# THE SFR FAUNA MANAGEMENT TEAM

**18TH OCTOBER 1993**



**PRESENT ;** R Hagan (Team Leader), T Foley, J Kimpton, G Doust, G Liddelow.

APOLOGIES: H Manning

**MISSION STATEMENT**

The Team will provide planned and coordinated management programs for fauna management in the Southern Forest Region, to enable an increase in the overall abundance of populations and numbers of native endemic fauna species, using a scientifically and systematic approach.

## 1. PREVIOUS MINUTES;

Accepted.

## 2. ACTION ITEMS;

1. Completed. A copy of the completed silhouettes is included in the questionnaire.
2. Completed. (Attachment 1)
3. Completed. (Attachment 2)
4. Completed. (Attachment 3)
5. Not completed. R Hagan was unable to contact A Burbidge prior to going on ARL to arrange a visit to the SFR.

## 3. AGENDA ITEMS;

### 3.1 Nature Reserve Inspection Report

A copy of this report form is shown as Attachment 1. It is supported by a database program, which was prepared by Wheatbelt Region. Members should discuss this within their The team confirmed that they were happy with the format of the Report form , and its suitability to our needs. Comments at next meeting.

### 3.2 Develop a Fauna Questionnaire

G Doust has prepared "Interim Management Guidelines for Mallee Fowl (*Leipoa ocellata*)", which is Attachment 3. Team members are asked to read these and provide comments to G Doust at Walpole by 1st November 1993.

ACTION - All team members to provide comments on "Interim Management Guidelines for Mallee Fowl (*Leipoa ocellata*)", to G Doust at Walpole by 1st November 1993.

### 3.3 Update on Perup Information

Shown on Attachment 2. R Simmonds and Manjimup District staff will continue to collate this list as background for use in the preparation of a Draft Management Plan for the Perup Fauna Priority Area

## 4. GENERAL BUSINESS

### 4.1 Kingston Logging Trials

T Foley reported that the District and SID staff have recently completed a weeks trapping to collect more base data in the Kingston / Warrup area. This trapping resulted in a capture rate of approximately 10% with a large number of Woylies and possums having been caught. There was also 1 Chuditch captured and a Numbat sighted in Warrup block.

### 4.2 Feral Animal Control

Manjimup staff have just completed their Spring fox baiting program. This involved approximately 3 weeks work for 2 personnel to lay baits, erect signs and carry out liaison and administration requirements. T Foley advised that Keith morris will fund the purchase and installation of permanent baiting warning signs for the Kingston area, and that the district will continue to use "paper" signs in other areas. He also raises the issue of the increasing need to commit funds and resources to maintain control in areas across the District. This will need to be reviewed before we expand the baiting any further.

### 4.3 Perup Information Day

Manjimup District have received a good response to their offer to hold an Information Day about CALM's activities for landowners adjoining the Perup. Once they have collated responses then they will establish an agenda and arrange a date.

### 4.4 Phillips' Sanctuary

R Hagan advised that we had received the Crown Law advice about the options for Testaments, Caveats and Covenants on the titles which may be consider in relation to joint agreements for managing Section 16 proposals. It seems that a Testament is not possible without a Legislative basis, a Caveat may be necessary once CALM has a significant investment to protect , and the Covenant may be used by the Phillips family to ensure continued purpose of management by their heirs.

None of these legal mechanisms are considered necessary at this time.

### 4.5 Liaison with Other Regions

J Kimpton requested that we approach the Swan and Central Forest Region and ask that they send us copies of their Fauna team minutes, so that we are not duplicating effort across the Regions.

ACTION - R Hagan to write to SR and CFR to seek feedback on fauna management.

### 4.6 Fauna Sightings Questionnaire

There was concern raised about the delay in completing the Fauna Sighting Questionnaire. It was agreed that we should complete this and have it circulated before the end of October.

ACTION - R Hagan and G Liddlelow to complete fauna silhouettes by 22/10/93.

