control of predators, particularly foxes (Kinnear *et al*. 1988; Friend 1990). The values of such interventions were tested by reintroducing native mammals – sometimes successfully, sometimes not. Almost all successes were linked to effective predator control (e.g. Brush-tailed Bettongs to 15 sites in Western Australia, mostly in the jarrah forest (Morris 2000); Burrowing Bettongs and Western Barred Bandicoots to Heirisson Prong in Western Australia: Short and Turner 2000, Richards and Short 2003). Almost all failures were due to ineffective predator management (e.g. Parma Wallabies to Robertson in New South Wales: Short *et al*. 1992; Golden Bandicoots and Burrowing Bettongs to the Gibson Desert: Christensen and Burrows 1994).

The Numbat has been a particular success story – responding to effective predator control at Dryandra – and being successfully reintroduced to seven other sites in Western Australia where predators were effectively managed (Friend 1990; Friend and Thomas 1994; Orell 2003). Reintroduction sites include Dragon Rocks, Boyagin, Tutanning, and Karroun Hill Nature Reserves, Batalling State Forest, Hills Forest and Stirling Ranges National Park. Clearly, the diagnosis of Calaby (1960) has not survived the test of time. The Numbat shares many life history attributes with Malleefowl (Table 2), perhaps suggesting the need for similar management regimes for both species to ensure their conservation.

Other successes linked to control of foxes and/or feral cats in the 1990s include:

- Isolated rock-wallaby populations in agricultural landscape have increased 5 or 6-fold in abundance following fox control (Kinnear *et al*. 1988, 1998);
- Official downlisting of the threat status of tammar wallaby, southern brown bandicoot, and brush-tailed bettong in Western Australia (Morris *et al*. 1998);
- Over 80 reintroductions in Western Australia of 24 species from 1990-9 (Morris 2000);
- Rediscovery of the 'extinct' Gilbert's Potoroo in the south-west in an area managed to exclude foxes (Sinclair *et al*. 1996);
- A reintroduced population of Burrowing Bettong has been extant for > 10 years (Short and Turner 2000). The last museum record of this species on mainland Australia was in 1942, 50 years prior to the successful reintroduction.

Table 1: Changing perceptions of mammal decline

Years	Status	Primary cause(s)	Sources
1860-80s	Over abundant	loss of Aborigines, dingoes	Jarman and Johnson 1977
1900-10s	Declining	excessive hunting	Lucas and Le Souef 1909
1920-30s	Declining	foxes, rabbits	Le Souef 1923; Troughton 1938, Short and Calaby 2001
1950-1970s	Declining	grazing stock, rabbits	Calaby 1960, Frith 1962a, b, Newsome 1971
1980s	Declining	lack of fire mosaic	Kitchener *et al*. 1980; Burbidge *et al*. 1988
1990s	Declining	foxes, cats	Kinnear *et al*. 1988; Friend 1990; Short and Smith 1994

Table 2: Comparative life history attributes of Malleefowl, Numbat, and Bush Rat

Species	Activity	Shelter	Reproductive output p.a.	Range	Susceptibility to aerial predation	Remaining strongholds
Malleefowl	Diurnal	Roost in trees, laboured flight	10-24 eggs	Semi-arid and arid woodland and shrubland	High	Uncleared areas towards mesic margins of former range
Numbat	Diurnal	Hollow logs	2-4	Semi-arid and arid woodland and shrubland	High	Mesic margins of former range
Bush rat	Nocturnal	Dense ground cover	*c.* 10 - 15	Forest and coastal scrub	Moderate	Mesic margins of former range

Foxes and Malleefowl

Early observers such as Griffiths (1954) in New South Wales and Ford and Stone (1957) in Western Australia attributed the decline of Malleefowl to foxes. However, Frith (1962a, b), who conducted a detailed study of the species in New South Wales, assembled a range of arguments to suggest that foxes were not the primary cause of loss of Malleefowl. They included: the high fecundity of Malleefowl; a history of exploitation of eggs, with predation by foxes merely replacing earlier exploitation by Aborigines, dingoes and early settlers; the lack of evidence of high levels of consumption of Malleefowl, particularly chicks, from the examination of fox scats; and the abundance of Malleefowl in areas where foxes were also abundant.

Frith's chief argument for dismissing a pivotal role for fox predation was a mathematical argument based on their high fecundity. He established that a pair of

Malleefowl produced an average of 19 eggs per annum and that the female may breed for eight years (Frith 1962a). Thus the pair may produce as many as 160 eggs in their lifetime but require just two birds from these eggs to survive to reproductive age to replace themselves. He established that fox predation on eggs was high, with 37% of eggs being lost (Frith 1962a). However, he considered that predation on chicks was low with a brief period of vulnerability immediately after hatching (Frith 1962b). He believed chicks rapidly acquired behaviours that made them less likely to be predated (roosting in trees at night and an escape response to terrestrial predators of flying into trees to hang upside down from a clump of leaves!).

Just as recent research on numbats has changed the perception of the relative importance on fox predation to that derived from research in the 1950s so recent work on Malleefowl has changed the perception of the impact of foxes from that of studies carried out in the 1950s. Priddel and Wheeler (1994, 1996, 1997, and 2003) reported fox predation on Malleefowl at all stages of their life cycle from eggs, newly-hatched, juveniles, sub-adults and adults.

Priddel and Wheeler have shown that predation on chicks is very high in the presence of uncontrolled fox populations – to the point that no reintroduced chicks survived (Table 3). Predation was particularly pronounced for younger birds and in the first days after release. Subsequent work has revealed some natural recruitment into populations, but insufficient to account for adult mortality (Priddel and Wheeler 2003). They also showed that adult deaths were very high, linked in part to drought.

Overall they believed Malleefowl were undergoing major decline, in both grazed and ungrazed sites, and in small fragmented sites surrounded by farmland as well as large areas of contiguous habitat. Declines occurred despite sites being long unburned, a factor known to have a major impact on Malleefowl densities (Benshemesh 1992).

Malleefowl have been introduced also to Peron Peninsula at Shark Bay in Western Australia (Morris *et al*. 2003). Peron is free of foxes, all having been eliminated by aerial baiting following the construction of a barrier fence across the narrow neck of the peninsula in 1995. It was a pastoral station but sheep were largely removed in the mid-1990s and the goat population reduced from *c.* 15,000 (15 per km^2) to < 400 by 2001. Malleefowl were released in 1997 and 1998. Birds were raised to 6-12 months in captivity from eggs sourced from Wubin in the northern wheatbelt, Kalbarri National Park, and from Nanga Station at Shark Bay. Ninety percent of 67 birds released survived for greater than six months, far higher than that of birds released in a nature reserve in eastern Australia where foxes were still present (Table 3). At least six active mounds have been detected since the release and there have been some sightings of chicks (Morris *et al*. 2003).

The relevance of the results of Table 3 to the successful recruitment of Malleefowl in the wild has been questioned. Benshemesh and Burton (pers. comm.) has argued that mortality rates for released birds raised in captivity burdened with radio-collars may not reflect that of wild-born birds. Nonetheless, captive reared and radio-collared birds released to fox-free habitat have persisted; captive reared and radio-collared birds released in the presence of foxes have not.

Table 3: Survival of reintroduced Malleefowl

Location	Foxes	Birds released	Age of birds	Food supplementation	Survival	Proportion lost to predation^	Proportion lost to food shortage or exposure	Source
Yathong, NSW	Absent	9	1 week	Yes	89%##	0%	11%	Priddel & Wheeler 1990
Yathong, NSW	Absent	20	1 week	No	0%##	30%^	50%	Priddel & Wheeler 1990
Wyperfeld, Vic	Abundant?	21	< 1 week	No	<25%#	48%	14%	Benshemesh 1992
Yalgogrin, NSW	Abundant	17	0-5 months	No	0%**	88%	6%	Priddel & Wheeler 1994
Yalgogrin, NSW	Abundant	15	3-6 months	Yes	0%**	93%	7%	Priddel & Wheeler 1994
Yathong, NSW	Abundant	24	3-5 months	No	4%**	87%	0%	Priddel & Wheeler 1996
Yathong, NSW	Abundant	12	14-28 months	No	25%**	58%	0%	Priddel & Wheeler 1996
Bakara, SA	n.d.	15	< 8 months	No	> 13%***	100%	0%	Williams 1995; Priddel & Wheeler, pers. comm.
Ferries-McDonald, SA	n.d.	15	< 8 months	No	33%**	100%	0%	Williams 1995; Priddel & Wheeler, pers. comm.
Yathong, NSW	Low	24	6-9 months	No	29%	88%	0%	Priddel & Wheeler 1997
Yathong, NSW	Low	24	4-5 months	No	25%	96%	0%	Priddel & Wheeler 1997
Yathong, NSW	Ext. low	24	6-8 months	No	75%***	21%	4%	Priddel & Wheeler 1999; Priddel, pers. comm..
Peron, WA	Eliminated	67	6-12 months	No	90%***	0%	n.d.	Morris *et al*. 2003

^ includes birds lost to avian predators; # survival to 10 days; ## survival to 30 days;
*survival to 2 months; ** survival to 3 months; *** survival to 6 months; n.d. no data

Does the high fecundity of Malleefowl counter the impact of fox predation?

A key difference between the ecology of Malleefowl and that of many native mammals is the high fecundity of Malleefowl. This attribute of the life history of Malleefowl has been considered to provide substantial protection from the impacts of foxes (Frith 1962a, b). Frith believed that losses of Malleefowl eggs to foxes was merely the loss of a "doomed surplus" – invoking Errington's (1946) view that predators take only the excess production of a prey population. Errington conducted a 25-year study of predation of musk rats by mink in the marshes of Iowa and believed that the number of musk rats was determined by territorial behaviour with surplus animals excluded by such social behaviour doomed to die.

Banks *et al*. (1999) tested Errington's hypothesis for the native bush rat in south-eastern Australia. This species has litter sizes of from 3-5 and can produce up to three litters in 93 days so has a fecundity considerably closer to that of Malleefowl than many of the mammals discussed above (Table 2). Banks *et al*. (1999) controlled foxes in two areas of 10-18 km^2 but not in two others. Rats were monitored in each to assess whether rats would increase in areas of fox control (and so be deemed predator limited) or remain relatively stable (foxes merely removing rats that were doomed to die from other causes). Rats failed to increase over two breeding seasons supporting the "doomed surplus" hypothesis. However, populations of Bush rats in south-western Australia have shown variable responses to broad-area control of foxes (Orell 2003). Populations were monitored at 14 sites, with seven showing an increase, three showing no trend, and four showing a decrease. It seems likely that factors such as vegetation density (linked both to annual average rainfall and immediate past fire history), inter-specific interactions with other species, and drought may have influenced the outcomes.

Malleefowl and bush rats share similar high fecundities, but differ in three important respects. Bush rats are likely to be buffered from fox predation by their choice of habitat and their short developmental period to sexual maturity. On the other hand, Malleefowl are long-lived relative to Bush rats and therefore have the opportunity to produce young over a greater number of breeding seasons. Bush rats have a preference for dense understorey in mesic locations around the coastal margins of southern and eastern Australia. Their density is strongly related to cover, with their numbers being greatly reduced by the opening up of habitat by fire and logging (Lunney 1995). In addition, they mature at 7 weeks of age and so are exposed to predation for a relatively short time before breeding (in contrast to the 3-4 years of Malleefowl: Benshemesh 2000). Bush rats have remained common in mesic parts of their range (such as in the dense vegetation of wet gullies and coastal scrub) but are now absent in drier sites on the inland margins of their former ranges. Malleefowl occupy a broad range of habitat densities but, like bush rats, appear to have persisted best in habitat which provides good cover. Malleefowl are potentially long-lived (cf. Priddel and Wheeler 2003), provided they survive to adulthood, and this means they can potentially produce young over many seasons and this may provide some protection from fox predation.

Hence, the impact of foxes is likely to be greatest in habitats of lower overall productivity for Malleefowl (in part, a function of lower rainfall) and where the

frequency and impact of drought is greatest. In general terms, this means a greater impact in more arid habitat. Such an effect may be exacerbated by more open habitat in drier areas facilitating higher levels of predation. This may be why there appears to be a difference in scale of impact of foxes on Malleefowl between sites in New South Wales and Victoria (Priddel and Wheeler 1997 cf. Benshemesh *et al*. 2002). Detected trends in Malleefowl abundance over time tend to suggest stable numbers at some sites in Victoria (Torpey's and Wandown: Benshmesh 2000), but a declining trend in New South Wales and north-western Victoria in relatively low rainfall areas of their range. However, recent work suggests that breeding numbers on Torpey's Grid, that have appeared stable for decades, have declined to the lowest level on record over the five years to 2002 (Benshemesh *et al*. 2002).

Predation interacting with other factors

A limitation of past studies of Malleefowl is that the effect of predation is not effectively separated from habitat quality. Grazing by sheep, goats and rabbits and harvesting of brushwood may have impacted the results of these studies, particularly studies in New South Wales (Benshemesh, pers. com.). For example, all experimental releases of Malleefowl to Yathong Nature Reserve detailed in Table 3 were prior to 1994 and apparently before effective control of goats was achieved by closing off watering points and by commercial harvesting (Priddel and Wheeler 1999, Benshemesh 2000). However, survival of released Malleefowl was greatly enhanced at Yathong with the expansion of the area of fox control, implicating fox predation as a primary cause of loss irrespective of the level of grazing (Priddel and Wheeler 1999). Similarly, there was low survival of released birds at Ferries-McDonald (a 843 ha remnant) in South Australia in the presence of high fox numbers despite this site being unburnt for > 60 years and with dense impenetrable stands of mallee indicating few exotic grazers (Table 3 and D. Priddel, pers. comm.). Highest survival (at Peron in Western Australia) has come with the total elimination of foxes from a fenced peninsula of a 1000 km^2. This site is in a habitat of *Acacia* shrubland where grazing pressure from sheep had been largely eliminated and that of goats reduced.

Land clearing for agriculture has resulted in a major loss of habitat. Frith's study was conducted at a site north of Griffith, New South Wales with an area of 2200 ha in 1954. Three years later, this was reduced to just 180 ha (8% of the original area), resulting in a reduction of the Malleefowl population from 37 to 11 breeding pairs (Frith 1973). This site is now Pulletop Nature Reserve. Malleefowl have not been recorded breeding at this site since 1989-90 (Priddel and Wheeler 1999). Malleefowl are likely to be subject to greater rates of predation in the small remnants of habitat that persist after clearing.

A range of factors other than predation are known or believed to be important in the persistence of Malleefowl. These include the impact of sheep grazing (Frith 1962a , b), altered fire regimes (Benshemesh 1992), drought (Priddel and Wheeler 2003), and avian predation (Priddel and Wheeler 1990, 1997). Predation by both foxes, other terrestrial predators (feral cats) and avian predators, appears strongly linked to vegetation density and this density is, in turn, linked to grazing, fire and drought. There is anecdotal evidence that predation by foxes on Malleefowl may also be intensified at times when there is a sudden reduction in their food supply, as has occurred with the loss of rabbits to diseases such as myxomatosis and rabbit calici

virus (Lloyd 1998, Benshemesh 2000). Benshemesh (2000) has cited evidence for a higher loss of Malleefowl eggs to foxes at these times.

Food shortage was a major factor in loss of birds released at one week of age into 1 ha pens of mallee habitat (Priddel and Wheeler 1990) and may also have been a factor in loss of juveniles released to the wild (Priddel and Wheeler 1996). The increased time spent foraging in the open when food was in short supply appeared to increase vulnerability to predation from both foxes and avian predators. Food availability is likely to be closely linked to grazing regime and fire history. Rabbits may also influence food availability as well as boosting numbers of both foxes and avian predators. Their control may be an effective way of reducing predation (Priddel and Wheeler 1997). Feral cats have been implicated in the loss of chicks in some reintroductions. They are known to increase in abundance in semi-arid environments following the control of foxes (Risbey *et al*. 2000) – an effect known as a meso-predator release.

Fox control and Malleefowl conservation

If foxes are a major threatening process for Malleefowl then we would expect broad-area fox control to result in an increase in the abundance and distribution of Malleefowl. In Western Australia, the Department of Conservation and Land Management launched the Western Shield program in 1996 to control foxes in 36,000 km^2 (= 3.6 million ha) of the south-west. Some 780,000 baits per annum are laid to control foxes. Baits are laid from the air at a density of 5/km^2 with a frequency of four times per year over the forest areas and larger reserves. Isolated wheatbelt reserves < 20,000 ha in area are baited monthly from the ground. The response of mammals to this baiting is assessed at forty monitoring sites scattered throughout south-west Western Australia (Orell 2003). Unfortunately, no such extensive monitoring program is available for assessing changes in abundance of Malleefowl. Sightings of Malleefowl are collated by community groups such as the Malleefowl Preservation Group (MPG) and the North-Central Malleefowl Preservation Group and by a limited number of grid searches by the MPG in the far south-west. An adequate assessment of changes in abundance of Malleefowl over time is likely to require the continued monitoring of active mounds on an expanded network of grids and this has been recommended in the Recovery Plan (Benshemesh 2000).

An example cited to suggest that fox control may not bring the same benefits to Malleefowl as to mammals is that of Dryandra Forest in the Western Australian wheatbelt (Priddel and Wheeler 1997: 480; Benshemesh 2000). This reserve has been the site of fox control since 1982 to benefit Numbats, Brush-tailed Bettongs, Tammar Wallabies and a suite of other mammals (Friend and Thomas 1994). There are occasional Malleefowl sightings at Dryandra but there has been no obvious recovery of the species. However, this site is neither mallee nor *Acacia* shrubland, being predominantly brown mallet, wandoo and powderbark wandoo woodlands with a lack of *Acacia* shrubs in the understorey. Hence it may be marginal or unsuitable habitat for Malleefowl. The most likely food plant for Malleefowl at Dryandra is sandplain poison *Gastrolobium microcarpum*, a legume which forms a dense understorey monoculture through much of the reserve. Malleefowl have an approximate lethal dose (ALD) of 100-125 mg/kg (King *et al*. 1996), and birds could plausibly exceed this if they feed extensively on the seeds of this species. The air-dried foliage of *G. microcarpum* contains up to 600 mg/kg of the poisonous compound sodium

fluoroacetate in its leaves (Aplin *et al*. 1983) and this compound may be up to three times more concentrated in seeds (Twigg and King 1991). Hence a Malleefowl would need to consume about *c.* 10% of its body weight in seed per day to have a 10% chance of death. A variant of this hypothesis, if birds can limit their intake to reduce their exposure to the poison, is that birds may face critical food shortages in the midst of a surfeit of leguminous seed.

Typically, baiting programs in eastern Australia lack the scale, bait density and frequency of application required to effectively reduce fox numbers to a level likely to benefit threatened species. Benshemesh (1997) has described baiting regimes on two grids in north-west Victoria. The baiting regime of 15 baits per month in a 320 ha grid at Wathe Flora and Fauna Reserve (with a total area of 5900 ha), and a spring baiting at "about a dozen bait stations around the reserve" at Wandown Flora and Fauna Reserve (2750 ha) are inadequate to effectively control foxes. This intensity and scale of baiting can be compared with baiting regimes for mammals in Western Australia (see above) and for Malleefowl in western New South Wales (Priddel and Wheeler 1997, 1999).

An example of an effective regime from Western Australia is the community baiting of Heirisson Prong at Shark Bay to protect a suite of threatened mammals (Short and Turner 2000). This involves a twice-yearly baiting of a 20-km deep buffer beyond the reserve at 5 baits per km^2 and monthly baiting of the actual reserve and the adjacent road corridors where foxes might approach the reserve. Dried meat baits are used that have a life of up to one month (resulting in baits being present at all times) and that have the bulk (120 g fresh meat dried to *c.* 40 g) to limit intake by non-target species.

There is an important role for fox control by rural communities to protect Malleefowl. Communities can enhance actions in existing reserves and remnants known to contain Malleefowl by greatly expanding the area of fox control. The effectiveness of control operations against foxes is greatly enhanced as the area subject to baiting increases. Such baiting programs are already being undertaken by community groups across the range of the Malleefowl and could profitably be greatly expanded.

Summary

Fox control has been demonstrated to be pivotal to mammal recovery in Australia, despite a 30+ year history of reservations from many scientists. The perceived primary cause(s) of decline of Malleefowl has varied over time in a pattern similar to that of mammals, with periods of scepticism regarding the role of fox predation. Foxes are known to impact on Malleefowl at all stages of their life cycle and effective fox control is a necessary part of any recovery program. Malleefowl differ from threatened mammals in their higher fecundity and some authors believe that this may buffer Malleefowl from fox predation in some environments. These appear to be sites with dense understorey, lower incidence of drought, and reliable food supplies on the southern margins of the species' range. High fecundity linked with utilization of dense habitat appears to confer some protection from foxes to mammal species such as Bush rats. However, even in such an apparently robust species, effective fox control results in increases in abundance at many sites.

Recent successes in re-establishment of Malleefowl at Peron in Western Australia and Yathong in New South Wales suggest the need for effective fox control. This requires intensive broad-area control of foxes to minimise reinvasion. In many cases, this will be best achieved with a regional approach that transcends reserve boundaries. Hence there is considerable opportunity for rural communities in both cropping and pastoral areas to supplement existing baiting programs in reserves or to initiate new programs in areas where there are remnant populations of Malleefowl. Their actions may greatly enhance the effectiveness of fox control by expanding the area subject to control and deliver benefits to Malleefowl and potentially to a wider suite of threatened species.

Malleefowl have been shown to be sensitive to a range of threatening processes in addition to fox predation. It seems likely that fox control alone will not be sufficient to permit recovery and is certainly not an alternative to good holistic land management. Malleefowl will benefit greatly from effective management of exotic grazers (sheep, goats, and rabbits) and of fire (to maintain substantial areas of long unburnt habitat).

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Fire in Mallee Communities

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Fire is a 'natural' process in Mallee Communities. Noble *et al* (1980) found Mallee plant communities notable for their flammability and identified fire as a significant problem for land managers. Fire, along with drought, frost & storms, is a recurring disturbance event in Mallee communities (O'Brien, 1989, LCC 1989). Because of this, the flora & fauna of the Mallee has evolved in an environment with fire as a recurring event (Cheal *et al* 1979). This has led to plant adaptations to fire such as lignotubers (Mallee *Eucalyptus* spp), serotinus seeding (*Banksia ornata*) and a large proportion of resprouting species (Gill - Biota?, Cheal *et al* 1979).

The Mallee contains key habitat for several nationally rare and threatened bird species (Nat Plan ?). Four species which are of particular conservation concern are: slender-billed thornbill (*Acanthiza iredalei hedleyi*), mallee emu-wren (*Stipiturus mallee*), red-lored whistler (*Pachycephala rufogularis*), and malleefowl (*Leipoa ocellata*). The slender-billed thornbill and mallee emu-wren appear to favour vegetation which is recovering from fire, however as the vegetation becomes taller and denser (10 - 30 years after fire) their abundance decreases. Whereas the abundance of red-lored whistler generally increases after this period. The malleefowl prefers older vegetation (> 30 years), where mallee trees are taller and the understorey is more open and surface litter levels are higher (Benshemesh ?).

Other Mallee species, including mammals, reptiles and invertebrates are less well known, but appear to be have similar habitat preferences for different 'seral' stages of vegetation. Hence maintaining a range of successional states is important in determining Fire Regimes for Mallee vegetation. Even if the habitat favoured by each species is uncertain we can be sure that in a larger Mallee areas such as the Big Desert and Sunset, there are some species that need each of the successional states.

Ecologically-based Fire regimes

The process currently being used to develop 'ecologically appropriate' fire regimes in Victoria is based on 'Vital Attributes'. The 'Vital Attributes' of the flora and fauna of an area are used to determine the minimum and maximum Tolerable Fire Intervals for a particular vegetation type which will maintain the suite of species which it contains (Friend & Tolhurst 2001). This then forms the key tool to identify critical fire management issues which need management.

The vital attributes scheme of Noble & Slatyer (1980) is based on classifying plant species on the basis of their Regeneration strategy, Conditions for establishment and Relative longevity (Table 1).

Table 1: Noble & Slatyer's Vital Attributes for Flora

Species' Vital Attributes.

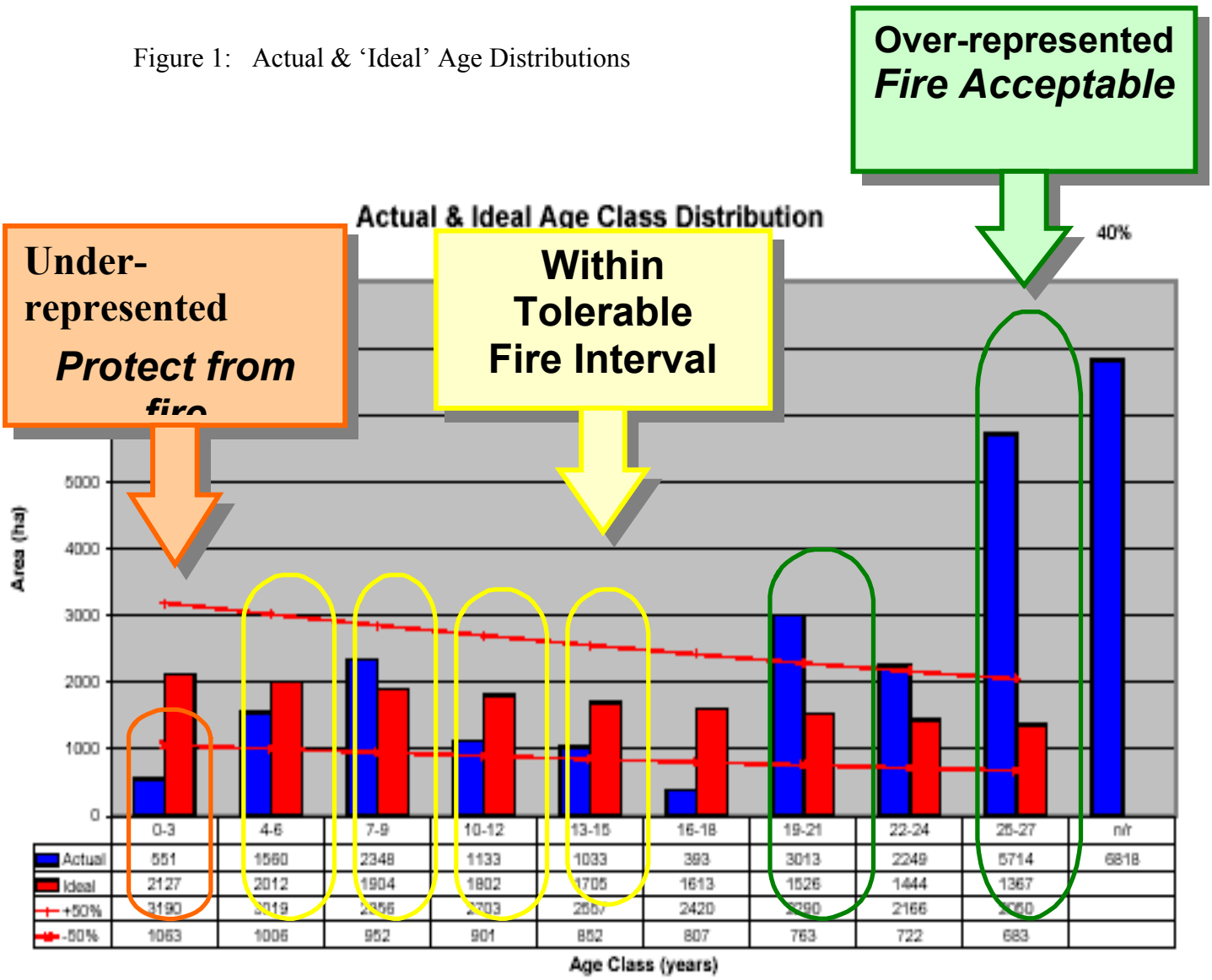
Regenerative Strategy / Method of Persistence (RS)	
	Seedling establishment
D	Seed dispersed long distances
S	Seed stored, maintains viability for long period, partial germination per disturbance
G	Seed stored, maintains viability for long period, single germination per disturbance
C	Seed short-lived, exhausted after single germination
	Vegetative mechanisms
V	sprouters: all ages survive, all become juvenile
U	sprouters: mature remain mature, juveniles remain juvenile
W	sprouters: mature remain mature, juveniles die
	Dual mechanisms
d (δ)	dispersed seed + mature remain mature + juvenile may or may not resprout (D + U or W)
s (σ)	Seed store + mature remain mature + juvenile may or may not resprout (S + U or W)
g (γ)	Seed store with one germination + mature remain mature + juveniles die (G + W)
Conditions for Establishment (TIR)	
T	tolerant, will establish in presence of adult competition (multi-aged population)
I	intolerant, needs disturbed site with competition removed (single aged population)
R	requires some precondition to be met before establishment, delayed establishment
Relative longevity (m, l, e)	
m	the time taken for a species to reach reproductive maturity (sexual or vegetative)
l	the longevity of the species reproductive population within the community
e	the time taken to reach local extinction (no reproductive material remains)

A similar scheme for describing the vital attributes of fauna species has been proposed by Friend (1999, 1989?). Response patterns in fauna are closely tied to the species shelter, food and breeding requirements, which generally depend on the structure and floristic composition of the habitat/vegetation.

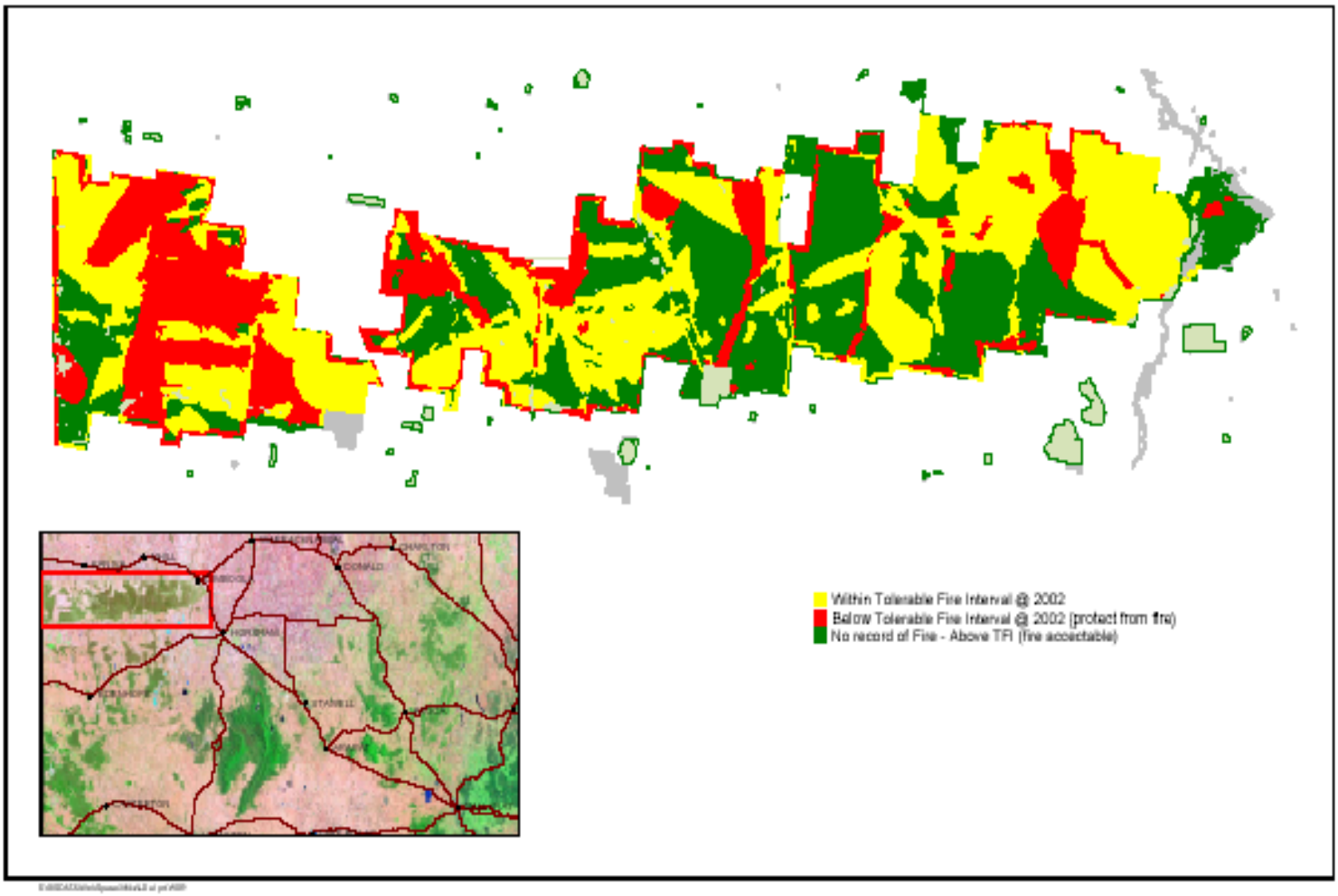
From these 'Vital Attributes' of the flora and fauna of the Mallee, we can identify those species which are most vulnerable to extremes of fire regime (eg too frequent fire intervals or too infrequent fire intervals) – we call these Key Fire Response Species (Friend & Tolhurst 2001). They are the most likely species to be affected by inappropriate fire intervals and hence are species which are critical in determining appropriate ecological fire regimes. The Key Fire Response species most likely to be affected by too frequent fire events, will determine the lower tolerable fire interval for a vegetation/habitat type, and the species most likely to be affected by too infrequent fire events, will determine the upper tolerable fire interval for a vegetation/habitat type. We now have some tools with which to assist planning fire regimes in relation to biodiversity outcomes.

The age class distribution for vegetation can be assessed against one that is 'ideal' for the range of flora & fauna of a vegetation type (Figure 1). The areas identified for management action can then be mapped (Map 1).

Figure 1: Actual & 'Ideal' Age Distributions



Map 1: Mapped Areas above/within/below Tolerable Fire Intervals



Fire Patterns in Victorian Mallee

In Victorian Mallee, the average fire occurrence (including prescribed burning) since 1932 is around 24,000 ha per year (Figure 2) and single fire events, occurring approximately every 20-30 years account for a significant proportion of this area (Figure 3). A high proportion (xx%) of these fires are caused by lightning and occur in the remote areas of the Big Desert and Sunset. Under the current climatic conditions and fire management arrangements, these historic levels of fire occurrence are likely to continue into the future.

Mallee communities in Victoria occupy both large blocks (> 1,000,000 ha in Sunset & Big Desert) and small reserves (some 400+ reserves of < 100 ha, most < 20) (Map 2). There have been some 500 fire events (both wildfires and prescribed burns) mapped since 1932 (Map 3), with a wide range of areas and locations. One of the key issues which need to be addressed in developing ecological fire management for the larger areas is catering for Malleefowl and the suite of other Mallee birds appear to prefer mature mallee habitat for breeding (i.e. > 40 years since fire). Currently only some 30% of Mallee communities provide suitable habitat for these species (Map 4). This is mainly due to the large fires in 1958, 1973, 1977, 1981, 1985, 1999 and 2003.

In the absence of fire events, this area will increase significantly over the next 30 years (Maps 5-7). However if the average area burnt per year of around 24,000 ha continues, this habitat gain may be significantly diminished (Figure 5).

Figure 2: Annual Areas Burnt in Victorian Mallee 1932-2003

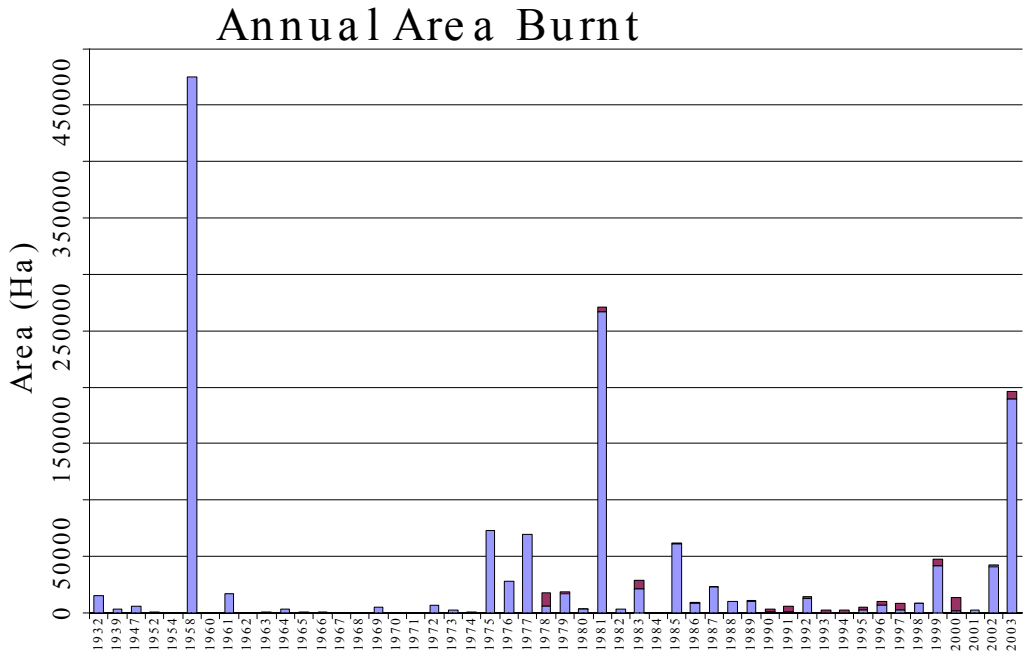


Figure 3: Average Annual Areas Burnt in Victorian Mallee

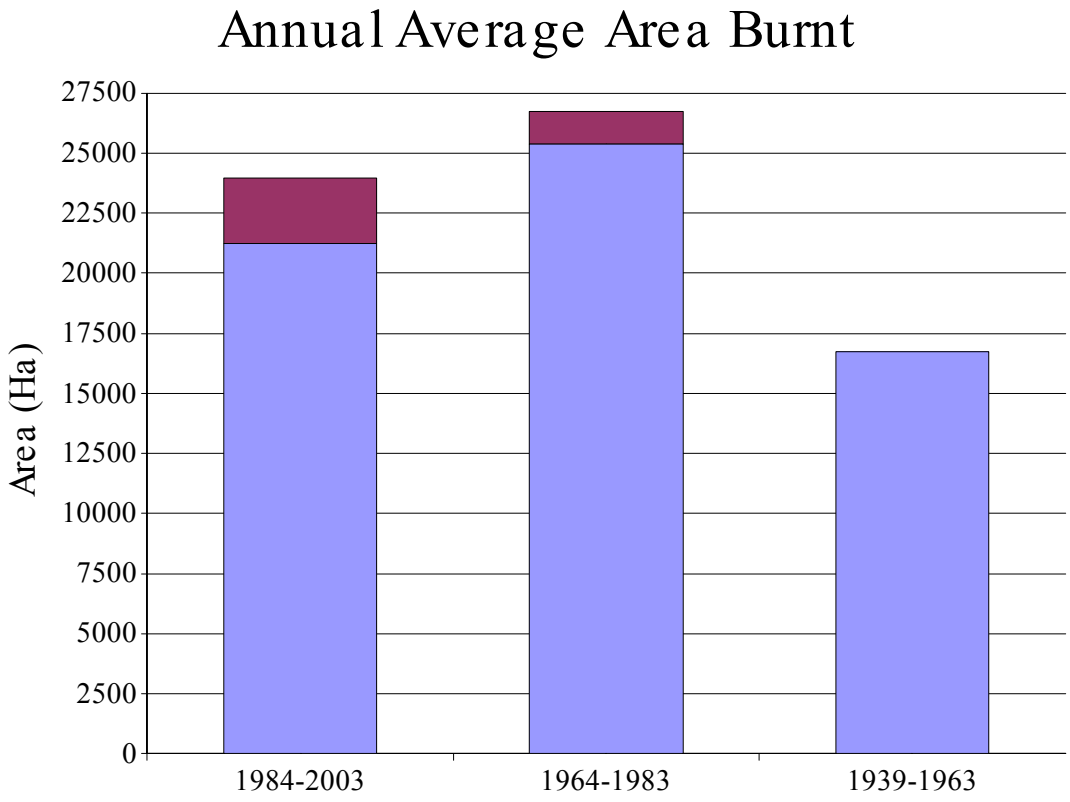
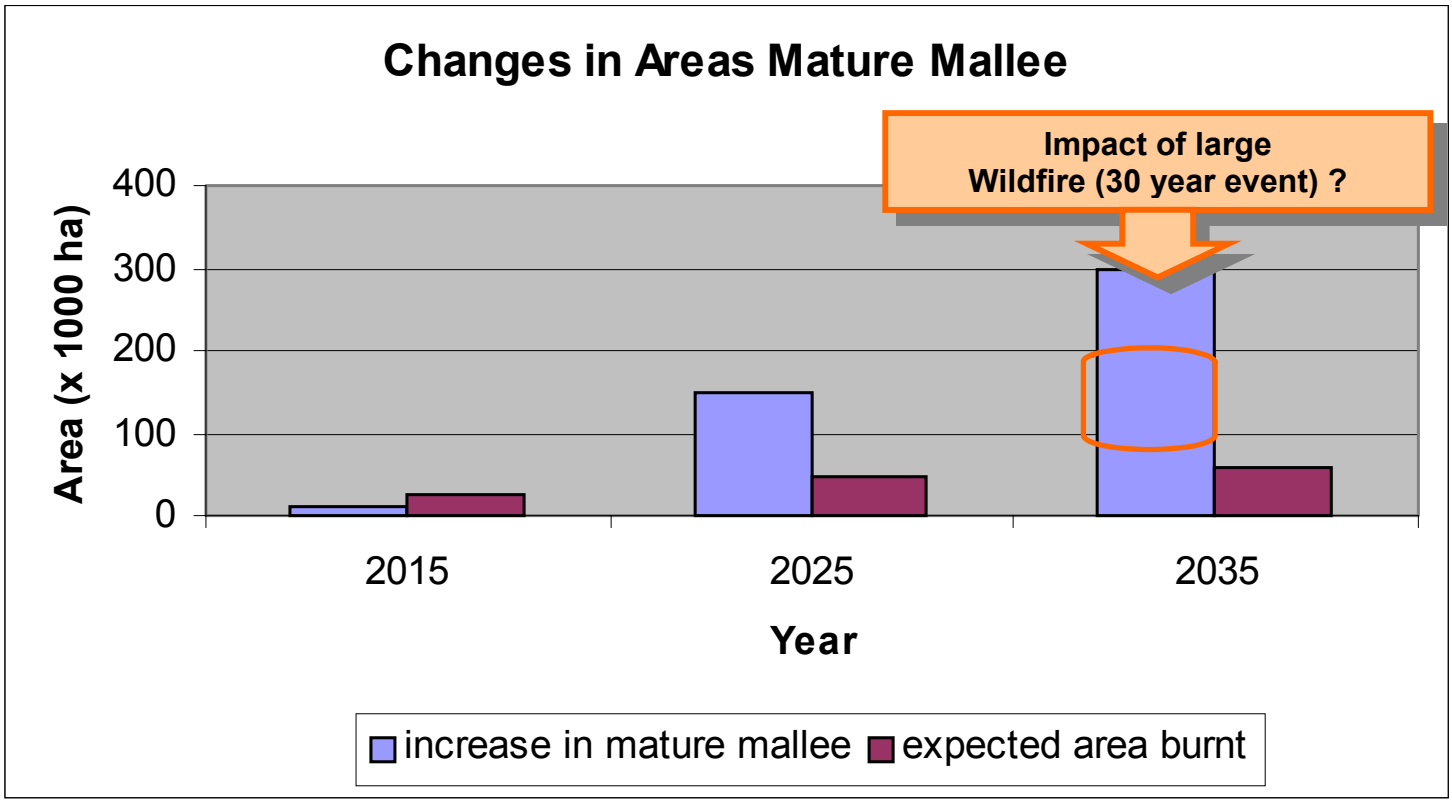


Figure 4: Changes in Area of Mature Mallee (without fire)



Managing Fire in Mallee Communities

In summarising, Fire is an important tool to manage Mallee communities, and achieve good conservation outcomes. To ensure the ecologically appropriate use of fire in Mallee Communities, we need to shift our management away from trying to re-introduce 'natural' or 'historic' fire regimes and think in terms of 'ecologically appropriate' fire regimes & the 'windows' of tolerance needed to maintain the biodiversity elements in the communities occurring across the landscape. We need to actively manage fire (including prescribed burning, fire exclusion and fire suppression) in the Mallee environment. Fire events will (and need to) occur in Mallee communities, we as land managers, biodiversity managers, fire managers and the community need to focus on how to manage their impacts & effects.

Focusing more closely on Malleefowl (the focus of this Forum) and fire, there are several key actions which need to occur. The habitat requirements of Malleefowl needs to be more clearly identified and hence the critical habitat for fire management (i.e. key areas of > 40 years post-fire) determined. We need to combine and analyse fire, habitat (vegetation) and malleefowl density data for the various states, so that the regional & longer-term habitat situation for the species can be assessed (particularly with respect to fire). Clear fire management objectives for Mallee communities & the species they conserve (including, but not only Malleefowl) need to be set so fire (including fire suppression, fire protection of sensitive areas and the active use of fire for long term habitat) can be appropriately planned and managed.

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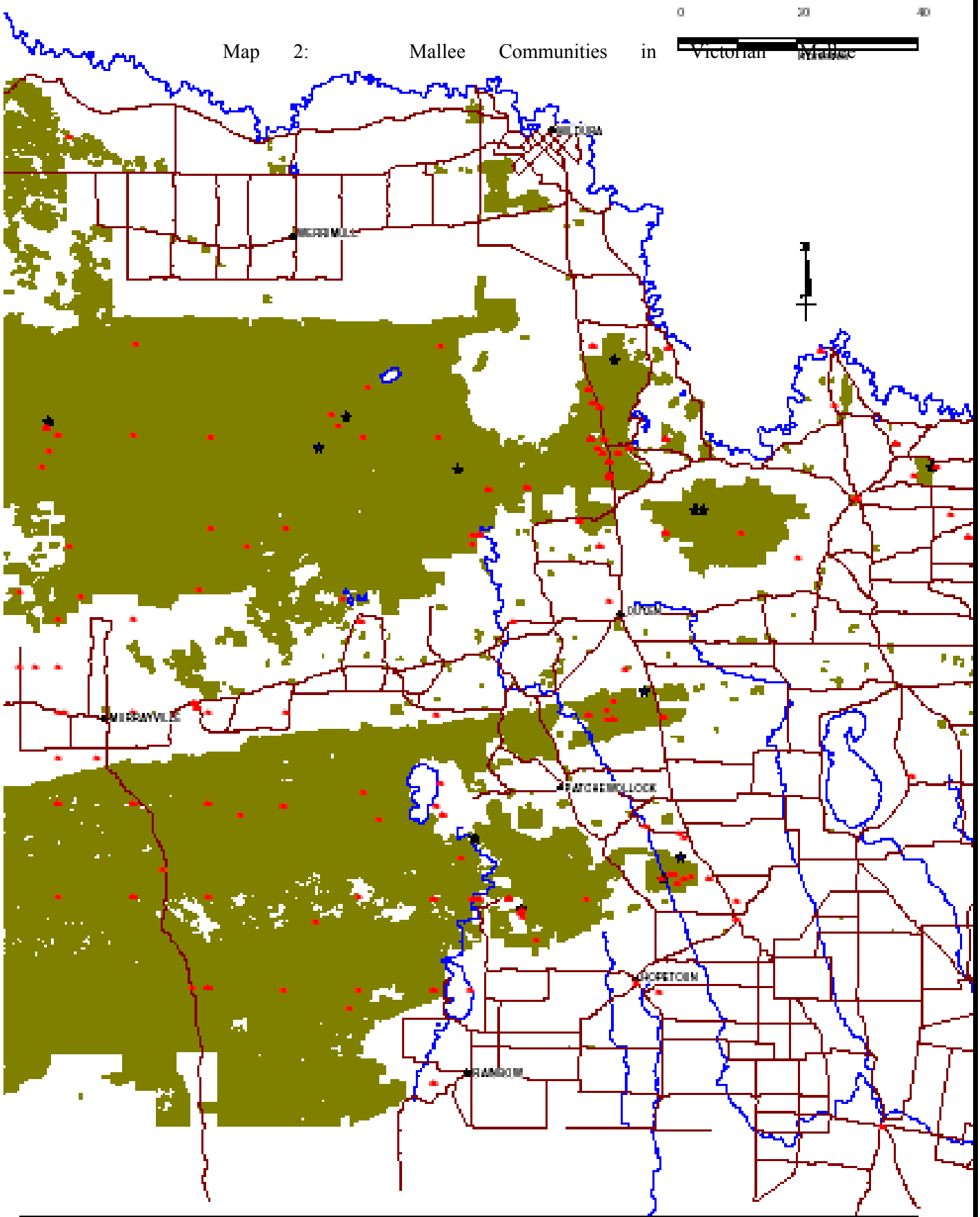
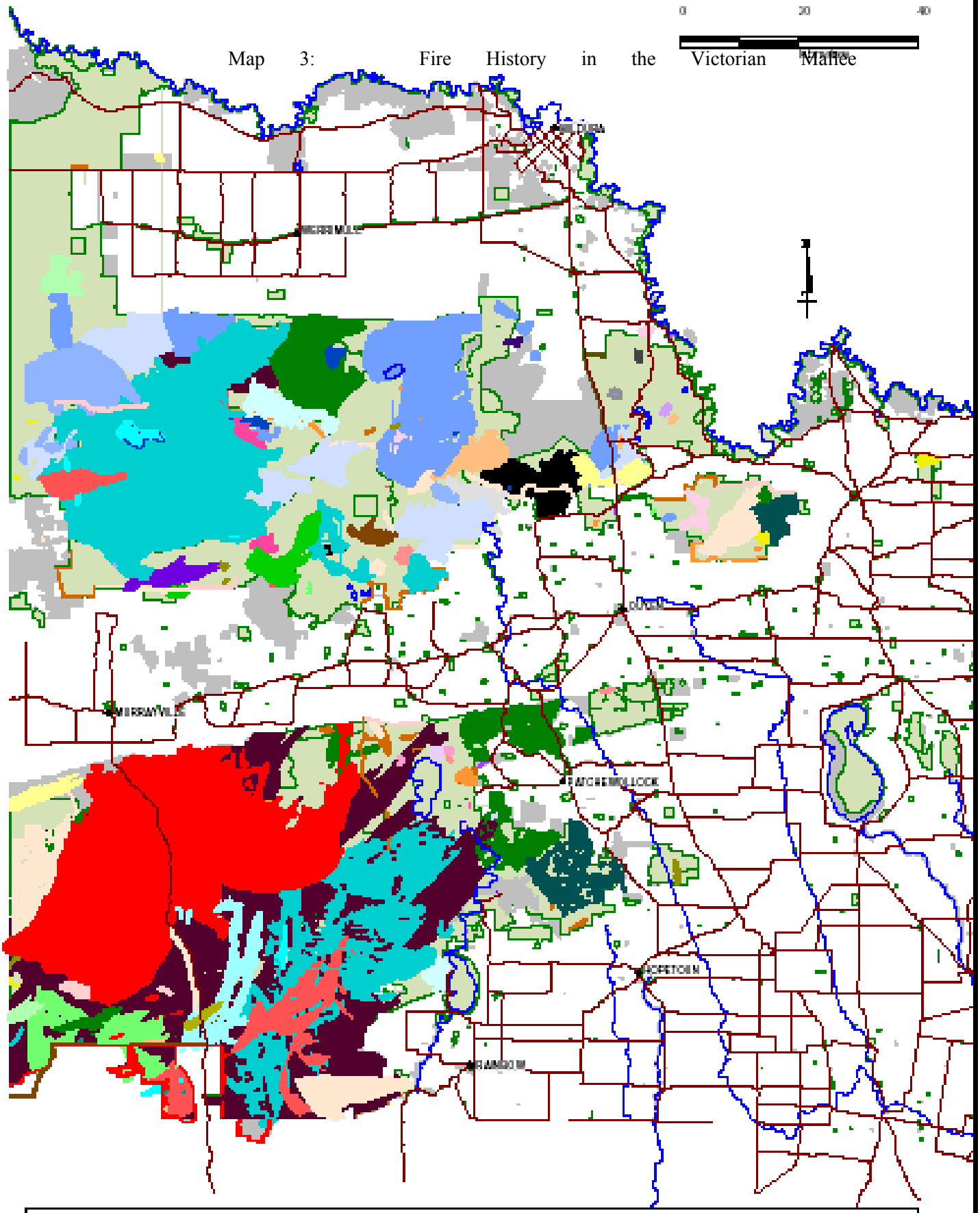
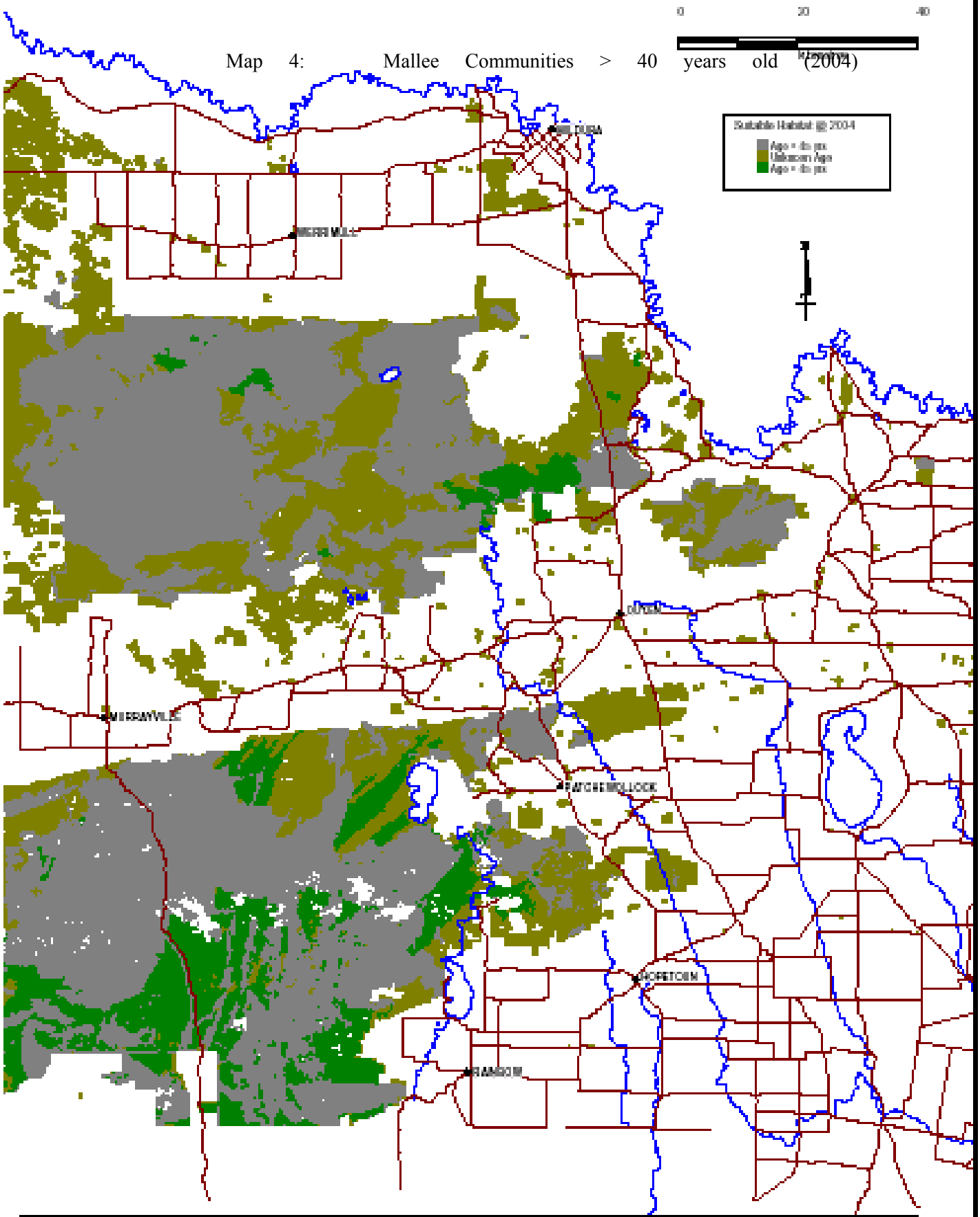
Map 2: Mallee Communities in Victorian Mallee