ACTION - Fauna Sighting Questionnaire to be circulated to Districts for photocopying by 25/10/93

### 4.7 Trap Numbers

We are unsure about how many Elliott, Sheffield and other wire traps we have available in the Region. It was suggested that we carry out any inventory of these so that we can identify what we have available.

ACTION District staff to carry out an inventory of all traps that they have so that we can identify what resources we have in the Region.

**4.6 Stratification**

Team agreed to focus on stratifying the Region for survey and trapping at the next meeting. Identified a range of reference material which will be required for this work.

ACTION - G Liddlelow to locate and bring along copies of Churchward's Landform maps for the Region.

ACTION - R Hagan to provide copies of CALM Management Plans, API maps, Beards vegetation maps, and access to aerial photo's, Landsat photo's etc.

**5. NEXT AGENDA;**

The Team members discussed the results of today's meeting and agreed that the format of the next meeting should be;

| | | |
|---|---|---|
| 1. | Previous Minutes | |
| 2. | Action Items | |
| 3. | Define aims and objectives of stratification | All |
| 4. | Link to regional goals and strategies | All |
| 5. | Reference Management Plans | All |
| 6. | Develop a tenure link and weighting | All |
| 7. | General Business | All |

**6. NEXT MEETING**

Date ; Friday 12th November 1993
Time ; 0930 - 1200 hrs
Venue ; Regional Conference Room, Manjimup

Meeting Closed; 1200 hrs

R Hagan
Team Leader
18th October 1993

Distribution;

F 9/4
R Hagan
D/M Manjimup fyi
T Foley
D/M Pemberton fyi
H Manning
J Kimpton
D/M Walpole fyi
G Doust
G Liddlelow
K Morris fyi
Regional Manager (CFR) fyi
Regional Manager (Swan Region) fyi
Dr A Burbidge fyi

fauna32.doc

# ACTION STATEMENT

**TEAM NAME :** SFR FAUNA MANAGEMENT TEAM

**MEETING NUMBER : 5** **DATE :** 18th October 1993

**MEMBERS PRESENT :** R Hagan (Team Leader), G Liddlelow, T Foley, J Kimpton.

**APOLOGIES ;** H Manning

| ITEM | ACTION | NAME | DATE |
|---|---|---|---|
| 01 | All team members to provide comments on "Interim Management Guidelines for Mallee Fowl (*Leipoa ocellata*)", to G Doust at Walpole by 1st November 1993. | All | 01/11/93 |
| 02 | R Hagan to write to SR and CFR to seek feedback on fauna management. | RPH | 22/10/93 |
| 03 | R Hagan and G Liddlelow to complete fauna silhouettes by 22/10/93 | RPH / GL | 22/10/93 |
| 04 | Fauna Sighting Questionnaire to be circulated to Districts for photocopying by 25/10/93 | RPH / GL | 25/10/93 |
| 05 | District staff to carry out an inventory of all traps that they have so that we can identify what resources we have in the Region. | TF, HM, GD | 05/11/93 |
| 06 | G Liddlelow to locate and bring along copies of Churchward's Landform maps for the Region. | GL | 05/11/93 |
| 07 | R Hagan to provide copies of CALM Management Plans, API maps, Beards vegetation maps, and access to aerial photo's, Landsat photo's etc. | RPH | 05/11/93 |

**NEXT MEETING: DATE:** 12th November 1993

**TIME:** 0930 - 1200

**VENUE:** Regional Conference Room.

**LEADER:** R Hagan

# NATURE RESERVE INSPECTION REPORT
(Human Usage)

RESERVE NO.: .................. SHIRE/S: ...................... VESTING: ..................

PERSONNEL: .................... DURATION: ...................... DATE: .....................

SURVEY No.: ..................

COMMENTS/RECOMMENDATIONS: (Inspector)

..................................................................................

..................................................................................

..................................................................................

Initials/Date: ........................

COMMENTS: (District Manager)

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..................................................................................

Initials/Date: ........................

OFFICERS TO NOTE: 1. ................ 2. ................ 3. ................