Map 3: Fire History in the Victorian Mallee

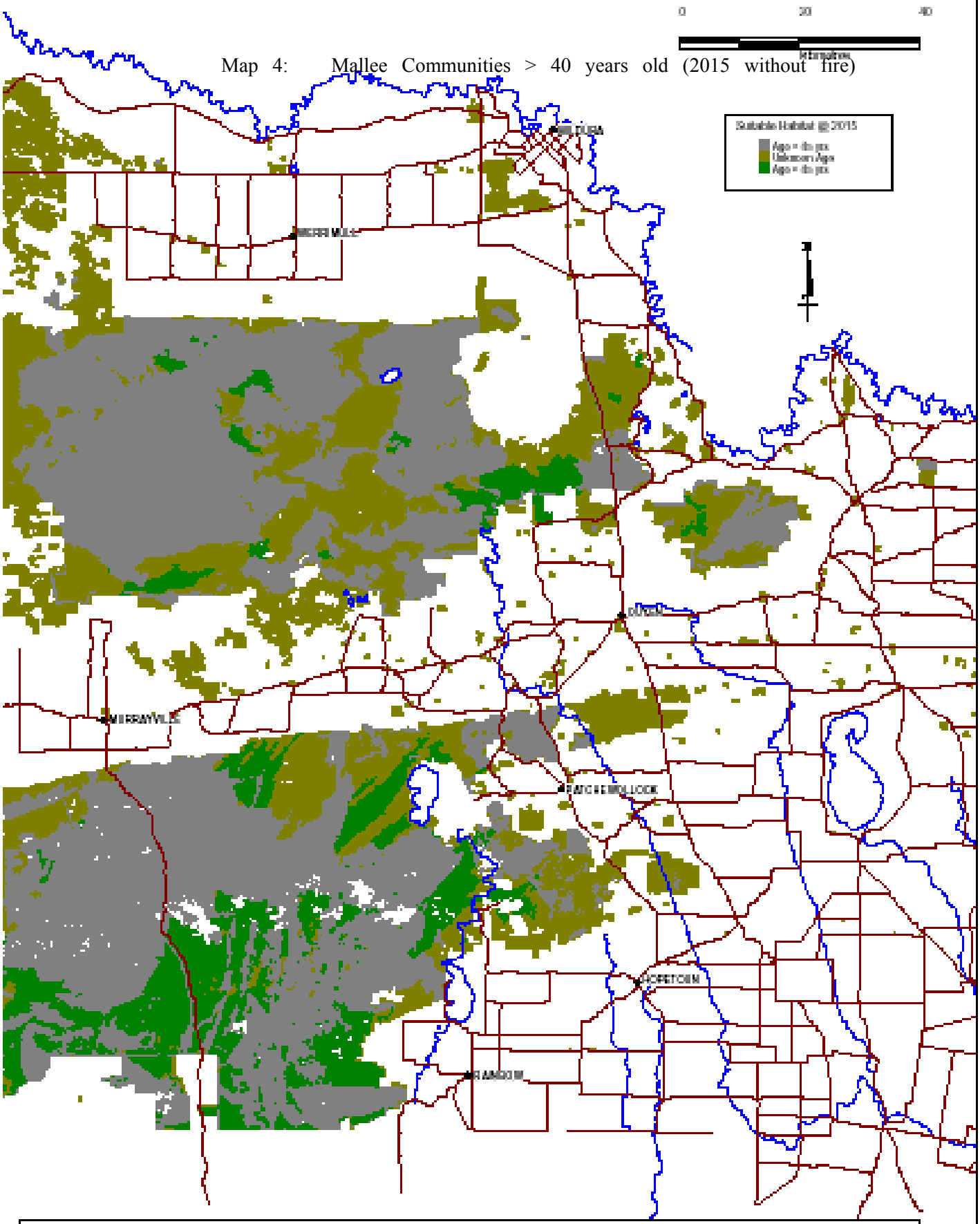


Map 4: Mallee Communities > 40 years old (2004)



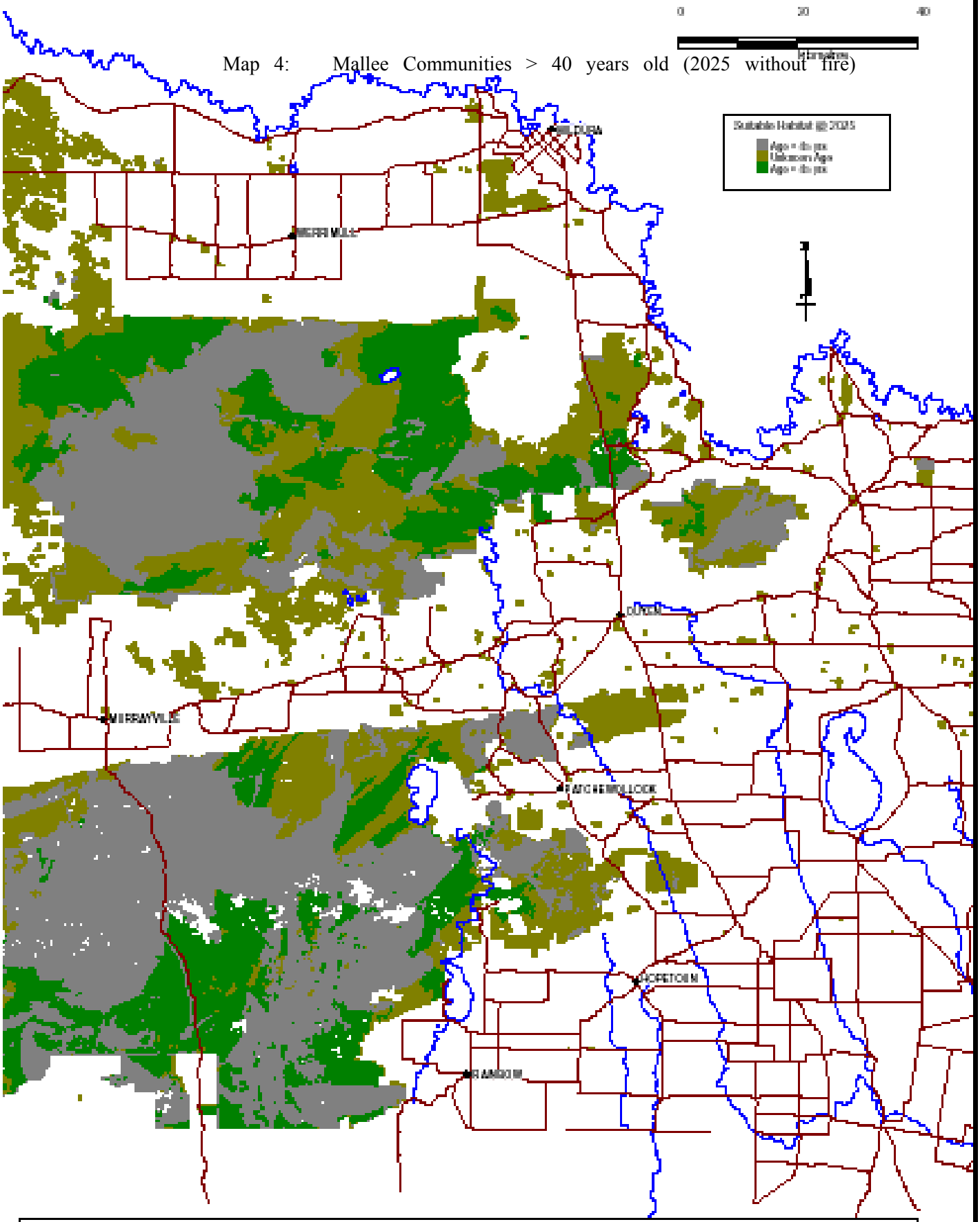
Habitat @ 2004

Map 4: Mallee Communities > 40 years old (2015 without fire)

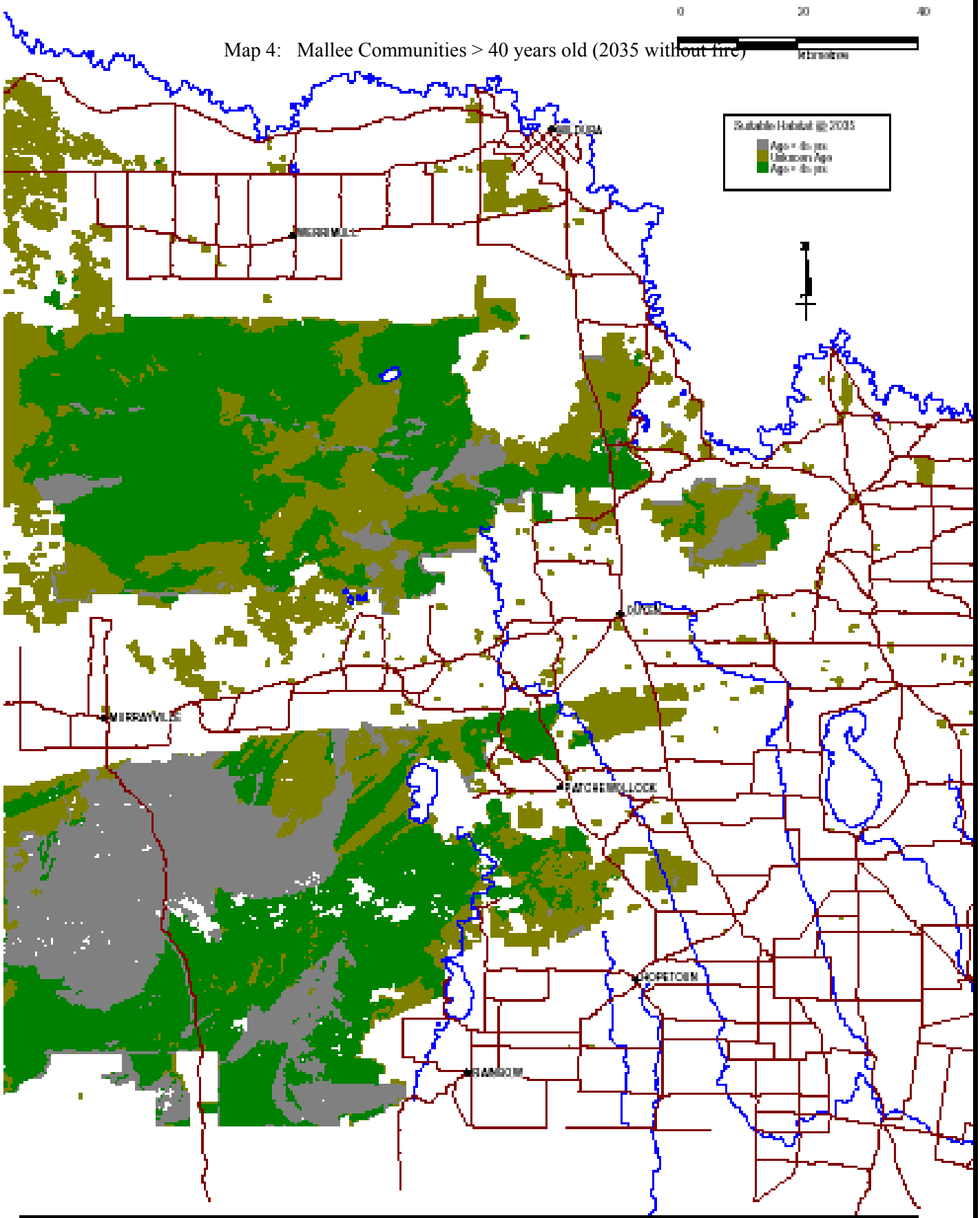


Habitat @ 2015

Map 4: Mallee Communities > 40 years old (2025 without fire)



Map 4: Mallee Communities > 40 years old (2035 without fire)



Habitat @ 2035

Mallee fires and malleefowl – seeking a balance

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Abstract

Fire is a natural part of the mallee landscape. Mallee ecosystems exhibit adaptations to fire, with many species being either fire dependant or fire tolerant. So why has fire become a key threatening process for some of the endemic mallee species, such as the malleefowl?

The presence of fire in the mallee landscape is not in itself the problem. However significant changes have occurred in mallee fire regimes – the sequence of successive fires – particularly in relation to fire frequency, intensity, size and patchiness. Large and/or frequent fires can have significant negative impacts upon local malleefowl populations, through direct impact and through reduction in habitat suitability in subsequent years. The effects of undesirable fire regimes have been exacerbated by broad-scale land clearance, which has fragmented and isolated areas of suitable remnant habitat.

Most mallee fires are started by lightning, which cannot be prevented. Malleefowl require long unburnt mallee vegetation. So how can this paradox be resolved? Fire management strategies should define an acceptable range of fire regimes, which meet the requirements of vegetation communities and key groups of animal species. Fire management actions should seek to promote variability in habitat in both time (age structure) and space (distribution and patch size), while ensuring that adequate areas of long unburnt mallee are retained.

While this may not maximise the abundance of malleefowl at any one point in time, it will help to ensure that malleefowl (and other species with similar habitat requirements) persist within an area at all points in time, thus avoiding extinction.

Introduction

Within the context of malleefowl conservation, fire is often perceived in negative terms such as threat or impact. Fire has been an integral part of the formation of mallee ecosystems, so why is it now seen as a problem?

This paper discusses the role of fire in mallee ecosystems and the importance of understanding the concept of fire regimes. Threats to malleefowl conservation are summarised and the risks associated with undesirable fire regimes are described. Contemporary challenges for mallee land managers are examined, with particular emphasis on managing fire regimes for mallee fauna.

Fire management strategies tailored to achieve conservation outcomes are discussed. The conclusion is drawn that clear conservation objectives designed to meet the habitat requirements of mallee fauna (including malleefowl), integrated with a pro-active fire management program, will minimise the risk of species extinction in the future.

Malleefowl and fire in the mallee landscape

Fire is a natural part of the mallee landscape. Mallee ecosystems have, in part, been shaped by fire. Many mallee plants exhibit adaptations to fire, broadly divided into "sprouters" and "seeders" (Gill & Catling 2002, Bradstock & Cohn 2002). Species that resprout following fire include spinifex (*Triodia scariosa*), mallee eucalypts and the distinctive mallee poplar (*Codonocarpus cotinifolius*). Species which release seed following fire include desert banksia (*Banksia ornata*) and needlewood (*Hakea leucoptera*). Additionally many species have soil-stored seed that germinates following fires – notably the wattles (*Acacia* spp) and many other legumes (NSW NPWS 2002). For many of the "sprouters" and "seeders", fire provides the best opportunity for recruitment of new individuals into the population (Keith et al. 2002a, Bradstock & Cohn 2002).

Fire does not however treat the landscape with an even hand. Flammability varies between vegetation communities and with season, promoting variability in the size and pattern of fires. For example, the highly flammable spinifex (*Triodia scariosa*) is usually found on sand dunes (Bradstock & Cohn 2002). Resulting fires generally conform to dune crests, leaving the swales unburnt. This creates a mosaic of different vegetation age classes, which may become even more diverse following successive fires (Woinarski 1999).

The impact of spinifex fires on biodiversity depends upon a range of factors including intensity, size and patchiness (Allan & Southgate 2002). Broad scale spinifex fires can disadvantage many species including malleefowl, particularly where it forms part of a mallee-spinifex vegetation association. However, small spinifex fires increase the range of vegetation age classes, which may be beneficial to malleefowl (and other mallee species with similar habitat requirements).

In contrast, extensive growth of spear grass (*Stipa* spp) may occur after successive wet years (Willson 1999, Gill 1997). Spear grass grows extensively in dune swales and open flats. Together with spinifex on the dune crests, this creates an almost continuous fuel bed that results in landscape-scale fires (Gill 1997, Willson 1999). Biodiversity impacts of such fires is usually severe.

Optimal habitat for malleefowl is generally regarded as long-unburnt mallee between 30 and 60+ years (Benshemesh 2000, Benshemesh 1997, Bradstock & Cohn 2002, Woinarski 1999). However this varies between regions and local vegetation

characteristics. Malleefowl will tolerate fire at a higher frequency, if fires are patchy and areas of long-unburnt mallee remain (Benshemesh 1997, Benshemesh 1994, Woinarski 1999). Malleefowl will forage in recently burnt areas, particularly adjacent to areas of unburnt habitat (Benshemesh 2000, Woinarski 1999).

The malleefowl is considered to be an indicator species for healthy mallee habitat. Consequently, if an effective fire management program is implemented that successfully conserves malleefowl, then many other mallee species will benefit (Benshemesh 2000, Benshemesh 1994).

Fire events vs fire regimes

Fire is commonly viewed in terms of a single event – the "emergency" that requires immediate control (Gill 1999). The perception of fire as a short-term event is reinforced in daily television reports and newspaper headlines such as "the most devastating one-day fire in Australia's history" (The Daily Telegraph, Monday 20 January 2003). Biodiversity conservation outcomes do not however result from a single fire event, but from a longer-term fire regime (Gill et al. 2002).

Fire regimes are the sequence of successive fires, including variables such as fire frequency, intensity, seasonality, size and patchiness (Gill et al. 2002, Watson 2001). Fire regimes are complex, as these factors operate in both time (including pre and post-European settlement) and space (across and within the landscape) (Noble & Grice 2002, Woinarski 1999).

Inappropriate fire regimes often have negative, although sometimes unintentional, consequences. For example, frequent burning to reduce a perceived fuel hazard may reduce perennial vegetation and increase the growth of annual vegetation (such as grasses), resulting in an increased fuel hazard (Keith et al. 2002b).

The effects of inappropriate fire regimes have also been demonstrated in mallee ecosystems. Mallee eucalypts experience low mortality at a fire interval of 5-10 years. However, higher mortality resulted from more frequent fires, particularly autumn fires (Bradstock & Cohn 2002).

Threats to malleefowl conservation

The National Recovery Plan for Malleefowl (Benshemesh 2000) describes the following major threats to malleefowl populations:

- vegetation clearance: the better habitat areas have been almost entirely cleared
- fragmentation and isolation: little opportunity for dispersal/recolonisation, increased risk of local extinction
- stock grazing: significantly reduces habitat quality for malleefowl
- predation: "fox predation is the greatest single cause of malleefowl mortality" (Priddel & Wheeler 2003)
- wildfire/intentional burning

The grazing effect of feral goats and native herbivores in mallee vegetation communities is not well documented, but may contribute to the degradation of habitat quality for malleefowl (Noble & Grice 2002, Benshemesh 2000).

The significance of fire as a threatening process becomes more apparent when it is considered in context with the other threats to malleefowl, particularly habitat clearance and fragmentation. Prior to broad-scale land clearance, fire operated as a largely natural ecosystem process, and was unlikely to cause significant long-term negative impacts to biodiversity (Benshemesh 2002).

Habitat clearance and fragmentation has exacerbated the effects of fire, by changing fire regimes (particularly frequency and extent) and therefore increasing the likelihood of negative consequences (Priddell & Wheeler 2003, Benshemesh 1992). Fragmentation may lower fire frequency, but it also increases the possibility that a single fire can entirely burn an isolated habitat remnant and consequently the possibility that local extinction of malleefowl may occur (Benshemesh 2000, Seager 2001). In these cases, recolonisation is unlikely (Benshemesh 1994).

Where deliberate burning is undertaken a higher fire frequency is likely. While deliberate burning may not burn the entire habitat remnant, it is likely to increase the younger age classes and decrease the long-unburnt mallee resources that malleefowl require, such as leaf litter for nesting (Benshemesh 2000, Benshemesh 1997).

Excessive post-fire grazing by native and introduced herbivores may have serious and long term negative impacts on malleefowl habitat (Willson 1999, Benshemesh 2000).

However, fire also has positive effects for malleefowl. Young vegetation may provide greater food resources, particularly in terms of seed production (Woinarski 1999, Benshemesh 1994). Benshemesh (2002) states: “many plants that provide food for malleefowl are dependant on, or at least benefit from, occasional fire”.

Managing mallee fire regimes for mallee fauna

So, how can remnant habitat areas and fire be managed in ways that promote the ongoing survival of malleefowl and other mallee species with similar habitat requirements?

To address this challenge, we must:

- develop an understanding of flora and fauna responses to fire regimes and fire frequency thresholds
- develop an understanding of fire regimes and fire history
- evaluate risks to biodiversity from undesirable fire regimes
- identify desirable fire regimes for biodiversity management (even in the absence of comprehensive information)
- develop clear conservation goals and objectives, including strategies for managing high priority risks
- implement a pro-active fire management program
- monitor and evaluate against the stated goals and objectives, on an ongoing basis (both fire regimes and malleefowl populations)

- use an adaptive management process to redefine goals and objectives and re-target management actions as required

(Seager 2003, Gill et al. 2002, Keith et al. 2002b, Willson 1999)

The principal conservation goal for remnant habitat/management areas is to avoid the extinction of species. A specific objective may be to ensure that malleefowl persist and breed within the management area over a 10-year period.

In order to achieve this objective, suitable malleefowl habitat must exist within the management area at all points in time over that 10-year period. If at any stage suitable habitat is not available, malleefowl may become locally extinct.

The major risks to malleefowl from fire are from large fire events that burn the entire remnant habitat/management area, or from multiple fires events of high frequency that collectively burn all areas of long-unburnt mallee (Seager 2001).

To ensure that suitable habitat is always available, strategies need to ensure that the entire management area cannot be burnt in a single large fire and that the desired area of long unburnt mallee is retained.

Fire management actions should promote variability in habitat in both time (age) and space (distribution and patch size), maximising opportunities for species with differing fire responses and fire frequency thresholds (Bradstock & Cohn 2002, Willson 1999).

Within the acceptable range of fire regimes, actions may include:

- strategic burning, to limit the spread of wildfire (by interrupting fuel continuity)
- strategic burning, to promote patchiness during wildfire (by interrupting fuel continuity)
- strategic burning, to increase habitat diversity (by increasing range of vegetation age classes)
- actively controlling wildfire, to limit the amount of long-unburnt habitat affected
- passive containment – if a wildfire is unlikely to exceed the acceptable range

(Bradstock 2001, Willson 1999)

Regular assessment of vegetation age classes will help to determine the most appropriate fire management strategies (ie active control/passive containment/active burn) (Bradstock & Cohn 2002, Bradstock 2001).

Active control (fire suppression) seeks to limit the spread of wildfire and therefore increases older age classes (ie maintains long unburnt habitat). If active control is always undertaken and is always successful, long-unburnt habitat will increase and age class diversity will decrease.

Alternatively, active burning introduces fire into the landscape, decreasing older age classes (ie reduces long unburnt habitat). However, the areas burnt through the prescribed use of fire are usually relatively small.

In addition, an appropriate monitoring program measuring malleefowl breeding densities must be undertaken, to measure the effectiveness of the fire management program and to guide future strategies and actions (Keith et al. 2002a).

The pro-active fire management program described above requires effective communication with stakeholders, particularly where public relation risks are perceived to be higher (for

example in association with increased prescribed burning or less "active" fire suppression) (Seager 2003).

The relative merits of various fire management strategies are examined in the following figures. Three different scenarios relating to a fire in a hypothetical habitat remnant are presented:

- fire in a habitat remnant containing a single vegetation age class (40+ years old)
- fire in a habitat remnant containing multiple vegetation age classes
- fire in a habitat remnant containing multiple vegetation age classes and with a pro-active fire management program

Scenario 1: Habitat remnant with single vegetation age class

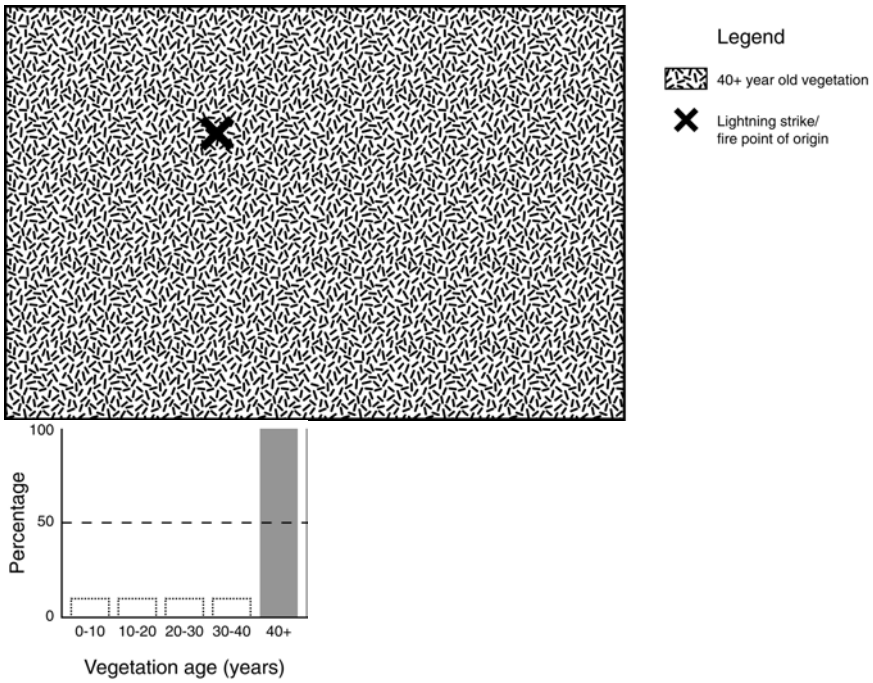

Figure 1a: Hypothetical habitat remnant of approximately 5,000 hectares. Single vegetation type (mallee-spinifex). All relatively long-unburnt (40+ years old, as shown in adjacent vegetation age class graph). X shows a lightning strike and subsequent fire ignition.

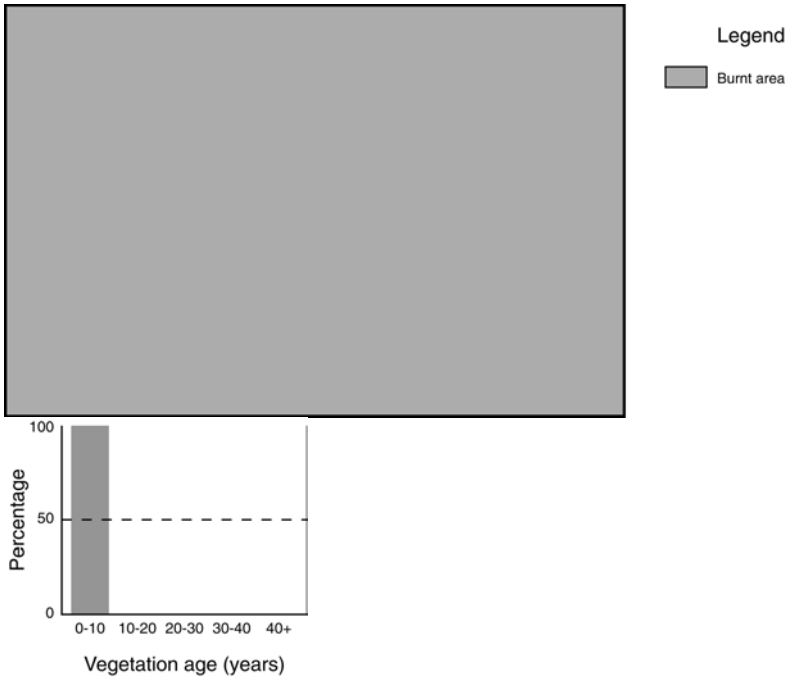

Figure 1b: Fire spreads unchecked and burns entire remnant. All vegetation now 0 years old (as shown in adjacent vegetation age class graph). No suitable malleefowl habitat remains. Malleefowl may become locally extinct.

Scenario 2: Habitat remnant with multiple vegetation age classes

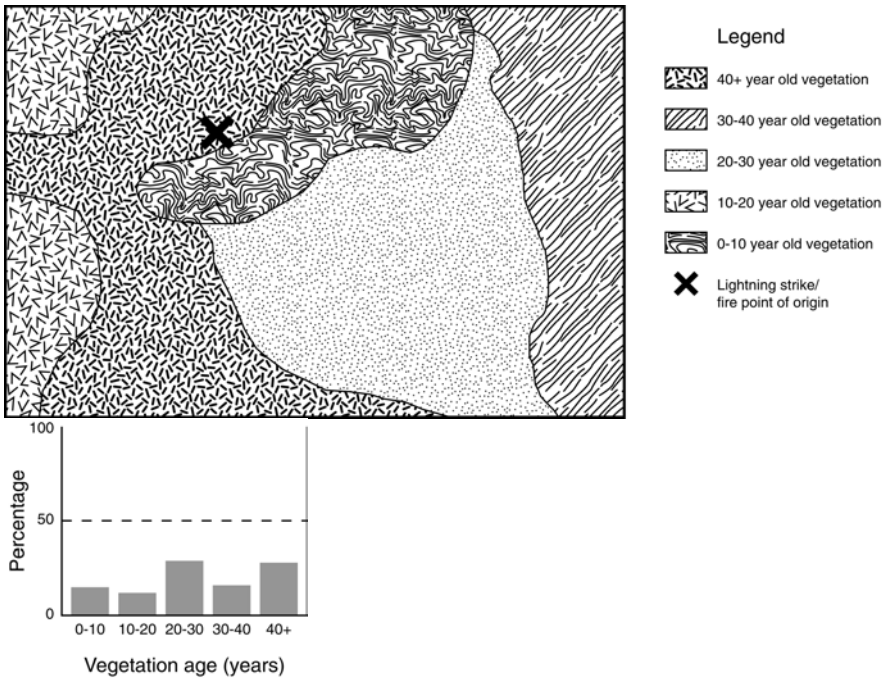

Figure 2a: Same hypothetical habitat remnant. Single vegetation type (mallee-spinifex). Five different age classes (as shown in adjacent vegetation age class graph). X shows a lightning strike and subsequent fire ignition.

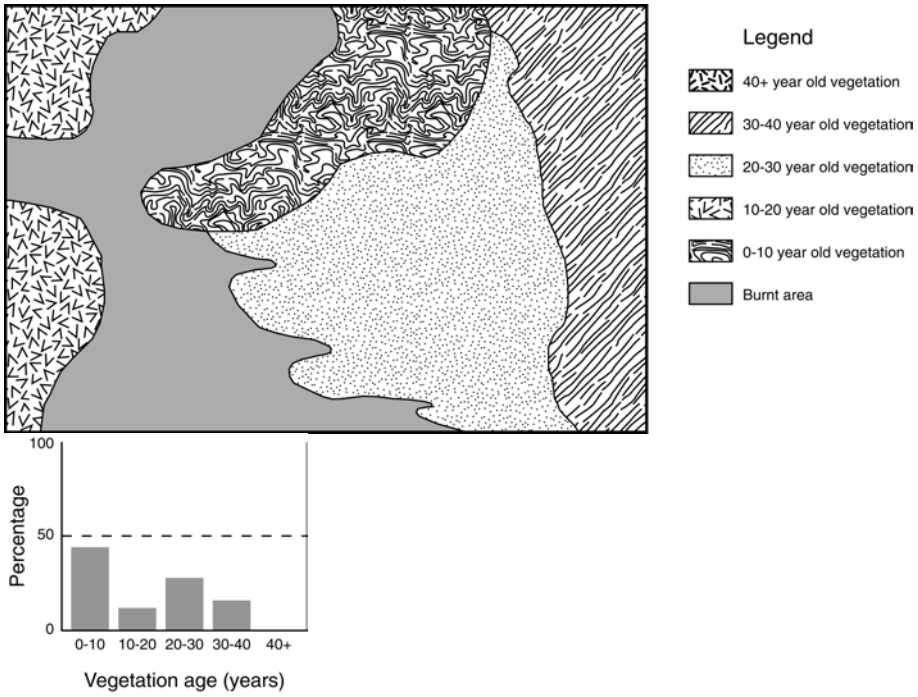

Figure 2b: Spread of fire is largely constrained by younger vegetation age classes with discontinuous fuels (a small amount of the 20-30 year old vegetation is burnt). All 40+ year old vegetation has been burnt (as shown in adjacent vegetation age class graph). Large areas of <40 year old vegetation remain. Malleefowl may persist.

Scenario 3: Habitat remnant with multiple vegetation age classes with pro-active fire management program

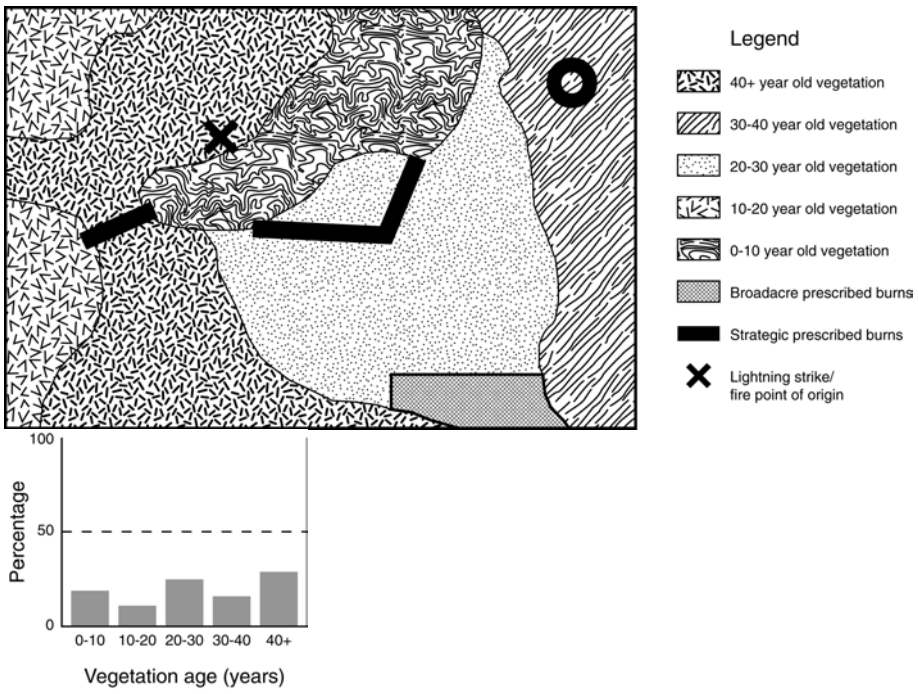

Figure 3a: Same hypothetical habitat remnant. Single vegetation type (mallee-spinifex). Five different age classes (as shown in adjacent vegetation age class graph). Pro-active fire management strategies include strategic prescribed burning (both linear fuel-reduced zones

and for specific protection of a localised biodiversity asset) and selective broadacre prescribed burning. X shows a lightning strike and subsequent fire ignition.

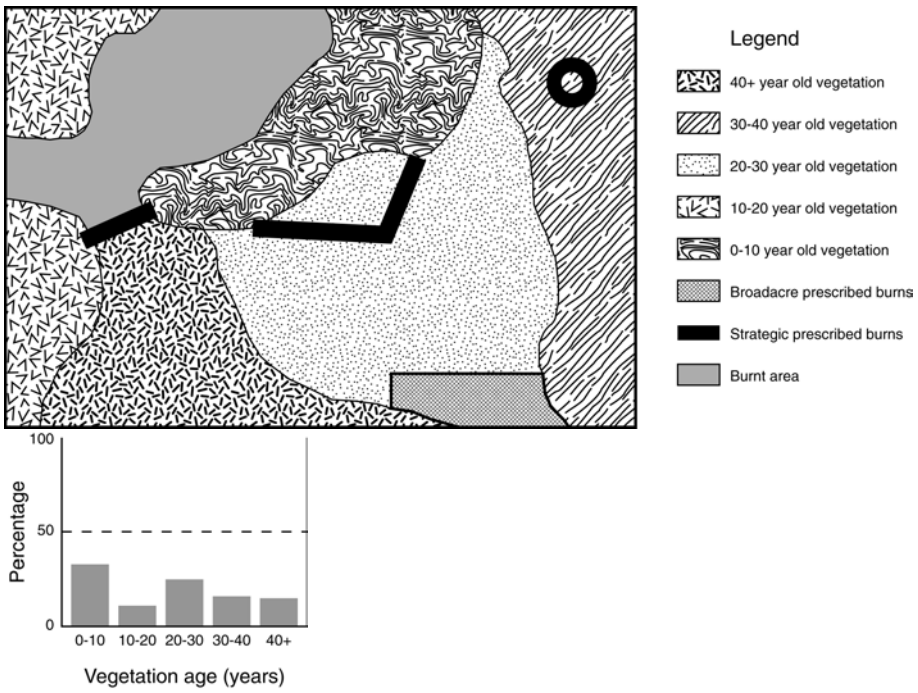

Figure 3b: Spread of fire is constrained active fire management strategies and by younger vegetation age classes with discontinuous fuels. Approximately half of the 40+ year old vegetation is retained (as shown in adjacent vegetation age class graph). Malleefowl likely to persist.

Conclusion

Fire can have both negative and positive effects on malleefowl conservation. Fire can render habitat unsuitable for malleefowl for many years. Inappropriate fire regimes can cause local extinction of malleefowl, particularly in small and/or isolated remnant habitat areas. However fire can also provide greater food resources and, as discussed in this paper, provide a mechanism for successful malleefowl conservation.

A pro-active fire management program should define an acceptable range of fire regimes, based on an understanding of flora and fauna responses to fire and fire frequency thresholds. A range of vegetation age classes should be promoted, providing opportunities for species with different habitat requirements. Fire management actions should be tailored to maintain this age class variability. An adaptive management process should be used, to assess the effectiveness of the fire management program, to redefine goals and objectives, and to guide future management actions.

The pro-active fire management program described in this paper will not maximise the abundance of malleefowl at any one point in time. However, it will help to ensure that malleefowl (and other mallee species with similar habitat requirements) are conserved within a management area at all points in time, thereby avoiding local extinction.

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Ecological consequences of clearing and fragmentation of native vegetation

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The removal of native vegetation on a broad scale is non-random process that leads to a collection of fragmented vegetation patches in a matrix of different vegetation and/or land uses. The result is a series of fragments or remnants located in different positions in the landscape, on different soil types, possessing different vegetation types and associated fauna, and varying in size, shape, isolation and type of ownership. What are the ecological consequences of this reduction and fragmentation of native vegetation?

Removal of native vegetation results in changes in radiation fluxes with increases in solar radiation leading to higher temperatures during the day. There are also increases in re-radiation at night resulting in lower night temperatures. Surface and soil temperatures increase in range and may be very much greater by day and lower at night than before clearing took place. There also may be an edge-effect in relation to solar radiation depending on the angle of the sun; the higher the latitude, the more it penetrates the edge of the remnant. The implications of these factors alone are significant. Changes in microclimate may result in changes in the species composition at the edges of remnants and may have major impacts on the soil biota with potential effects on ecological processes such as nutrient cycling. In addition, species present before clearing may not be able to be re-established because the changed microclimate may not provide a suitable environmental for them.

Clearing native vegetation also results in changes to the pattern of wind flow across the landscape, with less resistance and protection. Species that established themselves when the vegetative cover was continuous were relatively well-protected from the effects of wind. Increased exposure often results in increasing rates of wind throw and wind pruning of dominant plant species. This creates gaps in cover with increased chances for invasive species to establish. Increased exposure to wind can lead to increases in evapo-transpiration, reduced humidity and increasing dessication rates. Increased wind may also lead to increases in fall of litter with potential for changes in the litter fauna. In addition, there may be increasing movement of dust and seed into patches from the outside, further increasing the chances of invasion by species from outside the remnant.

Major changes in the hydrological cycle result from the removal or thinning of native vegetation. Deep-rooted perennial vegetation uses much more water than the annual plants that largely replace the former vegetation. More rain falls directly to the ground in cleared areas than under uncleared land, with the potential to damage the soil by impact. There may be less buffering and more extreme run-off events. More water flows across the landscape, moving topsoil around, in some cases into the remnants

themselves, while in other cases soil and litter is removed from the remnants; this depends on the position of the remnant in the landscape.

Native vegetation is often resistant to invasion, but is less so when disturbed and enriched. Water moving soil from areas surrounding remnants into remnants can constitute a major disturbance. The soil is usually accompanied by seed and nutrients (eg, fertiliser, droppings from domestic livestock). This provides ideal enriched conditions for the establishment of weeds.

In extensively cleared areas, more water enters ground water resulting in a rise in the water table, in some cases very rapidly. Water-logging occurs when the water table reaches ground-level. Rising water tables are often accompanied by salt (sodium chloride) that has been stored deep in the soil profile leading to increasing soil salination, destroying otherwise productive agricultural land and remnant vegetation. The effect depends on the position in the landscape. Dryland salinity is now a major problem in many parts of Australia. In addition, saline waters flow into watercourses leading to destruction of freshwater ecosystems and loss of potable water. It is ironic that in the driest continent after Antarctica, some of our environmental problems stem from too much water in the landscape.

Loss of native vegetation and its fragmentation has a number of biotic consequences that can be moderated by a number of factors. For example, time since isolation or creation of the remnant is a major modifying factor. The Theory of Island Biogeography states that at the time of isolation the island (in this case remnant patch) is carrying more species than it is capable of carrying over time and so species will be lost. This is the process of species "relaxation." The longer a remnant has been isolated the more species it will lose. Obviously for some species, such as those dependent on native vegetation with requirements for large areas, the process of relaxation will be rapid, probably a matter of years. However, for long-living, sedentary species, like the dominant tree species, it may take centuries. **The point to note is that remnants will lose species over time and this will pose major management problems**.

The number of species lost will also be modified by the distribution of native vegetation and the dispersal mechanisms of the plants and animals of the remnant. The shorter the distance between remnants and the greater the number of species with the ability to cross that distance, the greater will be the chances of the species remaining. Some species, which require other species to help them move around the landscape, are doomed if their transport is lost from the area. This may be the case with some species of the genus *Santalum* when the emu is lost from an area.

Remnants now occur in a matrix of human-dominated landuses. Every one is likely to be affected by what is happening in the surrounding land. This means that what happens in that land can have a major impact on the remnants. Nutrients and seeds being deposited in the remnant have been mentioned earlier. Species that depend on the surrounding land can also have an effect. Domestic stock are obvious examples but there are other more subtle ones; like the galah that has expanded its range because of human activities and competes with remnant-dependent species for nest hollows, damages and kills trees, and introduces the seed of invasive species via its droppings.

There are a number of characteristics of remnants that help to modify some of the degrading processes. Remnant size is an obvious one. The larger the remnant the longer it will be able to resist some of the degrading processes. Unfortunately we have no general information on how large remnants should be; that will be determined on a case by case basis, depending on position on the landscape, etc. Larger remnants will contain more species than smaller remnants. However, the non-random nature of clearing of native vegetation will almost always ensure that the larger privately owned remnants are on the poorer soils and are not representative of the original vegetation associations.

The shape of the remnant will also help modify the effects of degrading processes, as will the position of the remnant in the landscape. Larger remnants have less edge compared with their area than smaller remnants and are therefore subject to fewer edge effects. Those remnants lower in the landscape can be exposed to more of the impacts from the surrounding matrix.

The ultimate remnant is the individual tree isolated from other elements of native flora by “parkland clearing.” This vegetation type needs urgent protection and management. We are faced with vast areas of these "living dead"; aging trees with no replacements. What will these landscapes look like in 50 or 100 years without extensive management? They will be vastly different and, on present trends very much species poorer than at present.

What follows from the ecological imperatives?

History tells us that clearing is no longer the major degrading force. The era of broadscale clearing has finished; if only because most of the land suitable for agricultural, horticultural, etc (but not for urban development) purposes has been cleared. There is still the danger of whittling away at the remainder; the supposed “death of a thousand cuts.” There is no doubt that both education and legislation are required to halt this process. Legislation needs to put all applications for clearing into a perspective that shows transparently that the planned clearing will not result in the loss of a remnant of high conservation value or of high ecological value. That means identifying and weighing its value as part of the ecological function of the area; in its water use, moderation of erosion, etc. Individual trees also require this type of protection.

We also need to value remnant vegetation better in an economic context. At present, remnant vegetation on agricultural land is valued on the basis of the economic value of the land on which it occurs, if put into agricultural production, or on the contribution it adds aesthetically to the resale price of the property. This valuation system is fundamentally flawed because it takes no account of the contribution the remnant vegetation makes by providing a range of ecosystem services from local to regional scales.

The critical need in relation to native vegetation is that of management. **Most remnants are degrading. Simply putting a fence around them to stop domestic livestock from grazing them will not be sufficient to halt the loss of species.** Management of internal dynamics of remnants is necessary in order to halt the process. This management will depend on the size of the remnant. With larger

remnants it may be necessary to manipulate disturbance regimes like fire as well as the population dynamics of key organisms. In addition it will be necessary to examine external influences and see if they can be moderated. On smaller remnants it will be necessary to concentrate on the external influences. **Management of remnants is essential.** This means integrated landscape management on an ecological basis with knowledge of what each remnant contributes to the ecological whole.

Managers of native vegetation need to concentrate on the practical issues relating to the impact of fragmentation on natural ecosystems and managing fragments for their retention. This means understanding both the physical and biological consequences of the fragmentation of landscapes, and the options available to mitigate the processes leading to the degradation of the fragments.

Chicks, Food and Fragmentation

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Introduction

There has been extensive fragmentation of habitat and many local population extinctions of Malleefowl have occurred. There are however, many small isolated remnants, particularly in the Western Australian wheatbelt, which support small populations of Malleefowl and most of which are privately owned. Food availability is an important factor in the survival of both adults and chicks. In studies of chick mortality, it has been shown that metabolic stress, due to an inability to find food, is a major cause of mortality (Benshemesh 1992; Priddel & Wheeler 1990; Frith 1962).

Malleefowl Diet

In 2002, I was able to undertake a student project on diet analysis of Malleefowl at Curtin University, Western Australia. For this, I examined the crop and gizzard content of 19 birds, 8 from SA and 11 from WA. The results of this study confirm the birds are opportunistic feeders taking a wide range of plant material and invertebrates.

There was a diversity of invertebrates identified, particularly ants, with a low number of individuals from each species. Invertebrates are taken opportunistically and not sought out. The birds also took advantage of insect outbreaks. One SA bird had taken a large number lerps, others had taken large numbers of grasshoppers and winged ants. There was no strong seasonal preference for any particular food type, however seeds were the major food type taken, making up 66% of food objects in the stomach.

Apart from native seed, agricultural crop including lupins and wheat were also taken. Ten of the birds had taken either or both of these seeds. Crop seed is readily available, both in the field and from roadside grain spills after harvest. Vegetative material from weed species commonly found on roadsides was also taken. This, together with observations of birds feeding regularly in cropland (pers. obs.), indicates adults will readily seek food outside of the remnant habitat.

Chicks and Food

The stomach content of one chick was also able to be examined and was found to contain predominately termites and Fabaceae seeds, probably a species of *Daviesia* (Table 1).

Table 1: *MPG 09 Stomach Analysis, Narembeen Malleefowl chick*

CROP				GIZZARD			
Species	**Type**	**Size mm**	**No.**	**Species**	**Type**	**Size mm**	**No.**
Plant				***Plant***			
Fabaceae, *Daviesia* sp	S	2x3	18	Fabaceae, *Daviesia* sp	S	2x3	97
Hibbertia sp	S	1.5x1.5	2	*Hibbertia* sp	S	1.5x1.5	8
Lilieaceae/ Epacridaceae	P	4x3	3	*Eremophila* sp	S	3.5x2.5	2
				Hibbertia/ Epacrid: *Astroloma sp*	S	4x2	2
				Hibbertia sp	S	2x2	2
Invertebrates				***Invertebrates***			
Camponotus terebrans	H	-	4	*Camponotus terebrans*	H		1
Crematogaster frivola	H	-	5	Prob. remains of termites			
Terebrionidae; *Adelium* sp	C	-	1				
Termites	I	-	308				

KEY: S – Seed, P – Pod, H – Hymenoptera, I - Isoptera

Malleefowl chicks are independent and like other precocial chicks, have innate cues targeted at particular stimuli that will eventually lead, through trial and error, to the selection of food objects (Davies 1961; Göth 2002). But whereas most precocial chicks are able to learn from parents and siblings, Malleefowl cannot. Innate cues and the ability to learn edible from inedible objects quickly is important for successful foraging and survival.

The findings of the diet analysis are consistent with observations of chick behaviour after emergence from the mound. Pecking is orientated toward objects with reflective surfaces (such as insect carapaces) and objects of contrasting colour to the background (Waag 2003). A study of Brush-turkey chick pecking orientation had similar results (Göth & Proctor 2002). One interesting observation however, was the difference in time before pecking began. The Brush-turkeys were found to have a 40hr period after emergence before pecking began. The Malleefowl however, began pecking within half an hour of emergence.

Implications for small remnants

In small reserves, where isolated populations of Malleefowl occur, there may be insufficient food available for the chicks to learn to forage successfully in the critical period. There are a number of factors relating to food which should be explored for managing a remnant or rehabilitating an area in order to maintain the Malleefowl population through the survival and recruitment of the young.

Malleefowl chicks are in direct competition with adults for seeds & invertebrates, however, adults are also able to utilise vegetative material (shrubs which chicks cannot reach during foraging), agricultural crop and supplied grain. In order to maximise the amount of food available for chicks, food objects available at the ground level in small remnants must be targeted.

The presence of Fabaceae and *Acacia* species in a remnant is important to provide seed (Frith 1962). Seeding can be reduced by grazing, so fencing remnants and

control of herbivores such as kangaroos and rabbits which compete with the Malleefowl is important. In rehabilitation work, it is important not only to select indigenous plant species, but also plants with a range of seeding times, particularly those seeding during the summer hatching months.

The importance of termites in Malleefowl chick diet is not known. These invertebrates are found in a range of habitats and the behaviour of some makes them ideal prey for Malleefowl chicks. A large proportion of termite species in Australia are grass and debris feeders. Many of these species forage on the surface during the day when the chicks are active and can be locally abundant (Ratcliffe *et al* 1952). In order to support these species, a healthy herb layer and litter is needed.

Another invertebrate which occurs widely in the Australian landscape and could be of importance to Malleefowl chicks (though there is no evidence as yet) are the collembolans. These small (3-10mm) invertebrates inhabit the surface layer of soil and debris (Harvey & Yen 1997) and could be picked up by the chicks when foraging. The litter layer is important for these creatures.

During observation of the chicks after emergence, one chick displayed drinking type behaviour in reaction to a piece of reflective shade cloth on the ground (Waag 2003). This would seem to indicate the chicks have cues for drinking as well as feeding. Though moisture can also be gained from food such as invertebrates, it may be that rainfall or dew may also be quite important initially.

There needs to be more work examining the behaviour and diet of chicks in small isolated remnants in order to determine the factors critical to achieving successful foraging and ultimately, recruitment into the population.

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Bureaucratic and funding impediments to threatened species recovery

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Introduction

This paper considers the bureaucratic and funding impediments to threatened species recovery from the perspective of the community. It attempts to give a national perspective, however the author's work is focussed in Victoria and therefore many examples are Victorian.

Role of community in species recovery

Firstly, it is important to outline the primary role of the community in species recovery, in order to appreciate the various impediments experienced by the community. It is well recognised that the government does not have the capacity to recover species without assistance, and that the community plays a vital role in complementing the limited time and resources of agency staff. Additionally, the community is well placed to carry out species recovery actions both on public land and private properties. Volunteers often live close to the area that requires action, and they also have the passion, enthusiasm, interest, and the time to undertake recovery actions. There is also a diversity of skills and expertise among the community that can be usefully employed to generate conservation outcomes.

Impediments

Policy requirements

Lack of data is an important impediment to species recovery, particularly in the more remote areas of Australia. In remote areas where data on species and ecological communities is lacking, there may be a greater need for research and skill development before on-ground works can take place. A species or community may be significantly threatened with extinction, but not recognised as such due to a lack of ecological information. This information is required for a species to be considered it for listing under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. Species must be listed under this Act in order to receive Natural Heritage Trust species recovery funding.

Similarly, a species may be classified as threatened under state legislation and be the focus of recovery action in that state. However, unless it is also nationally listed, the species would not qualify for the majority of available threatened species funding that is provided through the Natural Heritage Trust.

Recovery Planning

Significant effort is currently being invested in Victoria into the writing of large quantities of action statements (state recovery plans). Some recently prepared documents are lacking in specific measurable actions and are predominantly "business as usual" documents, without any commitment or identified actions to assist with real recovery of the species identified. This could be a result of political pressures within state government agencies which results in resource use interests often being given greater importance than species recovery. An example is the recently reviewed Spot-tailed Quoll action statement, which places a limit on the number of quoll records that can be protected in forest management areas. In effect, the action statement only allows for the protection of less than 200 individuals of the species state-wide. There is some concern that this political battle within government agencies has led to lack of confidence that significant gains can be achieved in species recovery, and that this has subsequently led to lower goals being set in action statement and other similar planning documents.

Because of the significant resource that the community provides in conservation action, recovery plans that recognise the role of community are likely to achieve greater outcomes for the species. The national malleefowl recovery plan contains specific measurable targets and actions for the conservation of malleefowl. Additionally, the plan recognises the role of the community in recovery of the malleefowl and contains specific actions for volunteer and community involvement in monitoring and habitat protection for this species.

In relation to funding impediments, it is important to remember that threatened species agencies have limited funds compared to other areas of the bureaucracy. Hence they have limited capacity to devote significant amounts of time to one particular species and are forced to prioritise the allocation of their resources between large numbers of species. Similarly, agency staff in charge of coordinating recovery programs may find themselves in conflict when their loyalties to the agency outweigh their commitment to a specific recovery program. These limitations highlight the potential benefits of a community coordinated recovery program, whereby the community coordinator can focus on a particular species and not be constrained by competing interests.

In some cases across Australia, state agency staff are criticised for holding too much control over resources such as species data and conservation activities. This can be problematic mainly because agency staff do not have the resources and capacity to undertake or oversee all conservation activity. Therefore it is important that they increase their confidence in the community's ability to add value to the conservation process and share the available information.

Staff turnover is another important impediment to species recovery, both in state as well as Commonwealth agencies. Lack of continuity of conservation staff frequently results in a slowing of support and information flow which prolongs recovery progress. It is important to maintain a constant contact point for a particular species or issue over time.

Regional Planning

Regional plans have become the leading document through which regional Natural Heritage Trust and National Action Plan for Salinity and Water Quality funding is directed. In seeking projects through the regional funding process, proponents must demonstrate the direct link to targets identified in a particular region's plan (known as the Regional Catchment Strategy in Victoria).

To date, many regional plans have taken a "business as usual" approach, with one region in Victoria recently quoted as aiming to "do what we're doing now, plus a little bit more". This is a potential impediment to species recovery, as planning bodies need to be leading significant environmental management changes in order to address the current extinction crisis in Australia. Community groups can play an important role in suggesting issues, targets and actions to be addressed in their regional plans.

Regional bodies (such as Catchment Management Authorities in Victoria) have experienced some difficulties in engaging community groups in the regional planning process. The community may see the process as long and boring, finding it difficult to prioritise spending time in meetings and reviewing long planning documents. However it is important to note that community input into these plans is very valuable, particularly from community members of recovery programs. Recovery teams input into the plans and specific targets in the plans could assist with future funding allocations to these programs. Specific actions that are relevant to the goals of the malleefowl recovery program will assist with seeking funds in future through the regional Natural Heritage Trust process.

Some regions in Victoria have adopted innovative ways to involve the community in the development of regional plans – such as holding a community survey, and providing cameras to individuals and asking them to take photos of places in the region of importance to them.

Regional funding

As noted above, accredited regional plans will provide the basis of regional Natural Heritage Trust funding, including funding of national threatened species programs. It is important to note that a project must be considered a priority by a region in order to be included in the regional funding bid, which is known as the Regional Catchment Investment Plan. Limited funding is available for threatened species recovery through regional Natural Heritage Trust funding. At the time of writing, it was estimated that approximately $300,000 would be available for biodiversity/threatened species in the 2004-05 Natural Heritage Trust funding round for each Victorian region.