FLORA OBSERVATIONS:

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FAUNA OBSERVATIONS:

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..................................................................................

1. SIGNS [Yes] or [NO]

| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | |
|---|---|---|---|---|---|---|---|---|---|
| Style: (O,N) | | | | | | | | | Old<br>New |
| Type: (A,O) | | | | | | | | | Area I.D.<br>Other |
| Maintenance: (N,R,M,X) | | | | | | | | | None<br>Replace<br>Maintce.<br>X Remove |

COMMENTS: (include recommendations for sign posting and maintenance) ....................

..................................................................................

..................................................................................

..................................................................................

2. **NEW MINING ACTIVITY** Yes or NO

(Since Last Inspection)

| Pit No.: | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 |
|---|---|---|---|---|---|---|---|---|
| Type: (G,S,O) | | | | | | | | |

Gravel
Sand
Other

Other: ..............................................................

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 |
|---|---|---|---|---|---|---|---|---|
| Age: (R,M,O) | | | | | | | | |
| Area: ($m^2$) | | | | | | | | |

Recent
Moderate
Old

**Rehabilitation Required**:
(N,R,C)

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 |
|---|---|---|---|---|---|---|---|---|
| Ripping: | | | | | | | | |
| Reshaping: | | | | | | | | |
| Seeding: | | | | | | | | |
| Planting: | | | | | | | | |
| Area Rehabilitation: Complete ($m^2$) | | | | | | | | |
| Associated Problems: (S,W,R,N) (up to 2 entries) | | | | | | | | |

None
Required
Complete

Soil
Weeds
Rubbish
None

3. **INTRODUCED AND DECLARED PLANTS AND ANIMALS**

Yes or NO (Indicate area on Reserve Map)

| | | | | | |
|---|---|---|---|---|---|
| **Type:** (R,F,C,S,P,O) | | | | | |

Rabbit
Fox
Cape Tulip
Sour Sob
Patersons Curse
Other

Other: ..............................................................

**Location**: ....... ...... ....... ....... .......

**Comment**: ....... ...... ....... ....... .......

Indicate position on map if small area. Comment on extent of infestation.

4. **RUBBISH DUMPING** [Yes] or [NO]

| Site No.: | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | |
|---|---|---|---|---|---|---|---|---|---|
| Type (Dominant): (M,H,I,V,S,C,A,W) (up to 2 entries) | | | | | | | | | Mixed<br>Household<br>Industrial<br>Vehicle<br>Soil<br>Chemicals<br>Animals<br>Wire |
| Age: (R,M,O) | | | | | | | | | Recent<br>Moderate<br>Old |
| Form: (S,H) | | | | | | | | | Scattered<br>Heaped |
| Size: (S,T,X) | | | | | | | | | Small<br>Trailer<br>X Truck |

Comments on cleanup required: ..........................................................................

..........................................................................................................

5. **RECREATION USAGE:** [Yes] or [NO] (Indicate area on Reserve Map)

| | F1 | F2 | F3 | F4 | F5 | |
|---|---|---|---|---|---|---|
| Type: (P,C,W,V,O) | | | | | | Picnic<br>Campsite<br>Watersport<br>Vehicle<br>Off-Road<br>Other |
| Other: .............................................................. | | | | | | |
| Associated Facilities: (F,B,S,T) (Multiple entry if necessary) | | | | | | Fire Place<br>Bins<br>Structures<br>Toilets |
| Environmental Damage: (N,Y) | | | | | | None<br>Yes |
| Facility Damage: (N,Y) | | | | | | |
| Associated Rubbish: (N,Y) | | | | | | |

COMMENTS: (Note activity adjacent to reserve also) ..............................................

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6. TIMBER CUTTING: ☐
(N,R,M,O)

Species: ................ Purpose: ................

| |
|---|
| None<br>Recent<br>Moderate<br>Old |

7. STOCK GRAZING: ☐
(N,R,M,O)

Type: ..............................