Coordination of effort

The coordination of recovery effort across regions is an on-going challenge in species conservation. Some species recovery programs only require funding from one region and others require funding from numerous regions. For example, the red-tailed black cockatoo recovery team currently seeks funding from 3 separate regions that span the range of this bird in Victoria and South Australia. This is particularly time-consuming in terms of application and reporting requirements. However, there is an opportunity for recovery programs to seek multiple-region funds, coordinated through one region, which is currently referred to as "regional competitive" funding. Bids of

this nature require cooperation, good communication and clear goals identified by all regions involved.

Inconsistencies in time lines and communication have made it difficult for community groups and recovery teams to engage in the regional Natural Heritage Trust funding process. For example, most regions had different time lines for the submission of project ideas through an "expressions of interest" process in Victoria for 2004-05 funding – some regions closed their process in October 2003, while others were still undecided on the process in January 2004. Additionally, not all regions had a formal "expressions of interest" process. Accessing information regarding time lines required contact with individual regions. Hence the level of work for a recovery team wishing to access funds in various regions has been significant and somewhat confusing.

There is room for improvement in the communications area, however it is recognised that this is an evolving process and that Victoria in particular is experiencing a significant learning process. It would assist groups greatly if the funding process and time lines were more consistent and better communicated. While some groups are aware of the regional funding process, many (including some regional threatened species agency staff) are not aware of the detail and hence of the different opportunities available. For example, there is limited awareness of the opportunities through "regional competitive" funding (ie. funds to be invested across a number of regions, but sought through one region only) and that this funding is available through the annual regional funding process. As noted above, this funding has the potential to significantly reduce coordinated effort across regions.

Solutions

What can government do?

Overall, there is a need for significantly greater funding for threatened species recovery as evidenced by the lack of staff resources and limited funding available for species work through the Natural Heritage Trust. NRM facilitators employed in each region and across states could certainly help to increase staff resource capacity and communication about funding opportunities to community groups, but are likely to be overwhelmed by the scale of the task at hand. Other needs include the following:

Improved communication

i. There is a need for better communication to inform the community and regional threatened species agency staff of all available funding opportunities in a timely manner. Additionally, the application process needs to be clear, and consistent with other processes where possible.

Community input into planning documents

ii. Community involvement in recovery and other planning is recognised as being valuable for a number of reasons, including the limited capacity (staff and funding resources) of governments and the broad range of skills and resources held by the community. Members of recovery programs are also

well placed to identify relevant actions and targets for the regional plan and species recovery plan.

Meaningful planning documents

iii. In order to achieve adequate outcomes for threatened species and biodiversity conservation, recovery plans and regional plans need to have meaningful and challenging targets and objectives.

Trust in the community & sharing of information

iv. It is also important to recognise the value of community input and to share data and other information.

Building the knowledge base

v. In many cases the most pressing need for threatened species recovery is to conduct research and there is a need to provide support and resources in this area.

What can the community do?

The community has a key role to play in planning and implementing actions for threatened species recovery, and also in demonstrating public support for the prioritisation of threatened species conservation by government. In particular, the community can:

- Support and encourage government to allocate more funds to threatened species conservation.
- Become familiar with regional planning processes, which direct funding priorities in each region.
- Have input into regional and species/communities recovery plans.
- Share recovery successes with other species recovery programs and among different states working on the same species.
- Improve national coordination of actions, particularly of the national malleefowl program.

National malleefowl coordination

Several recovery programs are successfully coordinated across a species' habitat range. These include:

- swift parrot
- red-tailed black cockatoo and
- orange-bellied parrot

The habitat range of the red-tailed black cockatoo crosses South Australia and Victoria and the recovery team's work is not constrained by these boundaries (although it is required to work within the challenges of different laws between the two states, as well as between the various councils involved). The recovery team is hosted by Birds Australia, who employs a project officer to coordinate activities of the team, including writing of a newsletter, development of recovery projects, the annual count and the seeking of funding.

The habitat of the swift parrot covers Tasmania, Victoria, New South Wales, South Australia and Queensland. A national recovery team, coordinated by a project officer based in NSW, operates to implement the national Swift Parrot recovery plan. The recovery program benefits from the following:

- coordinated training workshops
- information sharing
- national policy input
- education materials & awareness raising
- annual count & other data collection
- developing pilot projects
- seeking funds

The Swift Parrot Program successfully sought "regional competitive" funding via one region in NSW for the years 2003-04 and 2004-05. This funding can be spent across the habitat range of the species to implement the national recovery plan. This "regional competitive" funding stream could also be suitable for the malleefowl program, to implement the recovery plan across various regions from different states.

Conclusion

Overall, there are a number of funding and bureaucratic impediments to threatened species recovery in Australia. The impediments are often related to political priorities, limited resource availability and/or gaps in communication. A lack of funding will ultimately mean that many threatened species do not benefit from recovery actions, and that agency staff cannot always provide the support required to assist the community in threatened species recovery. Funding and other impediments are often associated with political decisions and priorities - for example in some cases resource use interests will dominate the planning process and limit goals that can be set for a particular species. Poor communication means that it is increasingly difficult for community groups to be aware of and understand the various opportunities for involvement in threatened species recovery actions.

There are various issues that need to be addressed to remedy the resourcing, communication and other impediments to threatened species recovery, and suggestions for both the community and bureaucracy have been made in this paper. State and national coordination of recovery efforts is an important first step in facilitating improvements in this area.

The malleefowl recovery program could potentially benefit significantly from national coordination, particularly in the sharing of resources and knowledge. While some states are advanced in particular areas, such as the development of educational and promotional materials, others have much to share in other areas such as training. Sharing of these skills and resources should to some extent assist with overcoming resource constraints and also in demonstrating to funding bodies that the program is a valuable investment. Sharing of knowledge and skills can help to overcome some of the bureaucratic and funding impediments to malleefowl recovery, or to at least provide a suitable forum through which to manage these issues.

"Gnowing is Believing"

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Abstract:

The *Malleefowl Preservation Group* operates on a 95% volunteer basis from a small isolated and primarily agricultural community in South Western Australia. It was formed in response to concerns for the heritage values of the malleefowl or "gnow" (Noongar Aboriginal word) as the ***Gnow***angerup Shire faunal emblem. Through leading by example the *Malleefowl Preservation Group* has won five state environment awards through on-ground investments elevating the malleefowl's status to an iconic species now driving landscape changes.

Long-term malleefowl conservation relies heavily on the support and commitment of landowners, volunteers, community groups, corporate sector and networks. Managing a successful volunteer environmental organisation in the rural sector is not without many challenges. These include serious economic and social structure rural town declines and the need for an independent well-resourced advisory support network.

Biodiversity conservation stakeholders at all levels stand to gain through increased understanding of the strengths, weaknesses, opportunities and threats for future community conservation group programs across regional Australia.

Author's Note:

As current Chairperson/founding member of the *Malleefowl Preservation Group Inc* (MPG), fourth generation on my family wheat and sheep property and the owner of covenanted farm bushland, I proudly represent the grass roots agricultural and pastoral property *Malleefowl Preservation Group* members.

Malleefowl Preservation Group Background

The MPG was formed in 1992 as a Gnowangerup Land Conservation District Committee (LCDC) sub-group in response to community concerns for the decline of the *Gnow*angerup Shire faunal emblem, the "gnow" (Noongar Aboriginal name) or malleefowl (figure 1). Its slogan, "It's Gnow or Never" is widely advertised on merchandise and brochures. The group's achievements have earned the organisation five state environment awards over the past 7 years.

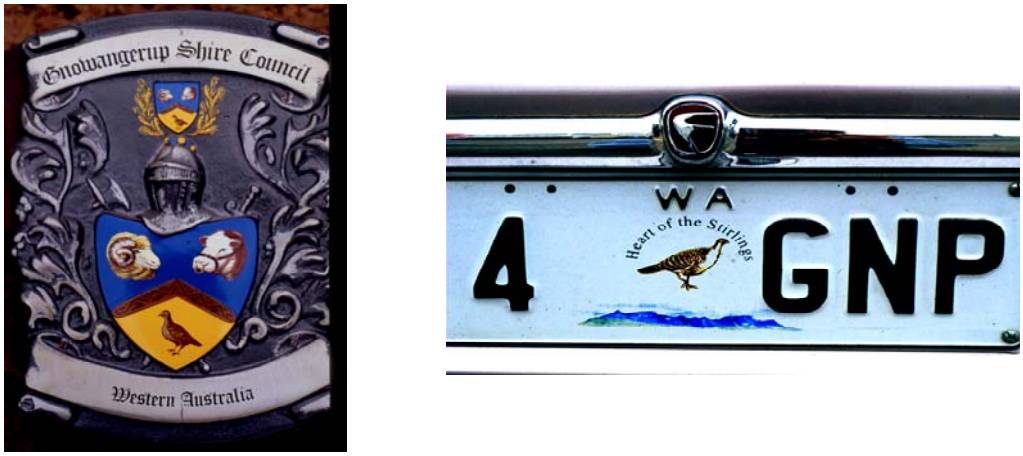

Figure 1 Gnowangerup Shire Coat of Arms and Vehicle Registration Plate

The *Malleefowl Preservation Group's* headquarters are in Ongerup, a small wheat and sheep farming community of 120 residents situated some 400 kms south east of Perth, Western Australia. Its 656 State, Interstate and International membership (approximately 1,800 individuals) represents all sectors of the community particularly farmers, pastoralists and similar interest groups (figure 2).

In response to the growth and success of the *Malleefowl Preservation Group*, the Ongerup Community Development Committee has raised $1.3m to construct a Malleefowl Research and Environment Information Centre (see "Survival on the Land, the Mallee, the Malleefowl, the Community" poster this publication). An ambitious and innovative project to address the region's economic diversification and sustainability needs.

Figure 2 - * West Australian membership distribution

Planning

In developing the *Malleefowl Preservation Group's* Strategic and Business Plans (1999), members held a workshop weekend to thrash out the strengths, weaknesses, opportunities and threats (SWOT analysis). A further workshop is planned in March 2004 providing an opportunity to incorporate important outcomes from this National Forum.

The majority of the challenges identified in 1999 have been addressed however some still remain. Does this mean that we have failed or are those challenges beyond the *Malleefowl Preservation Group's* capacity to influence and change for the better?

Workshop SWOT Analysis

Strengths	Reason	Actions taken/ planned
Grass roots membership	• Real ownership • On-ground focus	On-going
Clear Conservation Focus	• Focal Species Action plans provide clear direction for on-ground activities	Working to Community and National Recovery Action Plans
Group Profile	• Action based – "doers" • Five State Environment Awards • John Williamson as Patron • Centenary Medal to volunteer Group Coordinator • Extensive media, education and awareness campaigns	On-going
Flagship Value	• Well promoted and easily recognised indicator species for the benefit of broader biodiversity conservation	Concept of broader biodiversity benefits incorporated into other awareness and education programs
Diverse Management Committee	• Farmers, Teachers, Landcare, Conservationists, Rural businesses, tourism, and research expertise	Audio Link meetings established to encourage input from diverse expertise and agency representatives
Professional approach	• Well run administrative operation • Staff Instruction manual • Well managed volunteer network	Regular assessment on operational and volunteer needs. Monthly staff/volunteer meetings
A willingness to link with other organisations	• Invitations extended to Greening Australia, Dept Conservation & Land Management (DCLM), National Trust of Aust. (WA), World Wide Fund for Nature/Threatened Species Network, Regional Groups (SCRIPT/ ACC), Agriculture Western Australia and West Aust. Farmers Federation	On-going
Susanne Dennings	• Tireless dedication to biodiversity conservation and MPG Management • Ten year's learning • Good communication skills • Ability to hand on skills and assist with succession planning	Committed
Volunteer base	• Diverse skills	Retain and improve volunteer skills
"Vulnerable" status of malleefowl	• Sufficient populations to achieve positive outcomes and project success	On-going

Isolation	• Less human impacts on malleefowl populations • "Outback" adventure for urban based volunteers • Development of genuine long-lasting friendships	Promoting benefits
Weaknesses/ Threats	**Reason**	**Actions Taken**
"Threatened" status of malleefowl	• Not a "critically endangered" species – does not qualify for priority focus funding through some agency conservation programs	• Appointment of Scientific Advisor – Jack Kinnear • Encourage "Gnow or Never" conservation action values BEFORE species reaches critically endangered status
Member commitments and input to MPG direction	• Once only membership • Wide membership distribution (State, Interstate and International)	• Annual membership introduced in 2001 • Strategic Plan Priorities questionnaire posted out in 2001
Declining Govt. Agency Support	• No coordinated feral animal (fox and rabbit) controls • Closing of Agwest 1080 bait factory in WA • No DCLM support network • Increasing "User Pays" government ideology • Declining element of "trust"	• Lobbying Minister for Agriculture, Farmers Federation and LCDC's for support to re-establish coordinated feral animal control programs • Building improved relationships • Appointed DCLM/Agwest rep. to committee
Financial constraints	• Isolation and limited networking/ promotional opportunities • Office administration cost gaps (funding guidelines) • Declining rural economies/support ability	• Volunteer system being implemented in MPG office • Seeking full time project development/ management officer • Support to new Malleefowl Information/ Research Centre
Isolation	• Limited local skills and availability for managerial and project development • Increased operational costs (administration, travel and time) • Additional networking, promotion and fund raising campaign challenges • Restricted income source in local community • Low voting numbers and politically "safe" seat	• Audio conference meetings to allow appointment of distant committee members • Diverse committee appointments • Web site completed and regularly updated • Lobbying Environment and Agriculture Ministers • Advertise isolation as a plus for Malleefowl populations • Support to new Malleefowl Information/ Research Centre
Declining Rural Infrastructure	• Current economic downturn • Less people to do more voluntary work • Limited diversification (from farming) • Aging population • Additional stress due to economic downturns and declining govt. support • Loss of skilled personnel	• Source city based volunteers • Spread committee loads (outside Ongerup community) • Involve school children (Malleefowl Magic Education Package) • Support to new Malleefowl Information/ Research Centre
Public Apathy	• Concentration on today's dollar rather than tomorrow's long-term sustainability • "She'll be right mate" ethic	• Increase Awareness • Malleefowl Magic education Program
Limited local skills &	• Lack of local management and project	• Seeking full time project

resources	development expertise • No state or national support network	development/ management officer • Audio conference meetings to allow appointment of distant committee members
Susanne Dennings	• Susanne's strength in the organisation is also a weakness because the organisation is dependent on her. • Burn out	• Volunteer work-shop and plan developed Succession Planning with Peg Olsen - Nature Conservancy (USA) • Full time Project Development and Management officer funding being sought • Part time office assistant appointed • Volunteer team appointed for Administration operation • Malleefowl Matter editor appointed
Tourism	• Impacts on malleefowl and associated habitat	• Support and guide land managers to establish protection zones and visitor plans
Office facilities and equipment	• Operates from home spare bedroom • Need for upgrading of equipment and office furniture	• Office centre established and equipment upgraded • Support to new Malleefowl Information/ Research Centre
Opportunities	**Reasons**	**Actions**
Changes in Landcare to more agricultural focus	• Increases MPG's opportunities for biodiversity conservation projects	• Seek Australian biodiversity conservation funding/ sponsorship partners
Research	• Efficient recording and reporting	• Include research collation in Full time Project Management role
Tourism	• Malleefowl as a flagship species • Increased profile and support	• Support to new Malleefowl Information/ Research Centre
Patron and Sponsors	• High profile Patron, John Williamson • Large Corporate Sponsor connections	▪ Promote and "lean on" supporters and partners
CCT Fund	• Tax deductible donations	▪ Promote tax deductible fund
Shift in DCLM	• New DCLM Strategic Plan identifying community group support	• Approach dept for support
World interest in WA's biodiversity	• WA's south west identified as one of the world's 25 "biodiversity hot spots"	• Linking opportunities with International Organisations
Influence private landholders and Government policy	• Grass roots initiative • Act as a go-between • Catalytic benefits	• "Birds of a Feather, Let's Work Together" brochure produced • Involve politicians
Role model for similar organisations	• MPG has developed beyond a local community group to a state-wide organisation • Has little competition at this level	• Promote "role model" to other rural communities • Provide guidance to Politicians and government agencies

In summarising the workshop results:

Strengths

Networks and Volunteers

Developing it's own support network and volunteer database has contributed to member/volunteer ownership.

Figure 3 Human Chain Survey volunteers – Foster Road

To ensure volunteer satisfaction and project aim outcomes, we need to ask:-

- What projects are achievable on a volunteer basis
- Are the training skills, management and infrastructure in place to support and manage volunteers
- What motivates individuals to register as a volunteer
- What skills do they have and want to contribute
- The targeted age group
- How do we retain their interest and commitment

Weaknesses

Isolation: The *Malleefowl Preservation Group* and many other malleefowl interest groups are based in "malleefowl country" that traditionally face:-

- long distances from support networks
- declining rural communities (age, economic and social)
- increased travel and administration costs
- limited community skills
- reduced access to "needed now" volunteers (declining population)
- Communication challenges (poor telephone line and mobile services, regular power cuts)

"The problem for many declining wheatbelt communities, however, has been that economic restructuring has eroded the economic, human and social capital required to make self-determination possible and local strategies viable. The withdrawal of state and federal government services in rural areas, in line with the politics of economic rationalism, will only make the struggle for sustainable rural communities more difficult." (Matthew Tonts, Centre for Rural Social Research 1996).

	1971	1981	1991	Percentage Change 1971-1991
Cunderdin	873	731	688	-21.2
Dalwallinu	724	639	597	-17.5
Dowerin	351	410	374	6.6
Goomalling	757	600	535	-29.3
Koorda	411	378	344	-16.3
Quairading	856	741	696	-18.7
Tammin	360	254	226	-37.2
Wongan Hills	888	947	890	0.2
Wyalkatchem	573	453	419	-26.8
Meckering	176	144	116	-34.1
Ballidu	153	137	125	-18.3

Figure 4: Population Change in WA Settlements with a Population Exceeding 100, 1971-1991 (Source: ABS Census Reports)

Declining Regional Support Networks: The loss of agency infrastructure (figure 5) providing one-to-one support, coupled with employment insecurity for regional staff and Community Landcare Coordinators, has resulted in reduced participation in Landcare Natural Resource Management (NRM) programs. Farmers and pastoralists work on long-term programs that require long-term support in return for trust and friendship as an outcome from their invested time. They are tiring of "training up" new Community Landcare Coordinators (CLC's) in their regions only to see them leave after relatively short employment contracts. The enthusiasm of CLC's often without hand-over training is one to be admired, however with huge social challenges, isolation and landholder empathy, the communities' expectations of CLC's are in most instances beyond short-term employment contract capacities. As an example, the neighbouring Landcare Groups in my region were without Coordinators for 3-4 months in 2003. The result is an increase in requests for support to the *Malleefowl Preservation Group* as a replacement service provider.

	1966	1980	1994	Total Change 1966-1980	Total Change 1980-1994
Ballidu	12	11	8	-1	-3
Meckering	13	8	7	-5	-1
Wubin	11	9	7	-2	-2
Kalannie	5	9	7	4	-2
Pithara	7	4	3	-3	-1
Buntine	4	3	2	-1	-1
Cadoux	5	3	2	-2	-1
Jennacubbine	2	2	1	0	-1
Minnivale	3	2	0	-1	-2
Ejanding	3	3	0	0	-3
Korrelocking	2	1	0	-1	-1
Manmanning	2	1	0	-1	-1
Konnonong	2	0	0	-2	0
Dangin	2	0	0	-2	0
Yorkrakine	1	1	0	0	0

Figure 5 Total Number of Public and Private Services in Non-Shire Headquarters Towns, 1966-1994 (Source: ABS Census Reports)

Funding Restrictions & Responsibilities: Declining rural infrastructures, increasing volunteer and liability insurance, auditing costs, associated administration overloads (eg BAS treasury statements) and increased legal obligations have all contributed to the winding up of many volunteer based community groups. Such insurance and audits are compulsory before funding grants eg Natural Heritage Trust and Environfunds are disbursed. The most valuable administration funding support program through Environment Australia for Voluntary Environment and Heritage Organisations (GVEHO) was withdrawn from MPG in 2003/4.

Opportunities

"Big Picture" verses "Little Picture"
Landholders' circle of concern is their patch, their catchment and their town. They hold the key to community social and economic wellbeing. In as much as being part of the "big picture" can motivate us all, it is also important for community groups, property owners and volunteers to have real support at a coordinated grass-roots level to develop the "little picture" as "big picture" achievable goals. Without this commitment, the "bigger picture" might happen but unless there are unlimited resources, it's long-term future is questionable.

Survey Results - Assessment and Use: In response to years of monitoring, community groups are now asking for feedback such as a) malleefowl population trends [regional, state and national] b) feral animal impacts c) seasonal responses to breeding densities d) dispersal and survival of chicks from isolated remnants e) corridor values and f) best practice remnant vegetation management.

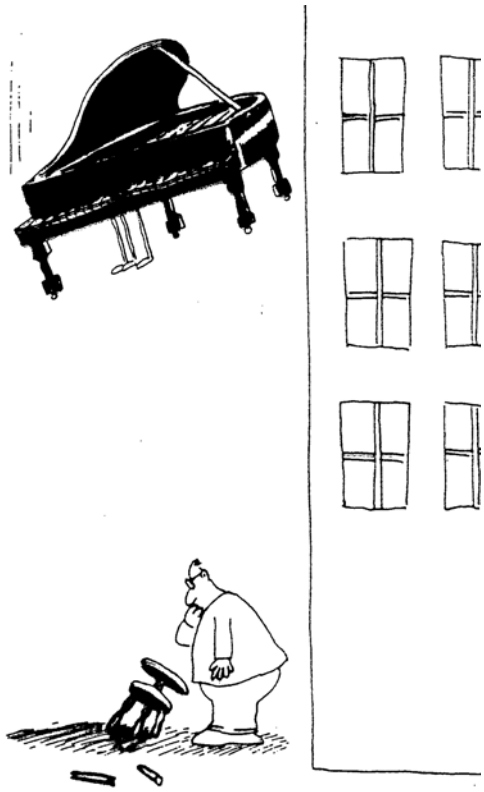

Figure 6 Understanding big and little picture needs – most of us work better on achievable "piano stool" goals as contributions to bigger picture "grand piano" visions.

Australia Wide Communication: Considering the isolated location of many groups, modern communication (eg video and audio conferencing, emails and web sites) is now providing easy access to expand and improve communication. The Threatened Species Network's "Around the Mounds" (is this still being produced?) and group newsletters such as the "Malleefowl Matter" are contributing to broader community awareness however this is primarily one-way communication. Good communication leads to better performance and increased ownership.

Thinking Nationally, Linking Nationally (or even Globally): Our sponsors and members would value being part of a National or even global plan. Program planning at the National Recovery Group level supported by officers in each state would contribute to linking on-ground malleefowl conservation actions to regional, state and national biodiversity priorities throughout Australia.

Developing Partnerships: Community groups have a lot to offer and a lot to gain from successful partnerships that demonstrate "gains not drains". We don't just want to be added to another partnership list to convince funding bodies that the project has community support, we want to be part of the action and have a slice of the cake too. Within a world of Natural Resource Management partnerships, we are all facing the same sustainability issues and biodiversity decline. This forum's endorsement of incorporating the National Recovery Plan for Malleefowl Actions into regional group planning will provide community groups with links and justification for on-ground regional group funding support.

Conclusion & Recommendations

As a National iconic species facing National threats, the malleefowl deserves a National conservation effort. Fragmentation is not only a threat to our remnants, it is a very real threat to conservation projects and community groups.

Our diverse network combined strengths throughout Australia are enormous and have the potential to play a major role in conserving Australia's biodiversity. The appointment of effective State/National coordinators will further strengthen the networks and link the National Recovery Group with Regional Groups, community groups, individual landholders, students and researchers. Western Australia in particular is well placed to appoint such a state coordinator.

With an eleven-year "leading by example" history in capitalising on a wealth of opportunities, the MPG has overcome many obstacles and will no doubt face many more in the future. As a committed team member, the *Malleefowl Preservation Group* aims to reduce these obstacles so that all groups and individual landholders may continue to play their part in conserving the "malleefowl", an indicator species representing whole ecosystem assets across regional Australia.

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Monitoring methods & protocol

Why monitor? The role of monitoring in environmental management

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Abstract

It is widely accepted that monitoring is an important part of environmental management. Through monitoring, land managers can address some of the uncertainty they face about what they manage, how much effort is expended on management actions and how effective those management actions are. This information enables managers to modify their actions based on sound information. Monitoring means different things to different people. For monitoring to be useful to land managers, it must be done in a consistent manner such that trends can be detected and it must relate to the objectives for the environment being managed. Hence, monitoring programs must have clear objectives.
As a land manager responsible for almost 17% of the area of Victoria, Parks Victoria requires a well-defined process to guide how it undertakes environmental management. To do this, it developed an Environmental Management Framework that relies on monitoring to relate the status of environmental values to the identified factors that threaten them and the actions undertaken to manage the identified threat. In this paper I will use this framework to illustrate the role of monitoring in environmental management. I will focus on the role of monitoring in evaluating how efficient management actions are as well as evaluating how effective those actions are in reducing threats, and ultimately, in conserving the values we aim to protect.

Introduction

Many people believe that monitoring is an important part of environmental management. However, whilst this view may be widely held, understanding of why monitoring is important and how information provided by monitoring can assist land managers varies. To help clarify why monitoring is an important part of environmental management, this paper explain Parks Victoria's approach to environmental management, and how monitoring fits into that approach. Whilst this paper focuses on Parks Victoria's approach, a number of points emerge that are relevant to most monitoring aimed at supporting environmental management, including monitoring by volunteers and friends groups.

What does Parks Victoria manage?

Parks Victoria is a land-management agency responsible for nearly 4 million hectares of land and sea, or approximately 17% of the land area of Victoria. This consists of approximately 3000 individual areas including National Parks, State Parks, Conservation Reserves, Metropolitan Parks and a range of other areas. With responsibility for such a large area spread across Victoria, Parks Victoria deals with

very diverse habitats and very diverse issues. The reasons different areas are managed and the uses of those areas vary too, ranging from conservation of natural and cultural values to a broad range of other uses such as water supply, education, recreation, apiary, fossicking and a multitude of other activities.

Uncertainty

The wide range of environments and the diverse range of issues that a management agency such as Parks Victoria has to deal with means one of the biggest challenges faced is uncertainty. For Parks Victoria, uncertainty exists at a number of levels:

(i) There is uncertainty about what environmental attributes and threats are being managed across Victoria. For some parks, there might be a high level of knowledge, but it is not possible to undertake comprehensive surveys of all parks, so some areas are not well known at all.

(ii) There is uncertainty about how ecosystems function in many places. For some areas that have been studied intensively, there might be a good understanding. For some areas, it might be possible to make reasonable guesses based on what is known for other locations. However, whilst science might be improving our knowledge of ecosystem functioning, a lot remains unknown.

(iii) A big area of uncertainty is how well Parks Victoria meets its environmental objectives. Whilst a range of management actions are undertaken across many areas, often there is little understanding of whether that management achieves the objectives it is supposed to.

(iv) Finally, there is uncertainty about whether management actions are undertaken in the best way possible to make good use of limited resources, time, people and money. This means there is not always good understanding of where improvements can be made.

This wide range of uncertainty means there is a big need for information to support environmental management. This information comes from a variety of sources, but one very important tool for land managers is monitoring. Through monitoring, uncertainty can be reduced, which hopefully will result in better management.

Monitoring

Monitoring means different things to different people. In its simplest form, checking what is at a particular location may be considered monitoring. Whilst this might be true, by and large, that sort of approach to monitoring is not very useful to a land manager. That is not to say information that this approach provides is not useful, but to achieve long-term conservation goals, land managers need more reliable information than this approach can give us.

Land managers need to be able to look for changes in what they are managing over time and to know with confidence when and where those changes happen. Hence, monitoring must be done in a consistent and repeatable manner so that across time, the same sort of information is compared. This monitoring might be as simple as systematic observation (e.g. a search over a specified area to record the presence of particular species), or more complex, rigorous measurement (e.g. transect-based sampling to estimate the abundance of a particular species in an area).