Evidence: ........................

| |
|---|
| None<br>Recent<br>Moderate<br>Old |

8. OTHER ILLEGAL ACTIVITY: ☐
(N,Y)

Type: ..............................

| |
|---|
| No<br>Yes |

9. UTILITY SERVICES

| | U1 | U2 | U3 | U4 |
|---|---|---|---|---|
| Type (T,W,S,O) | ☐ | ☐ | ☐ | ☐ |

| |
|---|
| Telecom<br>Water<br>SEC<br>Other |

Other: ..............................................................................

| | | | | |
|---|---|---|---|---|
| Recent Maintenance: (N,Y) | ☐ | ☐ | ☐ | ☐ |

| |
|---|
| No<br>Yes |

COMMENTS: ..........................................................................................

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10. RESERVE BOUNDARY ALIGNMENT CORRECT?: ☐ (indicate on map)
(N,Y)

| |
|---|
| No<br>Yes |

STOP Check you have covered everything and made appropriate comments and marked route of inspection on Reserve Map. Attach Reserve Map to Report.

NOTE 1 If this sheet is a mess, stop and neatly transcribe it to a fresh sheet.

NOTE 2 Recent activity is defined as less than 6 months old.
Moderate activity is defined as 6 to 24 months old.
Old activity is defined as greater than 24 months old.

ATTACHMENT 2

# WALPOLE DISTRICT

# INTERIM MANAGEMENT GUIDELINES

# FOR MALLEE FOWL (*LEIPOA OCELLATA*)



PHB 15/11

## 1. INTRODUCTION

During February 1993 CALM roading contractors reported sighting a population of Mallee Fowl (*Leipoa ocellata*) Lochart/Thomson forest block. Later in February Grant Wardell-Johnson (CALM), Rod Smith (R.A.O.U.) along with 13 others visited the Lochart/Thomson site and saw Mallee Fowl tracks at the roadside, and were quite convinced of the accuracy of the reports, though very surprised. The fifteen people then searched about 10 hectares of logged areas without seeing Mallee Fowl or nesting mounds. A Mallee Fowl was also recently sighted by a faller in an adjacent jarrah logging area.

Lochart/Thomson forest block primary land use is timber production and catchment protection. The area immediately surrounding the Mallee Fowl sighting has had logging but there is also areas of unlogged forest.

Other sitings of Mallee Fowl in Walpole District has occurred previously. During July 1971 forest guards Phil Tomlinson and Max Campbell were conducting a dieback survey in the north east region of Walpole District when they discovered a Mallee Fowl nest in the table drain of Western Road. This location is approx. 25km to the east south east of the latest sighting at Lochart/Thomson forest blocks.

Although the Mallee Fowl is not on the current priority list, this population is the only currently known population in the higher rainfall forest areas and therefore requires some consideration in the management of CALM's activities in the vicinity.

## 2. RELEVANT DEPARTMENTAL POLICIES/ADMIN INSTRUCTIONS

CALM has a range of Policies and Admin. Instructions that are relevant to the conservation of the Mallee Fowl.

### 2.1 Policies

Number 33 - Conservation of Threatened and Specially Protected Fauna in the Wild (May 1991).

- Develop wildlife management programs or interim wildlife management guidelines for species or groups of species of threatened and specially protected fauna.
- Monitor known populations of threatened and specially protected fauna.
- Undertake research on the distribution, taxonomy, genetic systems, population biology, protection and management of threatened and specially protected fauna.
- Train staff how to conserve and manage threatened and specially protected fauna.
- Establish whether threatened or specially protected fauna are present before undertaking any activity on CALM land that involves permanent destruction or major modification of habitat of native fauna.
- Ensure that any burning programme on land managed by CALM will not lead to threatened fauna being threatened with extinction.
- Maintains appropriate records/database.

Number 44 - Wildlife Management Programs.

- Prepare interim wildlife management guidelines for taxa (and their habitats) or ecological communities that urgently require management, but where there is insufficient data available to prepare wildlife management programs.

- Consult with interested non-government organisations and the public concerning the implementation of interim wildlife management guidelines via appropriate consultative committees and public consultation processes.

### 2.2 **Admin. Instructions**

Number 44 - Protection of Endangered and Specially Protected Fauna in Department Operations (July 1990)

- Maintain an "Endangered Animals Register".
- Record their locations on the H.O.C.S., Master Burn Plans and office coordination maps.
- Train appropriate staff in their management.
- Nominate an officer for their protection and management.

## 3. **BACKGROUND OF SPECIES IN W.A.**

Knowledge of the Mallee Fowl in W.A. is patchy, despite the fact that the species has been recommended for addition to the state list of threatened fauna.

The species has already disappeared from several areas of the south-west, such as the Busselton-Cape Naturaliste-Cape Leeuwin coastal fringe, the Lake Muir area (Storr, 1991 as cited by Orsini, 1992) the Kellerberrin District (Saunders and Curry 1989 as cited by Orsini, 1992).

The bird occurs in the Shire of Shark Bay (Storr, 1985 as cited by Orsini, 1992) and is sparsely distributed in the arid interior (Storr, 1985). A study has been in progress for several years at the Eyre Bird Observatory. The core of the birds distribution in W.A. today is the Mallee lands of the south-west of the state, particularly where some large areas of native bush remains (Orsini, 1992).

The main causes for the decline are;

* loss of habitat from clearing (Frith, 1962);
* fire (Benshemesh, 1990) Appendix 1;
* competition for food by rabbits and domestic stock (Frith, 1962);
* Predation by foxes (Priddel, 1990 as cited Orsini, 1992).

A excellent most factual account of Mallee Fowl habits can be obtained by reading a book by H J Frith (1962) "The Mallee Fowl" who studied the bird for seven years near Griffith NSW. A more condensed account of the Mallee Fowl habits can be found in Ian Rowley's book "Bird Life". See Appendix 2.

It should be noted that research undertaken on Mallee Fowl has been carried out in Mallee vegetation types in low rainfall areas.

The population of Mallee Fowl which these guidelines are addressing are in the high rainfall areas. Therefore the habits of the Mallee Fowl, while remaining similar, will be potentially modified to fit with environmental aspects such as shorter summers, vegetation types and landforms. Our research should address these modifications.

4. **<u>OVERALL OBJECTIVE</u>**

To increase both the overall abundance and numbers of populations of Mallee Fowl within Walpole District.

5. **<u>AIMS AND STRATEGIES</u>**

5.1 **<u>Aim</u>**

To consolidate existing known population.

5.1.1 <u>Strategies</u>

Determine numbers and current distribution of both range and nests using visual and aural observation.

5.1.2 Train staff in management practices necessary for the re-establishment and monitoring of population of Mallee Fowl.

Minimum of four people in the district will be familiar with handling, tagging and surveying (visual and aural) of Mallee Fowl.

One will have attended and passed the Mammal Conservation course.

Three people will be accredited to handle and lay 1080 baits. One of these will be an officer.

Train staff and contractors in identification and recording procedure for sighting of Mallee Fowl or their nest.

5.1.3 Determine management strategies to secure existing known population.

- Consider fire regimes on master burn plan.
- Predator control by fox baiting three monthly.
- Consider the effects of operations that cause structural habitat change.
- Map location of existing nedt mounds for internal use. e.g. Wildfire Suppression.

5.2 **<u>Aim</u>**

To increase knowledge of Mallee Fowl and their habitats in the high rainfall forests.

5.2.1 <u>Strategies</u>

5.2.1.1 Monitor and record nesting cycle.

5.2.1.2 Define effects of fire on Mallee Fowl and its habitat and recommend management guidelines;
* season
* intensity
* frequency

5.2.1.3 Impact of structural habitat change.

- Effect of harvesting timber, wildflowers.
- Proximity of roads.

5.2.1.4 Identify alternative habitat areas within Walpole District.

- Design system using vegetation and landform maps to identify possible habitats.
- Validate and map these areas.
- Recommend future management strategies e.g. relocate or facilitate natural desbursion.