The techniques used for monitoring vary depending on the questions being answered. Monitoring techniques must collect information relevant to the objectives of the

monitoring program. In addition, if a monitoring program is expected to detect change of a particular size, then the effort expended on monitoring must allow the detection of that changes. This is influenced by the level of effort expended. As effort increases, then the size of change that can be detected decreases. However, increasing effort increases the cost of monitoring.
As well as collecting information in a consistent manner using appropriate methods, a monitoring program needs to provide information that is useful for guiding management. Consequently, any monitoring program needs to have clear objectives. These objectives must relate to the goals for the area or aspects of the environment being managed. For example, if management actions are aimed at improving the breeding success of a population of a particular species, then we need to monitor something that tells us about breeding success.

Environmental Management Framework

To illustrate how Parks Victoria undertakes environmental management, and how monitoring fits into that management, it is necessary to describe Parks Victoria's environmental management framework (EMF). The EMF is a risk management framework that helps determine what management is required and enables evaluation

> ***effectiveness*: did it achieve what it aimed to?**
> ***efficiency:* what did it cost to achieve the outcome?**

of the effectiveness and efficiency of that management.

In its more elaborate representation, the EMF seems to be complicated but in reality it is a simple, logical process. At a fundamental level, the framework has 3 main components:

Values:	the aspects of the environment that we are concerned with, e.g. ecosystems, species, communities.
Risks:	the consequences of any processes that threaten the values we manage.
Actions:	what we do to reduce the risks and protect the values we are managing.

It is important to reiterate here that whilst this discussion focuses on Parks Victoria's approach to environmental management, clearly, the components that make up the EMF are part of any environmental management. The whole framework is integrated through monitoring at a number of levels. A simplified illustration of the EMF is given in Figure 1.

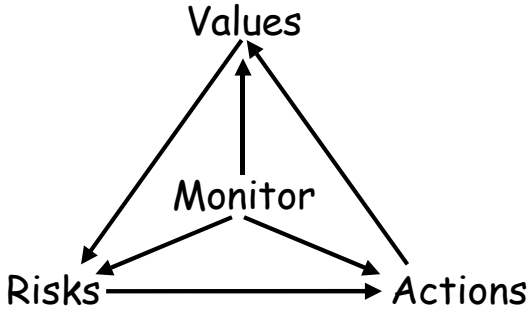

Fig. 1. Diagrammatic representation of Parks Victoria's Environmental Management Framework.

The step-by-step description of each of the tasks undertaken for the components of the EMF given below will help build an understanding of how the framework operates. This begins with the first component of the framework; environmental values.

Values

1. Identify

The first stage in the EMF is to identify the values of interest, i.e. what it is that you are managing. This may be a particular vegetation community, a species, a population or any aspect of the environment that we are concerned with managing

2. Objectives

Following from this, the next step is to specify in clear terms what our objectives for these values are, i.e. what do we hope to achieve for those values as a result of management actions. These objectives must be specified in a way that enables us to assess if objectives are being met. This is important because these objectives guide what management actions to do and what to monitor.

3. Monitoring

The next step is to determine what the current situation is. This is where monitoring is important. The current status or condition of the values needs to be determined relative to the objectives we set.

Risks

1. Identify

The next stage of the EMF considers factors that might prevent achieving the objectives set for the values, i.e. the risks to the values of interest. This information is essential for determining what management is required to achieve the objectives we set for the values.

2. Objectives

Once the relevant risks have been identified, it is necessary to determine what level the risk must be reduced to or maintained at to enable us to achieve the ultimate objectives for the values we are managing. This means we set objectives for the level of risk. As with the values, these objectives need to be specified in a way that is measurable.

3. Monitoring

Having set objectives for the level of risk, it is necessary to determine the current level of risk. Knowing the current level of risk helps determine whether management is necessary. It also provides a baseline against which the effectiveness of any management can be evaluated. Clearly, to do this, we need to monitor.

Actions

1. Identify

There is little point in undertaking any management actions without first considering the values being managed and the risks to those values. Once these things are known, it is possible to develop a management strategy that targets relevant risks and ultimately achieves the objectives the values being managed.

2. Objectives

As with values and risks, we need to set objectives for the management we propose to undertake. This is a clear statement of what action will be done and needs to be expressed in a way that is measurable so that we can evaluate whether we achieved what we said we would.

3. Monitoring

Monitoring actions involves recording what is actually done. This should include the nature of any work done, where it was done, as well as the amount of money, time and equipment used to do the work. Recording this information allows us to determine whether we did what we planned to do and relate what was actually done to what happens to the risks and to the values.

"Closing the loop"

The discussion above has described briefly each of the components of the EMF and the key tasks within each component. The framework enables evaluation of management. Evaluation is necessary to determine whether management is effective and to guide where improvements can be made. Monitoring is the critical link that enables this evaluation to occur. It is essential that this monitoring occurs at all levels, i.e. values, risks and actions. Through this monitoring, we are able to ask :

- Was the work done as planned?
- Did management actions reduce in the risk expected?
- Were the objectives for the values achieved?

By implementing the framework, a better understanding of how a system being managed operates should develop. This occurs through examining the relationships between management actions undertaken and changes in the level of risk and the values being managed. Because the framework is cyclical, what occurs as a result of management actions can be used to guide what to do in future. A worked example is given below.

Worked example

Values

As was described above, the first component of the EMF is *values*. In this example, the value of interest is a population of a particular species. The first task is to set objectives for this value. These must be specified in clear, measurable terms. Example could include:

- no reduction in population size
- an increase in the population size of x% over a specified time frame
- an increase of y% in breeding activity or reproductive success

All of these objectives are measurable. The next task is monitoring to determine the current status of the population relative to the objectives set. If the objective was an increase of 10% in breeding activity, we would need to measure what the breeding activity is at present.

Risks

The next step is to determine what threatens the population. It could be predation, fire, habitat fragmentation or a range of other factors. Assume the population is at risk from predation by foxes in this example. Having identified the relevant risks, we need to determine what the level of risk needs to be if we are to achieve our objectives for the population. Sometimes we might not know what level of risk is acceptable. In this case we still set an objective and use the results of the management to guide whether this is a sensible objective. In this example, we might set an objective to reduce fox activity by 50% over the next 12 months. Again, this is a measurable objective. To know whether management results in this objective being met, we need to monitor (using sand pads or bait-take for example) to determine the current level of fox activity is.

Actions
Once objectives for values and risks have been specified, the management strategy can be developed. In the example, if we are going to reduce fox activity, we might plan on implementing a poison baiting program. We also need to specify targets for how much work will be done. This might be to implement the poison baiting program over a specified area, with a certain number of bait stations placed a certain distance apart, and to check and bait those stations every 3 weeks. This is a clear, measurable target, and again, we monitor and record how much baiting was actually done, the time I took to do the work and what it cost.
Putting it together
Putting the results of monitoring all aspects of the EMF together can be used to guide future management so that objectives for the values being managed are achieved. With this information it is possible to examine if any changes in predator activity are associated with the amount of baiting done. It is also possible to evaluate whether there is with any change in the breeding success of the population we are trying to protect associated with the changes in predator activity. Answers to these questions will help determine whether more baiting is needed to reduce predator activity further or if what we are doing is enough.

Concluding remarks

Monitoring is a vital component of environmental management. By monitoring values, risks to those values, and what is done to reduce the risks, we improve our understanding of how the systems being managed operate and consequently, improve our knowledge of how to manage those systems. To be useful however, monitoring programs must have clear objectives and relate to objectives for the values being managed. For instance, there is little point monitoring the size of individuals if we actually need to know where they occur. Monitoring must also be done in a consistent way so the same sorts of information is compared across time.
Having acknowledged that monitoring is part of environmental management, it is important to also acknowledge that the resources of management agencies are limited. Management agencies deal with a multitude of issues. Consequently, agencies must determine what their priorities are and allocate resources to those priorities. Monitoring can be time-consuming and agencies don't always have the resources to do it. This is where volunteers have a capacity to make a big difference to management. The contribution that volunteers make by undertaking important activities such as monitoring is extremely valuable and enables thing to be done that otherwise would not. By working co-operatively with agencies to direct their work where it is most needed, the efforts of volunteers can be integrated with the management objectives for an area. Planning and effective two-way communication between volunteers and management agencies are essential to achieve this integration and make best use of resources of the agencies and the volunteers.

Monitoring Malleefowl: Options, problems and solutions

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Dedication: to the late Angus Torpey who was one of the pioneers in monitoring Malleefowl in Victoria and in Australia, and to Keith Hately, Max Downes and the Mid Murray Field Nats who did likewise. Angus kept a close watch on "his" birds and freely guided countless numbers of people, especially kids, out to the wilds of Wathe to educate them in the ways of Malleefowl, and to spin a good yarn or two.

Introduction

People who have seen Malleefowl in the wild may be a little surprised to hear that Malleefowl are actually an elusive and cryptic species that is particularly good at being unseen and disappearing. In fact, when you do see Malleefowl in the wild it is usually because you've stumbled onto an individual that is not too frightened of people and tolerates your presence. You generally never see the wary birds.
The cryptic nature of Malleefowl, coupled with their low densities and solitary (or paired) habits, presents a challenge for scientists and managers wanting to measure Malleefowl numbers across the landscape (survey) or through time (monitoring). Here, I will briefly discuss the options available and the various pitfalls, and provide an example of a successful monitoring project by a community group in Victoria.

Why Monitor?

Malleefowl have declined substantially in distribution and abundance since Europeans settled the Australia, and are now considered to be threatened wherever they still occur. This decline has been due to various causes and is expected to continue unless management of Malleefowl habitats and populations is improved. Monitoring involves tracking Malleefowl numbers in time in order to measure changes in populations. This is essential information for conservation planning and provides opportunities for targeting management that may benefit Malleefowl where it is most needed. Perhaps even more importantly, monitoring provides a means of measuring the effectiveness of management actions (eg. fox control, fire, etc), thereby providing a feedback loop so that we can continue to improve management and benefit Malleefowl.
In short, monitoring provides us with a finger on the pulse of Malleefowl populations, without which we are blind to the trends in Malleefowl numbers and the effectiveness of various management actions.

How? Monitoring options

Monitoring Malleefowl involves obtaining reliable and repeatable measures of the number of birds about so that changes can be detected. The term 'monitoring' is also sometimes applied to more detailed measurement of, say, egg production and survival, or individual longevity and recruitment of Malleefowl. However, I will use the term monitoring specifically to refer to measuring population abundance changes in time. There are basically three ways to do this without disturbing Malleefowl: counting individuals (sightings) or their signs (tracking), or counting their nesting mounds. I will discuss each of these measures in turn.

1. Sightings:unwanted biases

Most bird survey and monitoring is conducting by counting individuals in set areas for a set amount of time. While this works well for many species, especially conspicuous species, it is not a good method for monitoring Malleefowl because the birds are generally too elusive and because resident birds are not readily distinguished from those travelling through an area. The elusiveness of Malleefowl means that sightings are rare and sensitive to the immediate habitat, the tolerance of the individual bird/s to people, and chance. Thus, it is typical for the number of sightings of Malleefowl at a site to vary enormously from day to day, even in the very best areas. This low repeatability of sightings makes any statement about the actual number of birds in an area very difficult. Worse still, sightings don't provide information on whether a bird is resident or not, and this can lead to misinterpretation. For example, more Malleefowl are usually sighted during droughts and after fires because the birds have been forced out of their sheltered habitats and are searching for food. It would be misguided to conclude that the populations were doing well because there had been an increase in sightings. These birds are refugees, but can't be readily be distinguished by sight from resident birds. Likewise, Malleefowl occasionally disperse and settle in inappropriate habitats where they are sighted, although it is most unlikely that the habitat would support breeding birds. Such 'loopy locations' have been recorded wet forests and riparian woodlands where the habitats are clearly unsuitable for breeding, but sightings in less obviously inappropriate habitats may go unquestioned and lead to unsound data and conclusions.

While sightings do not provide an ideal index of Malleefowl abundance for monitoring, sightings do provide a useful basis for determining the distribution of the species. In particular, incidental sightings by birdwatchers and local communities provide a valuable means of identifying dispersal routes across agricultural landscapes. For example, occasional sightings of Malleefowl along roadside vegetation strips suggest that these may be crucial in linking Malleefowl populations in otherwise isolated reserves.

2. Tracks: traditional methodology

Observing the footprints made by Malleefowl, or 'tracking', is the oldest means of detecting Malleefowl in an area and is still used to great effect by Aborigines in the Anangu-Pitjantjatjara Lands of SA and other remote areas of central Australia. Malleefowl have very distinctive feet and travel mostly on foot, so on suitable substrates the ground betrays their presence much more efficiently than any other

method. Well-structured tracking can provide better information than sightings because the cryptic nature of the birds is less of an issue, and because their tracks also show whether a bird is resident, and whether it has a mate or is solitary. Moreover, the breeding mound can usually be found relatively easily by following footprints. However, tracking requires a suitable open ground cover with some loose sand and this is usually found only in arid regions such as in Central Australia. In these areas, breeding densities are typically extremely low and tracking is the only means available to monitor Malleefowl numbers.

3. Nests/Mounds: family censuses

Most Malleefowl monitoring programs involve counting or estimating the breeding density of the birds in set areas, thus providing an estimate of the breeding density in the area. This is by far the best indicator of population because these birds are reproducing and are clearly not refugees or dispersers, and because the estimate is linked to a very specific area on the ground. Monitoring is conducted either by visiting known mounds on the ground or by helicopter and determining how many are used for breeding, or by flying transects and counting all the active mounds flown over. Aerial surveys of this type are really only suitable in relatively open habitats because detection becomes unreliable where there is much overhead cover and shadow.

By far the simplest and most reliable monitoring data is collected on the ground by visiting mounds. This requires a thorough search of the site first and routinely every few years, but between these labour intensive searches monitoring can be achieved at relatively low cost by visiting and describing all the known mounds in the area. Malleefowl tend to renovate old mounds rather than start new ones 'from scratch', so revisiting all the known mounds provides a good estimate of the number of breeding pairs resident and reproducing in an area. This method of monitoring is also well suited to community involvement, although reasonable densities (>0.5 pairs/km^2) are required to make the initial search effort worthwhile.

It is desirable to collect estimates of breeding density every year for a host of reasons, but it is not essential. A monitoring site provides two valuable contributions for Malleefowl conservation. The first is that the breeding density that is initially observed will forever be the benchmark with which all subsequent estimates of breeding density can be compared. This is an enormously valuable statement about the specific patch of habitat at one time in the past. The second contribution is the routine monitoring data which provides information on current population trends.

Victorian experience

Measurement of Malleefowl breeding densities started in the 1960s, often by local communities wanting to demonstrate the value of reserving remnant patches of habitat. Angus Torpey used his family to search parts of Wathe, Keith Hately searched Kiata, the Mid Murray Field naturalists searched Wandown and the Wychitella Forest Preservation League searched Wychitella near Wedderburn. Also at this time, Max Downes of the Department of Fisheries and Wildlife organised some surveys in larger patches of mallee in NW Victoria, but unfortunately this information seems to have been lost. In 1987 and 1989 I revisited some of these sites in NW Victoria with a group of international conservation volunteers (Operation Raleigh) with the view of determining breeding densities for habitat research and for ongoing

monitoring. Since then the monitoring system has grown steadily with support from Parks Victoria and its predecessors in terms of the number of sites monitored, and also in terms of the organisation, sophistication and efficiency of the monitoring system. Currently, 24 sites and about 900 mounds are monitored each year by a small band of volunteers from the Victorian Malleefowl Recovery Group.

Cost$$

In Victoria, Parks Victoria and its predecessors have funded the Malleefowl monitoring program since 1991 and this has ensured both continuity of data and allowed the program to evolve. While Parks Victoria's predecessor originally tried to conduct the monitoring with its staff, field costs were prohibitively high due, in part, to the difficulty of re-locating mounds. Since then, the monitoring has been conducted by consultants (Paul Burton and I) and increasingly by community volunteers. The monitoring systems have also been improved enormously and is now entirely run by volunteers who organise and conduct the field work and submit the data electronically for storage in purpose built databases.

The monetary cost of the monitoring has fallen dramatically over this timeframe (figure 1) and currently three times as many mounds are monitored for less than a quarter the total cost incurred in the early 1990s. Moreover, data quality has also improved enormously, and data is checked and stored on computers rather than on paper forms.

While costs have plummeted, there is obviously a point at which they can fall no further without damaging the systems that are in place. This, in fact, is the current situation. Community groups require some funding in order to meet administration costs (eg. postage, stationary, phone calls), equipment maintenance and fuel costs. If community groups are unable to meet such costs the good work they do, and the good will, are likely to be dissipated.

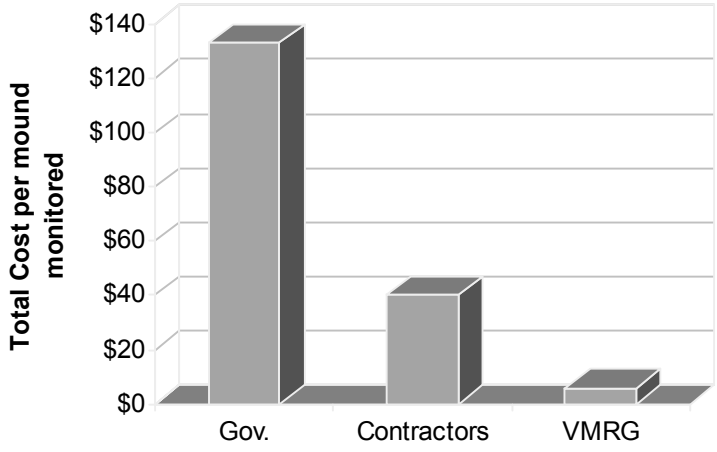

Figure 1. Total costs per mound monitored for the periods when the monitoring was conducted by government (Parks Victoria's predecessor) from 1991-1993 (10 sites, 300 mounds), consultants from 1994-1999 (19-23 sites, c. 600 mounds), and VMRG volunteers 1995-2003 (24 sites with 900 nests). Gov. costs do not include data entry or reporting.

Methods

In Victoria, Malleefowl monitoring has undergone many changes and improvements over the years, although care has been taken to ensure that data standards have been preserved. This is achieved by means of a set of standard definitions for every category on the datasheets: thus an "active" mound is defined as one that is currently being used as an incubator by Malleefowl and thus likely to contain eggs. Annual training days combined with social events also ensure that quality of data collected remains high. A detailed manual has also been produced, and it is currently being revised to reflect improvements over the past few years.

Searching sites

Most changes in the system have been improvements in the way data is collected, rather than what is collected. For example, searching sites previously involved working with compasses and carefully measuring out and marking areas to be searched (usually 4 km^2). Since May 2000, pocket GPS units have become accurate enough to satisfy all navigational requirements for monitoring without the need for any permanent markers through the study sites. Searching is now accomplished by uploading routes to be walked onto GPS units, although groups of people are still needed to search the sites efficiently.

Monitoring mounds

Routine monitoring is accomplished by teams of two or more people who visit every mound at a site. Mound locations are uploaded onto GPS units so that volunteers are guided directly to the mound of their choice. The monitoring data comprises a categorised description of each mound and is recorded either on a Palm handheld computer (preferred) or on paper forms. The Palm computers have greatly improved the monitoring system because they make data recording easier than on paper, and because once data is entered on a palm it can automatically be downloaded to databases for storage and analysis. This eliminates the time consuming, costly and error prone process of data entry that is necessary when data is collected on paper. The software we use on the Palms (Cybertracker) is specifically designed for simplified data collection in the field and is ideal for community volunteers.

Occasional re-searches: Efficiency vs Accuracy

In Victoria, we do not re-search every monitoring site every year, but rather visit known mounds every year and re-search sites every few years. This means that some active mounds might be missed if a site is not re-searched for a long time because Malleefowl do occasionally make new mounds. We have estimated that Malleefowl make new mounds at a rate of 1-2% per year. The main advantage in not attempting to re-search sites every year is a huge saving in labour: re-searching a site is about 20 times as labour intensive as just visiting known mounds. Put another way, visiting known mounds over three years provides 95% accuracy in breeding densities for about 5% of the labour cost.

Nonetheless, there is an important caveat regarding the interpretation of data collected by simply visiting known mounds in contrast to conducting full searches every year: Monitoring data may show a slight decline (estimated as 1-2%/year) where there is none because new mounds are not added to the monitoring lists every year. Thus, if the monitoring data shows a slight decline the site really needs to be re-searched to

assess whether the apparent decline is real. Table 1 expands on this point to consider other trends that may be apparent.

Table 1. Apparent and actual trends in breeding numbers as determined by monitoring only known mounds.

Monitoring suggests population has:	Actual population trend:
Increased	**Increase**
Unchanged	Unchanged, or increased
Declined	Declined, unchanged or increased

Victorian Results

Monitoring Malleefowl over the past 16 years in Victoria has provided a wealth of information on trends and conservation. We have found that while some sites show similar breeding densities from year to year, other sites show large fluctuations that are difficult to understand. This variability means that to get a reliable notion of the trends in large area we need to combine many sites so that the fluctuations at different sites can cancel each other out to reveal underlying trends.

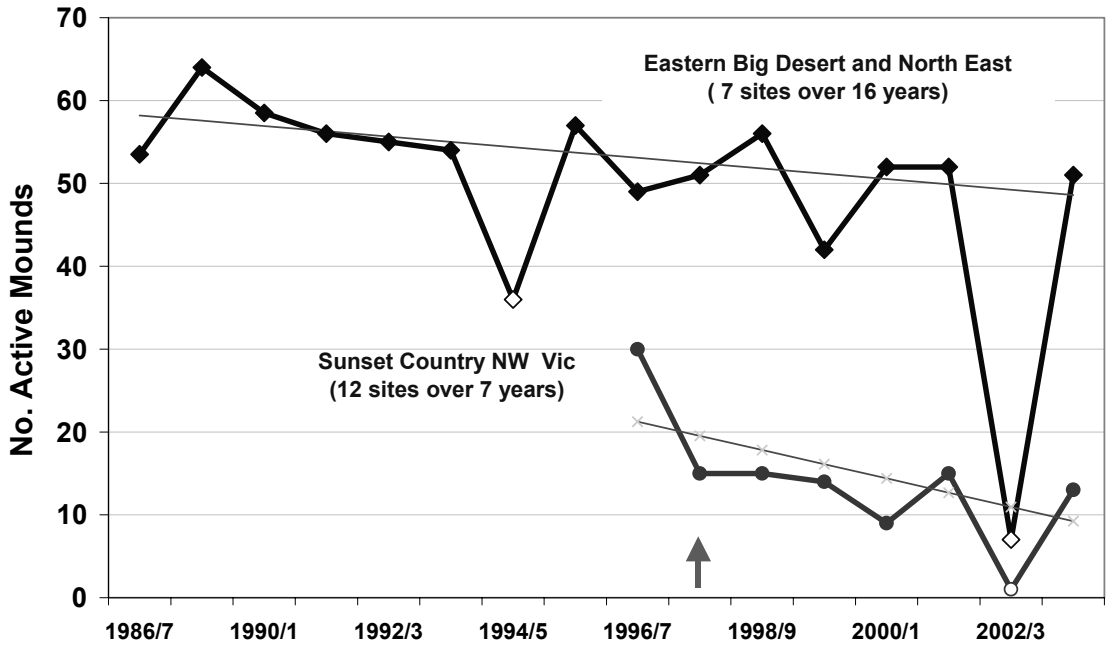

Figure 2. Combined monitoring results for sites in the far NW of Victoria (Sunset Country and Hattah/Kulkyne NP) and elsewhere (Eastern Big Desert and North East). Most sites were last re-searched for new mounds in 1996. Major drought years are indicated by white

Monitoring results for two regions in Victoria where we have sufficient information to assess trends are show in Figure 2. In the eastern Big Desert (Wyperfeld/Bronzewing area) and North East (Wandown area), there has been a slight decline of about 1% per year over the past 16 years (not including data from drought years). While this apparent decline is of concern, these seven sites have not

been re-searched for seven years so it is uncertain at this stage whether the decline is real. This emphasises the urgent need in Victoria to have the monitoring sites re-searched in order to maintain a high level of accuracy.

In the Sunset Country and Hattah/Kulkyne NP, Malleefowl breeding numbers have declined by about 50% over the past seven years (excluding droughts). These sites were re-searched at the same time as those in other parts of Victoria, but the decline is a much greater and of serious concern. While the cause of this decline is not fully understood, low winter rainfall over the past few years in this general area appears to be involved. Unfortunately, we do not have accurate rainfall data for many of these sites, and this highlights the need for such information if we are to make sense of future trends.

Where to from here?

There are three points I would like to make in conclusion:

1. Monitoring provides a foundation for management

Monitoring provides crucial data on trends in Malleefowl populations that are under pressure from a range of recent landscape-scale changes. Due to the cryptic nature of Malleefowl, targeted monitoring programs are the only means of assessing the species' conservation status. Measuring population trends is all the more important now that the climate appears to be changing.

Apart from providing information on trends, monitoring programs also provide valuable opportunities for measuring the effects of various management options such as fox and grazing control, fire regimes, and habitat manipulations. Indeed, the current Malleefowl monitoring sites across Australia have been greatly under-utilised in this regard.

2. Malleefowl need to be monitored across Australia

Monitoring is providing data that is essential for conservation and monitoring programs are required wherever the species occurs. Nationally, we need to standardise methods and centralise records so that data can be easily combined to provide regional impressions of Malleefowl trends. Techniques will vary in some cases (eg. tracking in arid regions where breeding density is not feasible), but national standards will also provide a more efficient basis for maintaining community support and analysing the resulting data.

3. Community groups everywhere could benefit from Vic experience

Developing and maintaining an efficient monitoring programs involves an enormous effort and is a considerable logistical challenge. In Victoria, we have been lucky to have the support of Parks Victoria over a number of years and this has provided the opportunity to develop and refine an efficient system. Monitoring is now easy, enjoyable and highly efficient, and the VMRG is now starting to collect additional data, building on the monitoring foundation. Community groups across Australia who are struggling with the challenge of monitoring Malleefowl could benefit from the processes and refinements that have made the Victorian system easy and enjoyable for volunteers. Critical components of this success, and of maintaining the high level of interest and professionalism amongst volunteers, are:

- The monitoring processes and administration are entirely run by the community
- The use of Palms and Cybertracker has simplified field work, eliminated data backlogs and improved data handling
- Annual weekends where training, AGM and social events are combined ensure a level of quality control and stimulate group harmony

Indeed, the administration is now so efficient that it would seem feasible to provide monitoring support for communities across Australia from a single office. This would not necessarily involve any loss of control by local groups of the work or data, but merely provide other groups with the benefits of equipment, processes and information to make their monitoring uncomplicated.

Malleefowl (*Leipoa ocellata)* Conservation on Eyre Peninsula, South Australia

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Abstract

Malleefowl continue to survive on northern Eyre Peninsula (EP) in isolated patches of habitat both in the reserve scheme and on private land. However, information on the viability of these scattered populations remains limited.

Ideally, to ensure the long-term survival of Malleefowl on EP we need to monitor population parameters such as abundance, breeding success and degree of genetic isolation to inform management decisions. Unfortunately this task is made difficult by the life-history traits and cryptic nature of the Malleefowl. As a start, the Department for Environment and Heritage (DEH) and the local community are monitoring the breeding activity of Malleefowl by setting up grids at 5 sites across EP.

These grids are located in Munyaroo, Pinkawillinie and Hincks Conservation Parks and on private land near Cowell and Lock. DEH and a Greencorps Team set up three of the five grids in 1998. These grids were surveyed in 1998, 2003 (partly) & 2004. Local Malleefowl enthusiasts have surveyed the Cowell grid for nine years. The Lock grid was recently set up in Oct 2003 in conjunction with a Greencorps Team and community volunteers.

Information gained by these surveys will be used to inform on-ground works and increase community awareness. It is also hoped that this baseline information can be built upon and expanded in the future by additional monitoring and research.
Other initiatives that are helping to conserve our Malleefowl populations on EP have also been outlined.

Introduction

The Eyre Peninsula Natural Resource Management (NRM) Region is located in the south-central part of South Australia (Fig. 1). There are still scattered populations of Malleefowl on northern Eyre Peninsula, both in the reserve scheme and on private land, but there are few recent records of the species from the southern agricultural regions (Fig. 2). This is probably due to the extensive vegetation clearance that has occurred on southern EP resulting in only small degraded remnants of habitat that are not large enough to support viable populations of Malleefowl. Although Malleefowl

still have a relatively wide distribution on EP, landholders are claiming that many populations are becoming locally extinct. Declines may be caused by factors including the degradation of Malleefowl habitat by the grazing, and the predation of juvenile Malleefowl by foxes.