# 32

# Management of Malleefowl - With Regard to Fire

J. Benshemesh

*Broad-scale fire eliminates malleefowl in the short term, and even 20-30 years after fire, breeding densities were found to be only about a third of those in long-unburnt habitats. As a consequence, optimal fire-frequency for malleefowl conservation is likely to be in excess of 60 years. The negative effects of fire are mitigated if fires burn patchily. In Wyperfeld National Park, some malleefowl were able to survive and reproduce in burnt areas where relatively small islands of unburnt vegetation remained as core-refuges. It is argued that the primary role of fire in the management of malleefowl is to lower the chance of fire in habitats important for malleefowl, and to encourage the formation of islands occurring in the event of wildfire.*

Malleefowl (*Leiopoa ocellata*) have undergone a dramatic reduction in the extent of their range over the past century (see Frith 1962a, Blakers *et al.* 1984, Kimber 1985). Furthermore, within their current range in New South Wales, the population density has declined over large areas during the past two decades (Brickhill 1987). Consideration of factors that may effect habitat suitability for malleefowl is therefore urgently required.

Apart from grazing by sheep, which has a dramatic and deleterious effect on malleefowl populations (Frith 1962a), fire is the major agent likely to affect malleefowl habitat suitability in uncleared areas. Like most other Mediterranean-type ecosystems, mallee habitat is both fire-dependent and fire-promoting (Mutch 1970), and fire plays a vital role in determining floristic and structural diversity. Gill (1975, 1977) has emphasised the importance of the fire regime (frequency, intensity, and season of burn) in considering vegetation responses to fire. In mallee, fire frequency is perhaps the most important attribute of fire regime as most fires occur in late spring to summer, and fire intensity is relatively invariable for a given habitat (Cheal 1984). For animals the pattern of fire (i.e. size and patchiness of fire) is also of crucial importance as unburnt patches may provide refuges after fire, and burnt/unburnt boundaries may provide additional benefits for some animals (e.g. Bolton & Latz 1978, Saxon 1983).

Given that some fire is necessary and inevitable in the mallee, I address two main issues here: what is the likely effect of fire frequency and pattern of burn on malleefowl; and what scope is there for management to benefit malleefowl?

## Flammability of Malleefowl Habitat

Mallee habitats are amongst the most inflammable habitat types in the semi-arid zone largely because of the accumulation of leaf, twig and bark litter under mallee trees (Gardner 1957). This litter forms a highly combustible fuel bed which, aided by hanging ribbons of decorticated bark, transmits fire to the canopy. Fires that develop often expand rapidly and burn vast areas of country despite discontinuities in the ground fuel. Few malleefowl are likely to survive such conflagrations.

The accumulated litter is also an essential requirement for malleefowl nest construction (Frith 1962b). Burnt country does not support recolonising birds for 10-15 years after fire, probably due to inadequate litter supplies for nesting (Cowley *et al.* 1969). By this time mallee may once again carry sufficient fuel for a fire (Leigh & Noble 1981).

## Frequency of Fire

### *Might fire improve malleefowl habitat?*

It has been suggested in the past that fire may improve habitat suitability for malleefowl in the longer term. Frith (1962a) showed the diet of malleefowl to be largely composed of seeds from shrubs (particularly *Acacia* spp.), and circumstantial evidence suggests that the abundance of these food sources is a major factor determining malleefowl breeding density (Frith 1962b, Booth 1987). Several authors have suggested that, as these food-shrubs tend to decline in abundance as mallee communities mature, malleefowl conservation may require periodic fire to maintain adequate populations of food-shrub species (Cheal *et al.* 1979, Noble 1984, Brickhill 1987).

I tested the validity of this argument by directly comparing the density of breeding malleefowl in four matched pairs of 'young' (20-30 years after fire), and 'mature' sites (at least 40 years after fire) in the Victorian mallee (see Benshemesh 1988). If fire improves habitat for malleefowl, 'young' sites should support higher densities than their 'mature' partners. The results revealed an entirely opposite trend: breeding density in 'young' sites was on average only about one third of that in 'mature' sites, despite higher abundances of food-shrubs in most of the 'young' sites compared with their 'mature' partners (Figures 1a,b).

*Possible effects of different fire frequencies*
The possible effects of different fire-frequency regimes on malleefowl breeding densities were estimated using the following assumptions (Figure 2a):

1. no breeding occurs for 10 years after fire;
2. there is a linear increase in breeding density from 10-25 years after fire, at which stage the density reaches one third of the maximum capacity of the habitat;
3. there is a linear increase in breeding density from 25-40 years after fire, at which stage the density reaches the maximum capacity; and
4. maximum capacity is maintained for a further 20 years.

For a hypothetical site (or reserve) that is burnt periodically in patches I assumed that equal areas of each age-class of mallee were present at any one time. The overall density of nests in the site was then calculated for different fire-frequency regimes as the average of the expected density in each patch (i.e. the cumulative area under Figure 2a), and this average density was taken to estimate the effect of differing fire-frequency regimes on malleefowl (Figure 2b).

This projective analysis provided a means of assessing the possible effects on malleefowl of fire frequencies previously suggested as normal or desirable for mallee generally. Leigh and Noble (1981) have estimated that fire occurs with a 20 year frequency in mallee lands, and pastoral mallee of New South Wales may be burnt at 15-20 year intervals for hazard reduction (Noble 1984). Cheal *et al.* (1979) suggested an average frequency of 40 years as ecologically desirable for flora and fauna conservation in Victorian mallee. At these fire frequencies malleefowl populations may be expected to be maintained at about 6% (20 year interval) and 30% (40 year) of the maximum carrying-capacity of the habitat (Table 1). Even an average fire frequency of 60 years may only maintain populations at about 54% of the maximum carrying-capacity, nevertheless this is a 75% improvement over a 40 year cycle of burns.

In summary, a strong case can be made for encouraging much longer intervals between fires than

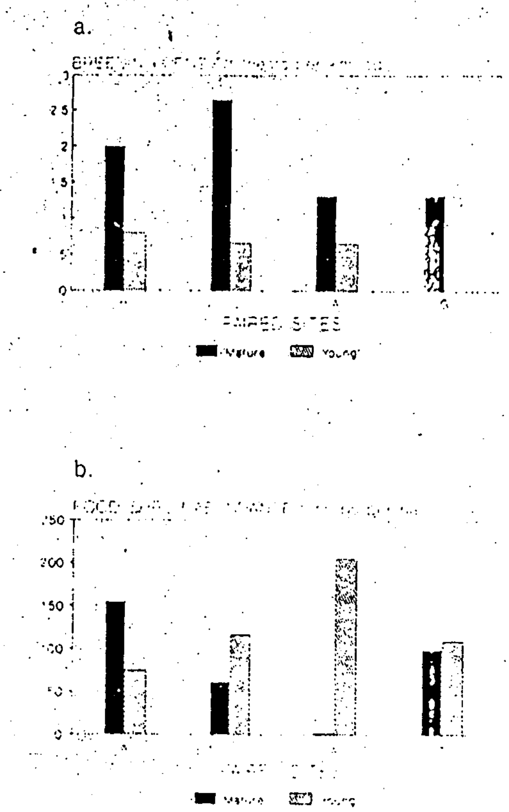


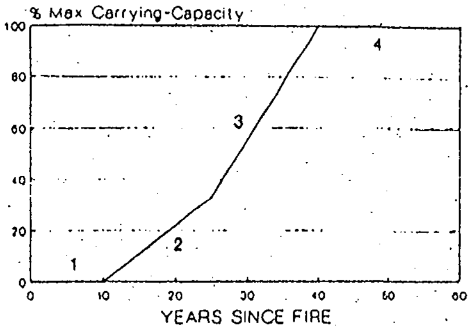
Figure 1 *Malleefowl breeding density and food-shrub abundance in 'mature' and 'young' sites:*
*(a) estimated number of used nests per 100 ha.,*
*(b) abundance of major food-shrubs. Letters indicate site location:*
*B, Bronzewing reserve; U, Underbool Track (Big Desert); A, Annuello block (eastern Sunset Country); G, Gunners track (north of Pine Plains). Sites were 150 ha in every case except Bronzewing where sites were 250 ha each.*

those previously considered for habitats which support, or potentially support, populations of malleefowl.