The majority of landholders on Eyre Peninsula appear to have a great interest in Malleefowl. This may be because the lives of farmers and Malleefowl are both affected by variations in season from year to year. In a good year, farmers can reap a decent crop and Malleefowl can breed successfully, while in a bad year, neither farmers nor Malleefowl prosper. There are many landholders on EP that have Malleefowl on their private property which they manage themselves to protect the birds. Some of these landholders believe that if they do not tell anybody where their Malleefowl are, their birds will survive into the future. This may be an excellent philosophy to foster as these landholders are taking ownership for the well being of Malleefowl on their property. It is however important that landholders are aware of the threats to Malleefowl and the actions they can undertake to alleviate these threats. Although most landholders appear to have this knowledge they may need financial incentives and some encouragement to undertake actions. Several programs that have been initiated to counter threats to Malleefowl on Eyre Peninsula are discussed below, along with the monitoring methods used to measure the success of these programs.

Fig. 1. The Natural Resource Management (NRM) Regions of South Australia. Note the Eyre Peninsula Region in the south-central part of the state.

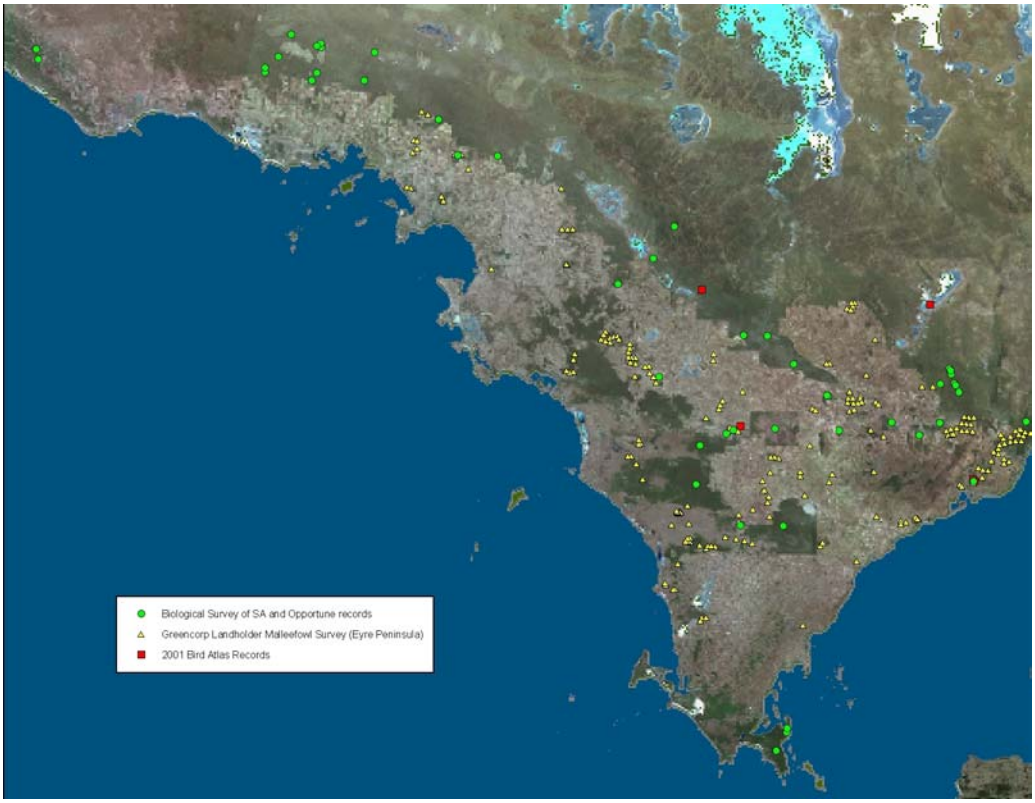

Fig. 2. The known distribution of Malleefowl projected onto an aerial view of Eyre Peninsula showing areas of remnant vegetation (dark areas) and cleared land (light areas). Distribution is based on a) the Department for Environment and Heritage (DEH) Biological Survey of South Australia and Opportune records (circles), b) a survey of Eyre Peninsula landholders conducted by DEH and Greencorps in 1998 (triangles) and c) 2001 Bird Atlas records (squares).

Initiatives contributing to Malleefowl conservation on Eyre Peninsula

Integrated Pest Management Programs

The West Coast Integrated Pest Management Program has encouraged integrated fox and rabbit control on public and private land in the Elliston, LeHunte and Streaky Bay Council areas since 1998 (Fig. 3). The timing of fox and rabbit control efforts has also been coordinated to increase its effectiveness at the landscape level.

Landholder participation in this program is high, with a total of over 370 landholders involved in early 2004, and 95 % of landholders being involved in integrated pest management in a coordinated approach in some areas. The program involves coordinated fox baiting twice a year in February - March and August - September to impact on the fox population when it is most vulnerable.

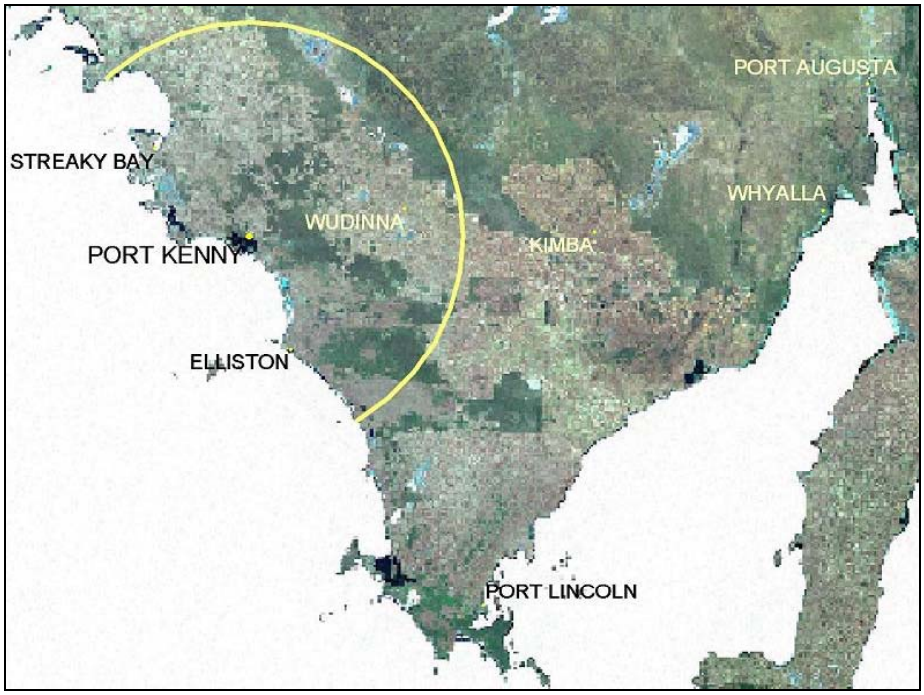

Fig. 3. Map of Eyre Penisula showing the area originally targetted by the West Coast Integrated Pest Management Program bounded by the yellow circle. The total area covered by the program has now spread beyond this area with over 370 landholders across northern Eyre Peninsula participating in coordinated fox and rabbit control.

Groups of landholders are met by Animal & Plant Control Board Officers and a Bushcare Officer to supply 1080 baits. Each group is briefed on effective methods and safety involving the use of 1080, and the importance of fox control to the continued survival of native species including the Malleefowl. There is also discussion about the Malleefowl population in their local area and what else can be done to alleviate the threats to the Malleefowl, such as the protection of vegetation from stock grazing. A number of areas of remnant vegetation have been protected from stock as a direct result of this interaction. Even though fox baiting has not been proven to decrease predation of Malleefowl on EP, this program facilitates the transfer of information between people interested in conservation and groups of landholders. This transfer can then lead to the improved management of our remnant vegetation that provides habitat to many threatened species including the Malleefowl.

Similar programs are also being initiated in the eastern and southern areas of EP. This is especially important in the eastern area, as the band of habitat extending from Munyaroo Conservation Park to Lake Gilles Conservation Park is probably the stronghold for Malleefowl on EP.

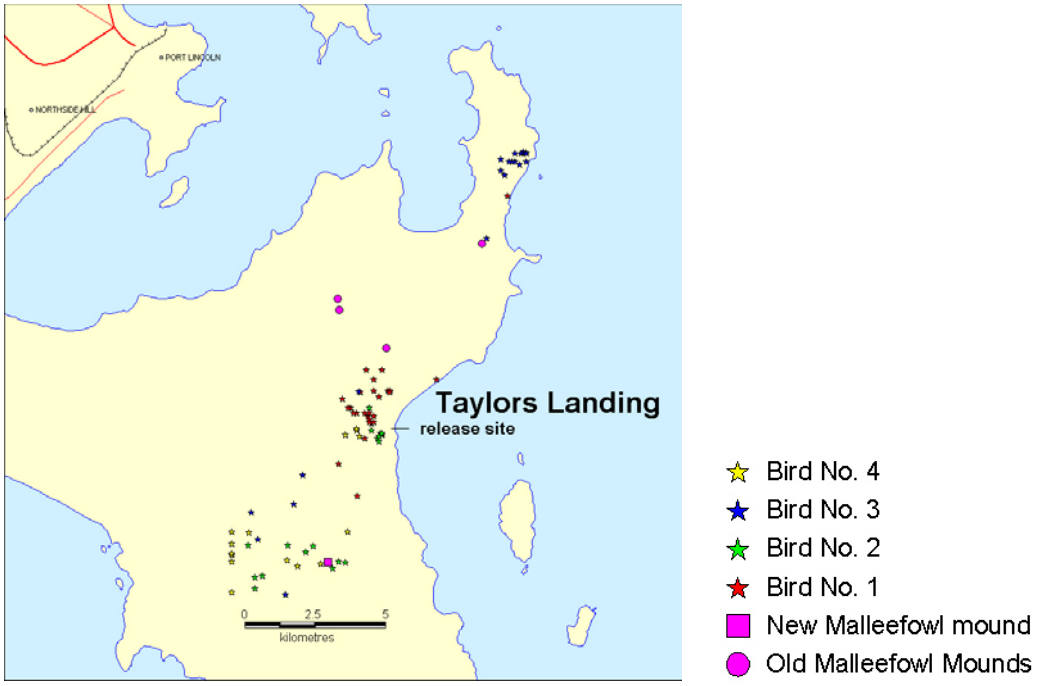

Figure 4. Locations of captive-reared Malleefowl in Lincoln National Park established by aerial radio-tracking on 20 occasions over nine months after release, and the location of old and new malleefowl mounds.

Fig. 5. The location of Malleefowl monitoring grids projected onto an aerial view of Eyre Peninsula showing areas of remnant vegetation (dark areas) and cleared land (light areas). Grids are located at a) Pinkawillinie Conservation Park, b) Lock (Heritage Agreement Area on private land), c) Hincks Conservation Park, d) Cowell (Heritage Agreement Area on private land), e) Munyaroo Conservation Park.

Table 1. Number of active Malleefowl mounds located in 2km x 2km grids on Eyre Peninsula. The total number of mounds located when each grid was first surveyed is shown in brackets. The total area of each grid was comprehensively searched by line transects unless otherwise indicated.

Grid name	Year surveyed								
	1995	1996	1997	1998	1999	2000	2001	2002	2003 - 2004
Munyaroo				1 (35)	ns	ns	ns	ns	4**
Pinkawillinie				1 (34)	ns	ns	ns	ns	0*
Hincks				2 (22)	ns	ns	ns	1*	1*
Cowell	10 (84)	7	5	na	7	13	9	6	7*
Lock									6 (54)

ns = not surveyed
na = data not available
* = Only known mounds surveyed
** = Only 80 % of grid searched

Fencing of native vegetation

The fencing of remnant vegetation has been made possible by allocating farmers incentives from Natural Heritage Trust (NHT) funding to undertake the fencing. The NHT project "Conserving Mallee Biodiversity on Eyre Peninsula" has resulted in the protection of approximately 9500 ha of mallee vegetation from stock grazing. All on-ground works have occurred in areas with Malleefowl present or in vegetation that is suitable Malleefowl habitat. The project has involved over 30 landholders, half of which have observed Malleefowl on or near their property.

Captive rearing and release

Another initiative undertaken on EP under the DEH banner of Ark on Eyre was a Malleefowl captive breeding and release program (Cotsell 2001) that resulted in the release of four birds into Lincoln National Park in December 2001 (Fig. 5). Prior to the release, Malleefowl had not been seen in Lincoln NP since 1972.

The released birds were aerially radio tracked for nine months until their transmitters failed. An active mound was found in the Park in September 2002 when one of the captive-reared birds – the only male bird released - had not moved for over two months. When the location was checked from the ground, the bird was observed near a previously unknown active mound.

The mound was excavated in January and March 2003 by Paul Burton (NSW NPWS) and Andrew Freeman to determine whether it contained eggs or was a practice mound only. Eighteen eggs were found in the nest, all of which hatched successfully. The nesting mound appeared to be recently constructed, an observation further supported by the coarse nature of the bulk of material, comprised mainly of large pieces of raked

up organic matter mixed with a small proportion of soil and large pieces of limestone. The eggs were not laid inside an egg chamber, unlike most other nests, especially established ones. Such a new construction could be explained by it being completed by a young male or that a new location was required for the pair.

As the eggs were numerous and of moderate size, it was likely that they were laid by a mature female, which may indicate that there was an existing population of Malleefowl in Lincoln National Park prior to the release of the captive-reared birds in 2001.

There were no signs of predators identified around the nest site, which may be an indication of the effectiveness of the quarterly 1080 baiting program that has been ongoing in Lincoln NP since 1997.

Monitoring of active mounds

Method

To assess the success of Malleefowl conservation programs on Eyre Peninsula, population trends need to be monitored. As Malleefowl density is difficult to measure directly, changes in the number of active mounds over time are being used as an indicator of changes in Malleefowl density, as recommended by Benshemesh (2000).

Five survey grids (2 km x 2 km) have been established in Munyaroo, Pinkawillinie and Hincks Conservation Parks as well as in two heritage agreements one just north of Cowell and one just north of Lock (Fig. 6).

The Cowell grid has been surveyed by local Malleefowl enthusiasts for nine years. In 1998, staff from DEH and a Greencorps Team established and surveyed the Pinkawillinie, Hincks and Munyaroo grids. In spring 2003 and summer 2003-2004, staff from DEH and the Eyre Peninsula Natural Resource Management Group (EPNRM), community volunteers and a Greencorps Team resurveyed 80 % of the Munyaroo grid, established and surveyed the Lock grid, and monitored active mounds in the Cowell, Hincks and Pinkawillinie grids.

Results and discussion

Results of the grid surveys are shown in Fig. 7. Only the Cowell grid has been searched comprehensively on more than one occasion and although the number of active mounds at this site has fluctuated over time, there is no evidence that numbers are either increasing or decreasing. It is interesting to note that the grids that are nearly totally surrounded by agricultural land (Cowell and Lock) have the highest number of mounds.

The low number of comprehensive repeat surveys for most grids limits the information that can be gained by the data. This is primarily because of the general difficulty in finding the number of people necessary to conduct the comprehensive surveys on Eyre Peninsula.

Future directions

Monitoring

Monitoring the success of conservation initiatives for Malleefowl on EP is still in its very preliminary stages. Although there is considerable community support for such initiatives, we are a long way from being able to determine whether current conservation initiatives are helping to conserve Malleefowl in the region. A long-term monitoring program that produces a meaningful indication of Malleefowl abundance is required. We intend to continue to monitor the five established Malleefowl grids on EP by conducting a complete survey of at least one grid each year, and alternating grids between years. This would enable each grid to be surveyed at least once every five years. Frequency of surveys will depend on the number of people available, including agency staff, Greencorps teams and volunteers. The effectiveness and cost of additional survey techniques such as aerial surveys (Brickhill 1985) and mound excavation may also be investigated in 2004.

Conservation initiatives

We have to be judicious about how we spend our limited resources for Malleefowl conservation programs in the region. The captive rearing and release program produced some valuable insights into the behaviour and breeding of the released birds, and also stimulated a large amount of community interest. However, a considerable amount of time and resources were used to get a final result of four Malleefowl released into the wild successfully. Despite the positive outcomes of this project, we need to consider the overall contribution of this initiative to Malleefowl conservation on a regional scale. The trick is to harness the enthusiasm generated by initiatives such as the reintroduction, and then encourage those involved to contribute to other initiatives that will assist the survival and monitoring of existing Malleefowl populations in other parts of the region.

Conserving Malleefowl on EP may also be largely about education as there are still many people in the community who do not understand the threats that face the Malleefowl. Face-to-face discussions with landholders can be very productive as many landowners who manage areas of Malleefowl habitat are quite prepared to put in some time and effort to help conserve the Malleefowl population in their own area, either by vegetation protection, fox baiting or a mixture of both. However, it is also important that incentives are made available to landholders to undertake these works, and that such incentives are targeted to high priority areas to generate the best conservation outcomes.

When making decisions regarding a large bird that lives over a vast area of Australia it will be important to use the landscape-level conservation principles (The Wilderness Society (undated) and DEH 2003). These principles include the connection of habitats via a comprehensive system of core protected areas buffered and linked by lands managed for conservation objectives. DEH and the EPNRM are working together to encourage stakeholders to manage large connecting areas of vegetation for conservation over northern EP. This includes the identification of high priority biodiversity areas (using Malleefowl as one of the flagship species) and offering support to landholders to manage priority areas for conservation.

It is hoped that a range of conservation initiatives, including the combination of landscape-level habitat protection and pest animal control, will help to ensure the survival of Malleefowl on Eyre Peninsula for a long time to come.

Acknowledgements

For financial assistance we thank the Natural Heritage Trust, the Department for Environment and Heritage (SA), the Eyre Peninsula Natural Resource Management Group and the Nature Foundation of SA. The conservation initiatives detailed above would not have eventuated without the time and energy of many individuals, including Stan Cornish, Paul Burton, Nigel Cotsell, Ross Allen, Simon Bey, Stuart Pilman, Ben White, EP Greencorp Teams (1998 and 2003), Andrew Graham, George Aldridge, Tom Bott, and many other community volunteers.

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' Ordinary People Doing Extraordinary Things '

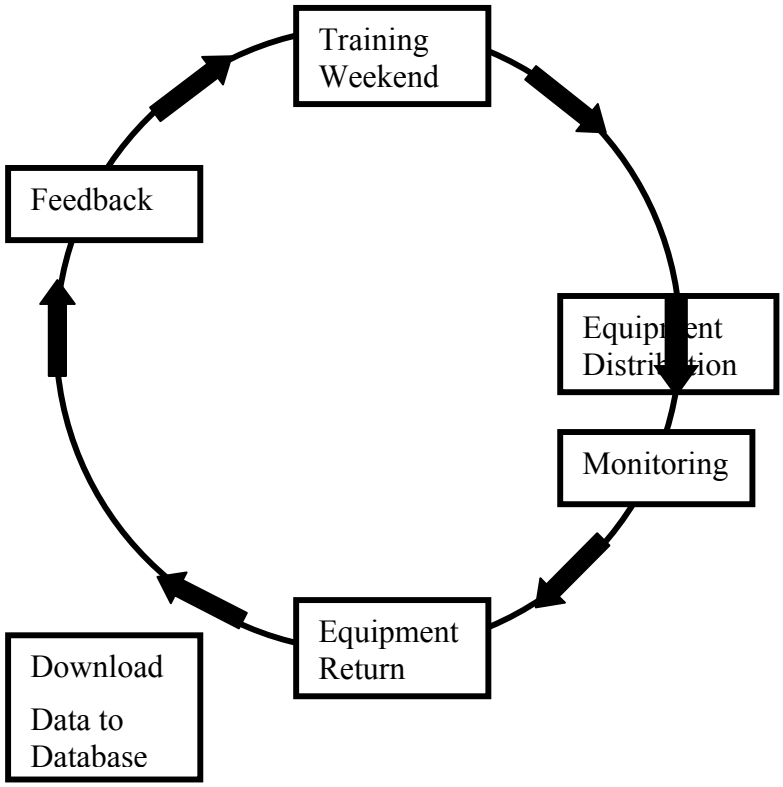
An outline of the processes used by volunteers to collect malleefowl data in northwest Victoria

Prepared by Ralph Patford, Ann Stokie, and Peter Stokie

The Victorian Malleefowl Recovery Group (VMRG) is a volunteer group of interested people who monitor approximately 900 malleefowl mounds annually in 24 established grids in the Mallee and Little Desert National Parks and Reserves of NW Victoria. The group currently comprises approximately 50 people who come together because of their mutual specific interest in malleefowl conservation, and their love of the mallee country in general. The members of the group come from diverse backgrounds, with slightly more than half living and working in the Mallee, and the remainder from regional and metropolitan towns and cities to the south of the Mallee. Those who don't reside in the Mallee have had long associations with the area, either as past residents or as frequent visitors for recreational purposes. It would be fair to say that individuals have a passionate interest in a range of environmental activities and are willing to devote considerable time and concentrated effort to be involved in the data collecting processes that are outlined in this paper in order to contribute in a significant way to the National Malleefowl Recovery Plan from a Victorian perspective.

The data collection process for the established Victorian grids has recently undergone dramatic changes with the use of technology. Previously paper entries and gridline searches were used almost exclusively until three years ago, when all known mounds were searched using grid lines, but were given a GPS position during this search. The following year, all mounds were located from GPS locations and data for many grids was entered onto a palm held computer, and later downloaded to the database from the palm. In this current breeding season (2003/04), all grids were monitored and recorded using the new technology of Palm, GPS and Digital Camera.

This paper outlines the processes that were adopted to ensure the success of changing our methodology of collecting and collating data from a tried and trusted system of paper and manual spreadsheet data entry to an electronic system that was generally unfamiliar and challenging to the volunteers of the VMRG. The process involved restructuring the annual training weekend, distributing monitoring equipment from a central source, gathering information in an electronic format, returning the equipment to the central source where the data was downloaded and then transferred to the central database. Monitors are given the opportunity to provide and receive feedback on the strengths and weaknesses of the system, and then the process is modified before the next training weekend.



Diagrammatic representation of monitoring cycle

The Training Weekend

The training weekend is the most crucial element of the monitoring cycle as it is here that skills are revised, and experiences are shared. Held in early October, the members of VMRG who wish to monitor a grid in the coming season share in a series of activities, *(Refer to appendix 1 for a typical agenda)*, designed to cover both theoretical and practical aspects of monitoring. As this is one of the few times that this group come together, there is a tremendous spirit of friendship and good will and much sharing of the year's personal and work events.

As members of the group have a common interest in the fate of malleefowl and a commitment to success of this monitoring program, the level of enthusiasm and motivation for the weekend's activities is assured. When introducing the new technology to the group, this sense of common purpose was instrumental in a decision taken to trial the system, despite a general distrust and even intimidation of such technology.

Monitors could see how the system as explained could improve the monitoring outcomes, and as most had only recently experienced monitoring using gridlines, they were willing to try another system. One of the strengths of the group is the mutual support that exists, and an unspoken understanding that nobody would be put under pressure if they could not manage palms and GPS's and the like. In fact many offers were made to support each other to make the new way work.

An interesting feature of the cooperative nature of the group is the open informal sharing of information and skills during the non-formal parts of the weekend program. With such a diversity of skills and backgrounds, and a generosity of people prepared to share such skills, fascinating discussions about mallee plants, birds, farming practices, stars and various encounters with malleefowl are common. Generally these interactions are just as informative and probably more interesting than the formal program. The lengthy discussions around the campfire and other small group interactions over cuppas and the bbq are an integral part of time spent together.

At the end of the training weekend, all grids are allocated to monitors and each monitoring team is given all the basic non-technical equipment such as grid maps, gps maps, the previous year's monitoring sheets and measuring equipment. Each monitoring team also indicates a preference for the dates when they think they will monitor. Some negotiation may occur here if too many want to monitor at the same time.

Old hands have revised their skills and new monitors have the necessary background to decide if they want to proceed. There is a general understanding that new people will be matched with an experienced person, at least for their first day of monitoring in a new grid. There is also an increasing belief that it should be compulsory for monitors to attend the training weekend each year if they intend to monitor.

Distribution of Equipment

The development of recent technology allowing incredible information to be contained within a handheld computer has dramatically altered the way the VMRG monitors collect data within the malleefowl grids. As a result of the decision to use the technology, it has been necessary to centralise the distribution of essential items of equipment. There is a limit to the number of Palms, GPS's and digital cameras to which the VMRG has access, so a distribution system had to be developed to ensure monitors have the equipment when they need it. A member of the VMRG committee has taken on this task, and with the efficiency of Australia Post and the cooperation of monitors, equipment is moved back and forth between the coordinator and monitors.

It is important that the distribution process be coordinated from a single source, as this is the link between the collection of data in the field and the transfer of data to the central database. The equipment needs some preparation before it is sent out, as the palm, GPS and digital camera need to be prepared to ensure that they contain the appropriate grid details, and that each machine has a synchronised time and date. The process of downloading data is well documented and follows a set pattern that is easily managed with limited computer knowledge and gets easier every time it is done. When the machines are set, they are then sent through the post, with some additional non-technical equipment, to the home address of the monitor. Care must be taken to ensure that all equipment that is sent will be working, contains the correct data and nothing is missing. A checklist *(refer to appendix 2)* that covers technical

equipment, instructions, notes and safety reminders has been developed, so that the monitors can be certain that everything they need has been provided.

The monitoring period covers a 10 –12 week period from mid October until early January. With 24 grids to be monitored and limited equipment, it is necessary to prepare a timeline in negotiation with the monitors, and this starts at the training weekend. The timeline needs to cater for unexpected hold-ups such as adverse weather, illness, or whatever that requires monitors to change their intended monitoring time. The timeline needs to cater for a two-week turn around with equipment, and in our case no more than three groups monitoring at any one time.

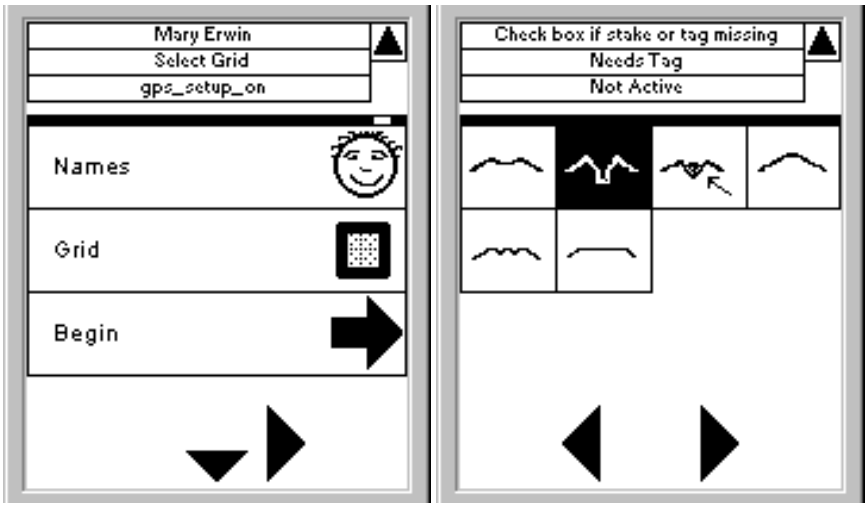
Timelines could be more or less flexible depending upon the equipment available. Based on two years' experience, we have needed seven sets of equipment to monitor our 24 grids over the time span of twelve weeks.

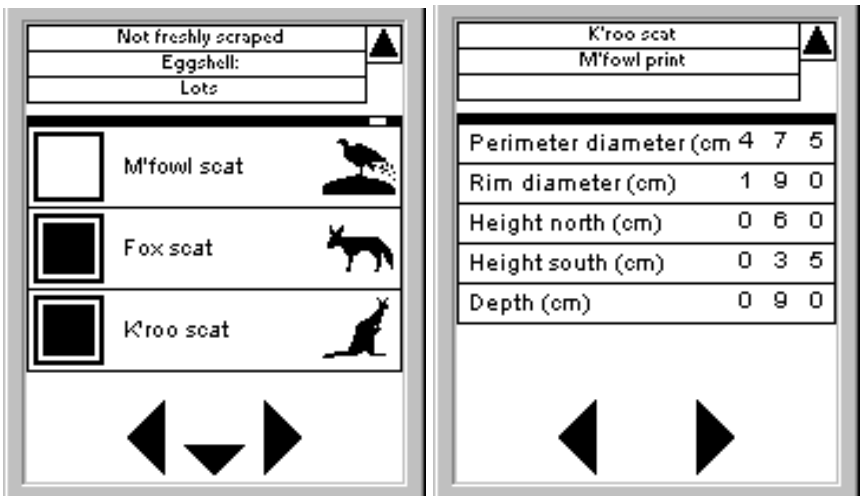
Communication and trust between the monitors and the coordinator is essential for this distribution process to be effective and phone and email contact help tremendously. There are responsibilities in this system for both the monitors and the coordinator, and occasional stuff-ups occur. No matter what the cause, the isolation or the heat of the day at the time, patience and an agreed 'no blame' approach resolve these matters.

Gathering Data

Location of mounds and the recording of data using the palm and GPS are considerably different to the old ways of following gridlines and using paper entries.

The efficiency of locating mounds by GPS makes walking through mallee scrub an easier and quicker task, and also increases the opportunity to observe the surroundings for other things of interest. Occasionally new mounds are found because identical tracks are not always used. The palm provides screens to replicate all the information that was previously recorded on paper.





Sample screens from Cybertracker program on Palm

The incredible advantage of using the palm is the electronic storage of data and the ease of transferring the data at a subsequent time to the database. Confidence with manipulating the palm increases with usage. The palm was introduced as an optional method two years ago and exclusively for this monitoring season. The palm requires entries on all screens, which ensure that all relevant data is collected, and has an inbuilt back-up system to lock in data. Monitors are still provided with paper data forms for backup in case of equipment failure. This has been required on a few occasions. Monitors have the option of filling in the paper forms as well, and in most cases this occurs, as monitors have an apprehension that the electronic data will disappear into the ether before it is downloaded. Digital photos are taken to record observations at each mound and they are instantly retrievable. Records of personal observation that are outside the scope of the palm, such as the sighting of interesting vegetation and birds, other photos taken, or other interesting sightings are entered into a small grid logbook, which will be taken into the field each year and over time will be a valuable resource regarding other activities in each grid.

None of our monitors have 'retired' because they couldn't handle the system. The same understanding of the need to collect accurate and scientifically valid data exists, and the same degree of 'ownership' of particular grids has been maintained. Monitors become attached to grids and generally request to return to the same grid each year. It doesn't seem to matter if monitors live locally, or come from another locality, a similar attachment to a grid develops.

The use of technology in collecting data does not necessarily improve the quality of the data. We still need the same level of enthusiasm and commitment to observation and care in recording what we see. What is different is the ease and speed of movement around the grid. More importantly, no longer does the data need to transferred to the database by incredibly time-consuming manual spreadsheet entries,

but the data is instantly transferable to the database in the format in which it was collected.

Return of equipment and data download

Once monitoring is completed, it is understood that the package sent through Australia Post will be returned promptly to assist with the turn-around of the equipment to other monitors. Monitors use the checklist (refer to appendix 2) to ensure that all essential items are returned, and any equipment failure or other problems are duly noted.

It is possible for the coordinator to download the data from the grid just monitored, and install the next grid's details in a few hours and have the next package back in the mail the same day it arrives. However this is rarely the case, and the coordinator can take time to complete the three tasks that are required to get the process under way again. Initially the data collected needs to be transferred from the palm to a home computer that contains the cybertracker spreadsheet, using a cradle interface. If there is some reason that data collected in the field has not been retained on the palm, it is an easy, and not too time-consuming, task to manually enter the data back into the palm from the paper nest sheets if they have been filled out in the grid. This is the only benefit of completing the nest sheets as a backup to the palm. The cybertracker spreadsheet has a useful review panel, which enables the coordinator to easily check the entered data if necessary.

Photos of mounds are downloaded to 'my pictures' and labelled according to the grid name. Later all photos are transferred to a CD where they are held for future reference.

Once the data and photos are saved, the old data is deleted from the equipment and all the necessary details for the next grid are installed onto the GPS and palm. The steps needed for this to occur are clearly documented and become routine after following the document a few times.

The electronic download process for the 24 grids is not overwhelming as the data entry is spread over 8-12 weeks, and each grid takes just a few minutes. Compared to the old way of manually entering 36,000 pieces of information onto a spreadsheet from the paper sheets for the 900 mounds monitored, the new way just requires the palm to be placed in the computer cradle 24 times and everything happens with the push of a button.

Transfer to database

The data download to a home computer and later transfer of data to the central malleefowl database is a simple process that doesn't rely on vast computer skills. Several clever programs have been devised that are incorporated into the cybertracker spreadsheet where the monitored details are held. When selected, these programs transfer the data automatically to the central database by zipping the spreadsheet to a manageable size and preparing it to be sent as an email. Once the data is transferred to the central database analysis of the data can commence and reports generated.

Feedback

The final process in the monitoring cycle is the mutual sharing of information amongst monitors and the data analysts. This feedback is both formal and anecdotal, and everybody's opinions and observations are valued.

The database generates a global report outlining the complete results of the season's monitoring, as well as a report for each grid. Reports cover past records and findings, and a detailed activity statement of all malleefowl and predator observations. These reports are published and made freely available to members of the VMRG.

Collected data and photographic records are stored on two CD's, and are able to be easily retrieved for educational and publication purposes, as well as for our web page, and as a general record of our achievements.

Group communication is constant using email, phone, newsletter and the web page. Digital photos taken by monitors can be returned to them on CD, and an annual survey "What worked, What didn't" is conducted at the end of the monitoring season to provide an opportunity for positive feedback and suggestions for improvements. All suggestions made are taken seriously, and acted upon, or discussed if not able to be implemented.

A formal "Reporting Back" membership meeting is held in March after the data reports and the survey analysis are completed. At this meeting Joe Benshemesh's Annual Report on Malleefowl in NW Victoria is tabled, and recommendations about future directions and monitoring process are recorded for the consideration of the VMRG committee. The meeting ends with a celebratory meal and camp-out back in the mallee country where this process began.

Concluding observations

We, the authors of this paper, believe that members of the Victorian Malleefowl Recovery Group have implemented the outlined system of monitoring malleefowl in an extraordinarily effective manner. The system is easy to follow when supported by a basic training program, so long as the training is thorough and provides practical, hands on experiences. The monitoring format is suitable to be used by non-technically trained people. In fact it is suitable for use by anyone who has goodwill, enthusiasm and appropriate training. The volunteers who belong to the VMRG are exactly these types of people and have proved that the system works.

The benefit of using a programmed technological process is not only time saving, but also helps to maintain the scientific integrity of data collected. All data is collected in an identical way. Hence the data collected by several different people is comparable. Members of the VMRG understand that they are part of a rigorous scientific project, and undertake their monitoring accordingly. They are proud of their achievements, and know that they are making significant contributions to the malleefowl recovery project.

A further compelling factor that supports the adoption of the system on a broad scale is the easily managed data control provided by electronic transfer of data. The benefits of storing and transferring data in this way, together with faster data analysis and more effective archiving of results for later reference are immeasurable.

Reference to technology, however, can detract from the ultimate strength of this monitoring program. It is people who make it work, volunteers who love malleefowl and enjoy days in the bush. Our volunteers make it quite clear that they get more out of the experience than what they put in, and would continue to monitor no matter what system is used.

APPENDIX 1

VMRG Training Weekend Agenda
Wonga Hut Campground, Wyperfeld National Park
11 – 12 October 2003
1.00pm Start

DAY 1 – Theory & paper work

Start 1.00 pm

1. Welcome
2. Introductions
3. Previous years summary
4. Aims of the monitoring program
5. Safety procedures
    - Remote locations
    - Use of trunking radio (demonstration)
    - Procedure for logging in and out of grids
    - Essential items to take
    - Insurance
6. Monitoring procedure
    - Explanation of grid and map translation
    - Locating a grid
    - Brief introduction to GPS
    - Finding nests (various methods)
    - Data recording/Cyber Tracker
    - Protocol on/at nests
    - Scat Collection
    - Digital Camera
7. Monitoring Kit
8. Data entry procedure
9. Timing
10. AGM (Agenda attached)
11. BBQ (BYO Drinks & eating utensils, plate, mug & bowl etc….)

DAY 2 – Practical demonstrations

Start 8.00 am sharp – Meet at Wonga Hut Camp Ground

1. Safety Procedure – fill out log sheets
2. Depart Camp Ground to selected grid
3. GPS demonstration
4. Finding a nest
5. Recording data

Back to camp

6. Confirmation of grids to volunteers
7. Distribute kits & datasheets
8. Summarise process
9. Close 1.00 pm
10. BBQ Lunch

APPENDIX 2

Monitoring Kit 7 Check List

Item	Check out	Return	Check in
Field intention Logbook sheets			
Field notebook			
Malleefowl scat/feather bags			
Fox scat plastic bags			
Fox scat ID sheet			
Battery charger with charged batteries			
Digital camera and Case			
*CD and documents for camera			
*Spare rechargeable batteries for camera			
*Spare photo memory cards			
Palm and GPS			
*Spare rechargeable batteries for Palm			
* GPS Manual			
Laminated instruction cards for			
* Camera			
* Palm			
* Cybertracker			
* GPS			
* Battery charger			
* Safety			
* Photo Sizing card			
* Trunking Radio contact numbers			
* Trunking Radio Keypad model			
Lerp Tool			
Lerp instruction sheet			
Expense claim form			
Return address label			
Registered Post and Insurance form			
Parcel Post satchel			

- *Do not rely solely on the charged batteries in this package. Take some extra AA and AAA batteries in case of battery failure.*
- *NOTE: If you are going to a designated remote grid you must have a trunking radio from Parks Victoria with you.*
- *Please contact the appropriate ranger prior to visiting your grid to inform them of your plans whilst in the grid. It is important that rangers know when and where you are in the park for emergencies and as a matter of courtesy.*

Poster papers

Conservation through community passion: Observations of Malleefowl *Leipoa ocellata* in the Mallee Region

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The Mallee has a long legacy of skilled amateur naturalists who have contributed greatly to our understanding of the ecology of species in this region. Mr Harold Buckingham is one example of an amateur naturalist. He resided in Wagin in the 1920's but soon after resumed his farming career in southern Victoria. During his time in Wagin he developed an interest in the natural history of the Mallee and maintained his interest with periodic visits to the Mallee. He befriended Rudd Campbell (Ranger, Wyperfeld National Park) and Ben Eggleton (Ranger, Hattah - Lakes National Park). Harold retired to Ouyen in 1965 and pursued a seasonal study of Mallefowl in the Timberoo area. He collected a large number of photographs and published two papers discussing the heat generation and management in the mound of the Malleefowl and a qualitative description on the birth of Mallefowl. Therefore, importance of field observations made by individuals and community groups should not be underestimated because through their passion and commitment a greater understanding of species ecologically at an intimate level, in this case, the Malleefowl has been achieved.

Survival on the land – the mallee, the malleefowl, the community

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Malleefowl conservation is about to get a big boost with the construction of Yongergnow Malleefowl Interpretive and Research Centre in Ongerup, Western Australia. Four years in the planning the centre is now taking shape with the completion of a visionary design which incorporates the shape of a malleefowl mound.

The development evolved from a mix of concern for the demise of the local shire emblem, the malleefowl, its disappearing habitat and a dwindling rural population. These elements were put together during community workshops and an innovative solution emerged in the form of a malleefowl interpretive and research centre.

The story of the mallee, the malleefowl and the local community will be told using displays, interactive and audio-visual media. Visitors will also experience the captive breeding program by viewing birds in a large aviary, chicks hatching in incubators and eventually being translocated to secure bushland areas in the region.

The aims of the centre are threefold:

- Support and contribute to the conservation of and research work for the malleefowl and its habitat
- Raise awareness of mallee habitat and ways of living sustainably within that environment
- Increase visitor numbers to the town and region and create employment opportunities for local people

Ongerup Community Development has received funding from local, state and federal governments and construction will begin early in 2004 with an opening in mid to late 2004.

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Aboriginal Legacies-Contributions Toward Community Awareness

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Two very significant reminders of the malleefowl can be used effectively in drawing attention of the community to the plight of the malleefowl and the need for its conservation. Neilloan, the malleefowl Creator Being of the Boorong Clan in north-west Victoria provides a nightly reminder for the six months prior to the egg-laying season. Known to Western astronomers as Lyra, this ageless celestial image suggests the need to provide a continuing future for the malleefowl. Another reminder is close to the home of the two remaining breeding pairs in Central Victoria. At Kooyoora State Park a probable malleefowl increase site lies as a silent reminder of a once thriving population of malleefowl in this part of Victoria. The recently established Wedderburn Conservation Management Network which includes Kooyoora in its area of responsibility has chosen the malleefowl as a potent symbol to represent its aim of halting the decline of biodiversity and reversing this trend. Protection of the remnant malleefowl and enhancement of its habitat is a number one priority for this action-oriented community group.

"Kitless Kat Klinicks" A Community Response to Cat Predation

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The delivery of two malleefowl chick specimens by pet cats to farm homesteads in Pingrup and Narembeen, Western Australia and community concerns for the number of feral cats in private bushland instigated a Malleefowl Preservation Group awareness campaign in 1999.

The "Kitless Kat Klinick" project was developed in consultation with the West Australian Veterinary Association and the Albany Veterinary Hospital mobile service as a free cat sterilisation clinic. In promoting a greater understanding of cat impacts on native fauna and supporting a "responsible" cat ownership philosophy, the project aims to increase community values of the region's biodiversity.

Kitless Kat Klinicks are funded by the community, cat owner donations and heavily subsidised by veterinary practitioners.

As a "one off" service to the Ongerup, Gnowangerup and Gairdner communities and current interest from the towns of Ravensthorpe and Kojonup, the Malleefowl Preservation Group recognises the potential to expand this program to country regions in Western Australia.

The Mulga to Mallee Link – a corridor vision

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The Foster Road survey site represents one of many isolated remnants scattered across the agricultural landscapes of Western Australia and is the starting point for the "Mulga to Mallee Link" wildlife corridor plan.

In response to community concerns for the cultural and heritage significance of the *Gnow*angerup Shire faunal emblem, the "gnow" (Noongar Aboriginal name), or malleefowl, a Community Action Plan was completed in 1994.

Concern for the isolation of the Foster Road site and personal observations (Dennings and Vaux) of malleefowl using an unfenced and degraded tree line lead to the development of a North Ongerup Malleefowl Corridor Plan. Given the size (138 ha) and breeding activity of five active malleefowl mounds in the Foster Road site, stage one involving 6 farmers and volunteers constructed 26 kms of corridor fencing in 1996. This year, a further 17 km incorporating local providence seed and germinated seedlings from the Foster Road site has extended the network to 63 kms. Within the corridor, a series of monitoring points have been established to record autumn and spring birds sightings (all species) and vegetation changes.

The existing Macro Corridor from the Fitzgerald River National Park and regional Landcare programs have provided the opportunity to develop the "Mulga to Mallee Link", a visionary project of approximately 1,200 kms to the most northerly reach at Yeelirrie Station 500 kms north west of Kalgoorlie.

How fox scat collection can provide information on fox diet.

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Members of the VMFRG have been collecting fox scats from Malleefowl nests in the course of their monitoring activities in the Victorian Mallee. Approximately 2500 scats have now been collected since 1996 – the year in which Rabbit Haemorrhagic Disease virus (RHDV) first arrived in this region. Parks Victoria have had the contents of these scats analysed in order to gain a better understanding of how fox diet might have changed in response to fluctuations in the abundance of prey items (particularly rabbits) and how diet might vary spatially. The collection of fox scats is a cost-effective means of surveying fox diet and perhaps abundance. Preliminary interpretation of the analysis of scat contents shows considerable spatial variation in fox diet. For instance, in areas of low rabbit abundance remote from farmland, reptiles appear to be a staple component of diet. For foxes resident close to farmland; house mice, carrion, and plant material are relatively important dietary items. The implications of this variability in fox diet for Malleefowl are still being investigated. In the meantime, it is recommended that the VMFRG continue to collect fox scats to assist with the development of a more comprehensive understanding of fox diet and the interactions with rabbits and other prey items, including Malleefowl.

Community searches for Malleefowl at Yeelirrie (WMC), central WA

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The decline of Malleefowl has been especially severe in the arid zone, although information is scant and there have been few field studies of the species distribution, abundance, or habitat requirements in such remote areas. Yeelirrie Station is a pastoral leasehold owned by WMC Resources Ltd. and situated in an arid area at the northern edge of the recorded distribution of Malleefowl in central Western Australia. Malleefowl have occasionally been recorded on Yeelirrie Station over a period of many years, but there have been no detailed records of the birds' distribution on the property. In August 2000 and 2003, the Malleefowl Preservation Group (MPG) conducted a series of searches for signs of Malleefowl at Yeelirrie. Volunteers were trained to recognise the footprints and tracks of Malleefowl, and searched along predetermined routes for these and other signs of the birds and other animals. Volunteers searched over 500km of transect for footprints and found Malleefowl in several widely separate areas, and also a few active and inactive mounds. On Yeelirrie, Malleefowl appear to be patchily distributed in shrublands of mulga, bowgada and sugar brother on deep sand. We also gathered all previous sightings of Malleefowl on and in the vicinity of the property. While occasional sighting of Malleefowl were recorded outside Yeelirrie, the property is a stronghold for the species in the area and of great importance for conservation. That the species persists at Yeelirrie is probably due to a history of low stock rates, historically low fire frequency and predator control that has operated at the property since the 1970s. This work has provided data on the distribution and habitat preferences of Malleefowl, and laid a firm basis for monitoring the species' persistence at Yeelirrie.

The Mapping of road verges in the Shire of Gnowangerup

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Gnowangerup Shire is in many ways typical of rural shires in Western Australia, with cereal crops, sheep and cattle being the prime agricultural pursuits. The local community however has developed a high level of stewardship towards its natural environment. This is illustrated by their involvement in events like the Ongerup Wildflower Display, which provides visitors with easy access to some of the diverse range (2,000 sp.) of unique local flora and Malleefowl Preservation Group conservation projects.

An approach by Ongerup community groups to their Gnowangerup Shire and the Roadside Conservation Committee to survey roadsides of the shire for 'conservation value' was made in 1998. The completion of this survey was made possible through the coordination and management commitment of the Malleefowl Preservation Group (MPG). The purpose of the survey was to identify roadsides of high conservation values using a rapid survey method devised by the Roadside Conservation Committee. It is known that roadsides are important wildlife corridors that link the fragmented landscape and those values are now being supported by the Malleefowl Preservation Group's mapping of malleefowl sighting records in the area. Thus a survey for the conservation value of roadside vegetation would provide indicators to the presence or absence of wildlife corridors between remnants and ensure that these high quality verges were managed in a sustainable manner.

The RCC survey provides data that assists road managers and utility providers to maintain their assets whilst minimising risk to the native vegetation. This data also provides a basis for decision making in fire management, verge weed control, tourism, Landcare and conservation.

Using Database and Mobile Computing Technologies for Recording Malleefowl Activities.

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Since December 1981, several pairs of mallefowl have been studied in a block of natural mallee habitat near Nhill in Victoria. Information from this activity was recorded on over 2,800 separate sheets thus making analysis and data sharing difficult. To preserve the information and facilitate analysis, a database was developed into which all the historical data was entered. This solution, although necessary for existing data, still requires field observations to be manually entered from data collection sheets – a time consuming and tedious operation. To overcome this problem a mobile computing solution using a Pocket PC is in the testing stage and will be used for direct entry of field observations in the near future. As well as eliminating the separate data entry step, the mobile solution allows direct entry of graphic information such as mound diagrams and other site characteristics that would normally require lengthy verbal descriptions. This presentation will describe the historical context of the data and illustrate both the database and mobile computing solutions.

Trust for Nature (Victoria)

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Victoria's Trust for Nature is a non-profit organisation that has worked to protect remnant vegetation and habitat on private land for over thirty years. Created through an Act of Parliament, *the Victorian Conservation Trust Act 1972*, Trust for Nature operates in several ways:

- Purchasing freehold properties with outstanding conservation value for the benefit of all Victorians. The most recent purchase was Ned's Corner Station on the Murray River 90 kilometres west of Mildura; properties such as this are retained by Trust for Nature as showcases of conservation, education and research, with strong community involvement in the their management. Trust for Nature currently owns over 50 properties across Victoria. Ned's Corner Station, at 29,000 hectares, is Trust for Nature's single largest property and is also the largest freehold property in Victoria;

- Conservation covenants; covenants are legal agreements negotiated with private landholders that remain on property titles in perpetuity regardless of change of ownership and supported by management plans and monitoring through a Stewardship Program; Over 500 covenants across Victoria now protect 25,000 hectares of habitat negotiated by an extension team of Regional Managers who work in the ten Catchment Management Authority regions of Victoria;

- Revolving Fund; this allows Trust for Nature to buy high conservation value properties, selling them on with conservation covenants to committed landholders.

The purchase of Ned's Corner Station has greatly increased Trust for Nature's overall focus on the Mallee region and the importance of protecting privately owned remnant vegetation for the benefit of species such as the Mallee Fowl. At present, two conservation covenants and one Trust for Nature property in the Mallee region protect known Mallee Fowl habitat. In 2004, Trust for Nature, in partnership with the Mallee Catchment Management Authority, the Department of Sustainability and Environment and Conservation Volunteers Australia, is piloting a new incentive program for Landcare Groups in the Mallee. The program will offer one-off management payments to landholders to encourage permanent protection and active management of remnant vegetation in the Mallee and at a landscape-scale.

"Malleefowl Magic" An Education Program for Primary Schools

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"Children instinctively understand the value of the natural world but they need to learn about it in some detail if they are to know how to protect it. This book (package) does just that. It is both practical and imaginative and I believe it can be a major factor in ensuring the marvelous malleefowl gets the protection it so badly needs " Sir David Attenborough CH.FRS –extract from *Malleefowl Magic's* forward to primary school teachers.

Teacher's responses to the Malleefowl Preservation Group Community Awareness and Education Program involving 60 West Australian Primary Schools 1995-1999 identified the need for an improved curriculum and outcome based program.

In gaining the support from children's book author, Pauline Reilly and artist Will Rolland, *"Malleefowl Magic"* evolved in 2000 with funding support from the Lotteries Commission WA and WMC Resources Ltd (Goldfields program). Reilly's book, "Malleefowl, The Incubator Bird" was chosen as the primary school focus to develop a teachers' easy access manual and compact disk for junior, middle and upper primary Science, Society and Environment learning areas.

Advertised and promoted on the Malleefowl Preservation Group's web site, the success and popularity of *Malleefowl Magic* has extended its education value and scope to Language Other Than English (LOTE) curriculums including Noongar Aboriginal education programs in Western Australia.

Landholder and community efforts to protect malleefowl populations in the northern wheatbelt of WA

Sally and Wally Cail

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The North Central Malleefowl Preservation Group Inc was formed in 1994 and has since been involved in a number of malleefowl conservation projects. A total of 756 farmers have baited a 2,290,000 ha area using 37,699 1080 dried meat baits with an overall 73% of baits taken from 1995 – 2003 for the purposes of safeguarding malleefowl on their properties. In addition, jumpers, T-shirts and displays have been developed and distributed to raise awareness of malleefowl conservation issues and community efforts in protecting these intrinsic threatened species. In the next year, our group will be setting up grids and surveying for active malleefowl mounds to establish the distribution and abundance of malleefowl in our region. This poster illustrates our efforts over the last decade through the use of photographs, mapping and highlighting some of the major community efforts to protect malleefowl for future generations.

Workshops & Recommendations

Groups were asked to discuss 4 key areas to progress Malleefowl conservation throughout Australia. The key areas for discussion included:

1. Monitoring
2. Coordination
3. Communication
4. Resourcing

Each key area was discussed by considering: why; how; who and recommendations on a local, regional and state scale.

Key points and recommendations from the workshop discussions are summarised.

Monitoring

- Need to have data collection standards
- Many groups are monitoring for different purposes, therefore, different methods may be required
- Should have agreed National Monitoring System
- Need to develop a monitoring manual
- Should have access to and sharing of results between groups

Recommendations

1. Develop National Register of Malleefowl monitoring programs that identifies: Who is doing what; where; how and why.

2. All States commit to a National Monitoring Framework

3. Adopt a standard set of protocols for 'baseline' monitoring

4. Require a National review of adequacy of existing monitoring programs

5. National Recovery Team need to agree to procedures and protocols for monitoring

Coordination

- Need a co-ordinated effort to preserve Malleefowl and it's environment
- Should send consistent messages and have a united front across Malleefowl groups
- Funded National Coordinator is required to assist in coordination between groups, across States and within States
- National Recovery Team need to be resourced and provided with Coordinator

Recommendations

1. Secure funding for National Coordinator

2. National Recovery Team provide coordination role

Communication

- Need to develop clear message to sell across the country
- Need to develop communication between community groups, agencies and other groups to: learn from each other; share success; and, maintain enthusiasm.
- Use internet more effectively eg "ChickCam"
- Use key words to "sell the bird":
  - Industrious
  - Weather forecaster
  - Hydrological engineer
  - Air conditional engineer
  - Ultimate survivor
  - Earth Mover
  - Tenacity
  - Can do a lot with very little
  - Measure of the mallee environment

Resourcing

- Access funding for Malleefowl conservation through State, Federal & Local Government; and, private sector
- Community groups need a coordinator to assist in accessing funds

Recommendations

1. National Coordination required to assist in developing local and regional priorities

2. Organise another National Malleefowl Forum in 3 years time to maintain and enhance human resource base

Key resolutions of the National Forum

All participants of the National Malleefowl Forum were asked to take part in a meeting of the National Recovery Team. The National Recovery Team hadn't met for some time and the National Malleefowl Forum was a perfect opportunity to reconvene and reinvigorate the Recovery Team. It was also seen as a good opportunity to discuss the outcomes of the National Malleefowl Forum.

Complied by Donna Tidey, Mallee Catchment Management Authority

- Need for a National Malleefowl Recovery Team
- Need goals and objectives of NMRT
- Gap Analysis needs to be conducted on the Recovery Plan in each state.
    - WA has completed Gap Analysis
    - VIC, SA and NSW need to follow suite
- Need to identify terms of reference
- Need to nominate and select Recovery Team members. Communication between members will be by phone, email and maybe group meetings. Membership could include; Government, non-government, Academics, Community Groups, local government and CMA's.
- Each state could nominate and select Recovery team Members.
- How will each state co-ordinate and move forward?

Western Australia
Responsible: Raquel Carter (TSN, WWF), Susanne Dennings (Malleefowl Preservation Group)

- Look at results from Gap Analysis and develop a relevant strategy
- Apply for funding for WA Coordinator and National Coordinator application
- Conduct a workshop to nominate and select WA representatives for National Malleefowl Recovery Team

South Australia
Responsible: Peter Copley (DEH), Karina Mercer, (TSN, WWF)

- Follow up on National Malleefowl Forum
- Determine who or which agency is responsible for management of Malleefowl data, TSN, DEH or community
- Need to nominate and select SA representatives for National Malleefowl Recovery Team

Victoria
Responsible: Neil McFarlane (VMRG, President)

- In next VMRG meeting (potentially March 2004) need to nominate and select VIC representatives for National Malleefowl Recovery Team, prior to this process happening, I think other stakeholders should be involved. I.e Mallee CMA, DSE, PV etc.
- VMRG to look into Gap Analysis for Vic section of Recovery Plan.

New South Wales
Responsible: Matt Chambers (Threatened Species Recovery, NSW PWS)

- Investigate outcomes and check out representation of issues and then identify representation on Recovery team at a later date.

Other Issues

- Possibility of a part-time National Recovery Team Convenor, National Co-ordinator, and State Co-ordinators (WA, SE Australia (SA, VIC and NSW) subject to funding
- VMRG website will have a list of forum attendees, forum proceedings and a link to the Recovery Plan. VMRG can circulate contact details including phone numbers internally (i.e. those that attended forum)

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