## Pattern of Burns

Habitats which are most suitable for malleefowl are probably the most likely to burn in the event of fire due to the accumulation of litter. Nonetheless patches of suitable habitat are occasionally left unburnt in the wake of mallee fires. Such islands may serve as reservoirs for the future recolonisation of the burnt country as it becomes more favourable over ensuing decades.

The viability of these unburnt islands as core refuges for malleefowl will depend on the balance between the survival of birds contained in them, and the recruitment of birds from within the patch and from outside sources. At their inception, unburnt islands are an extreme and perhaps critical stage of a fire-age mosaic, a.




b.

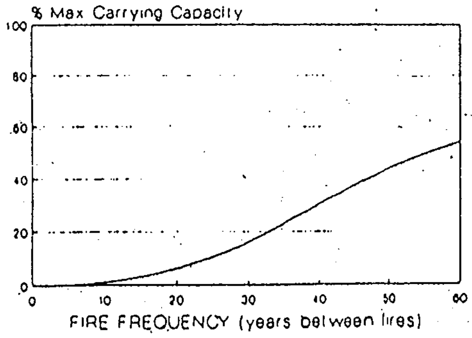



Figure 2 *Estimated responses of malleefow breeding density to fire. Breeding density is expressed as a proportion of the supposed maximum carrying capacity of the habitat at 40-60 years after fire.*
*(a) affect of time since fire on breeding density (numbers indicate assumptions listed in text).*
*(b) estimated effect of fire-frequency (years between fires) on breeding density.*

and the response of malleefowl is especially interesting as the active promotion of fire-age mosaics has been suggested for enhancing malleefowl habitat (Brickhill 1987).

*A case study of malleefowl after a patchy burn.*
A study of malleefowl before and after a wildfire in Wyperfeld National Park has provided some information on the response of the birds to fire generally, and on the effectiveness of small unburnt islands to support malleefowl (Benshemesh 1988).

The fire occurred in mid summer (January 1985), burnt over 10,000 hectares of mallee and left only 6-8 islands of unburnt habitat. Four of these islands were contained within the study area; each totalled 6-7 hectares (less than 10% of home-range) and was surrounded by 12-20 hectares of partly burnt habitat (Figure 3). Patches of *Callitris verrucosa* appeared responsible for the formation of every island left in the wake of this fire, probably because the scarcity of ground fuel under *Callitris* provided a barrier to the fire and split its front.

Eight birds were radio-marked prior to the fire and all initially survived the fire. Two of three birds banded before the fire (but not radio-marked) were recaptured in subsequent months. However, in the months following the fire most of these birds had either emigrated or died, and after nine months only four of the original eleven birds remained in the study area. It is noteworthy that all emigrating birds (four birds) used corridors of remnant vegetation and pine/belah woodlands, rather than traversing large areas of burnt country.

The remaining birds did not breed in the season following the fire, probably due to a scarcity of food for several months after the fire. Breeding resumed during the second season after the fire, and each island contained at least one active nest (one island contained two widely separated nests). The breeding success of these nests was similar to that measured in the study area before the fire in terms of the size, number, and hatching success of eggs laid.

Despite breeding in islands after the fire, recruitment of birds into island populations is probably lower than in contiguous unburnt mallee. Most radio-tagged chicks I released at nests dispersed widely and readily crossed into recently burnt habitat. As no breeding would occur in burnt habitat for at least a decade (Cowley *et al.* 1969), immigration into the islands will probably be far higher than emigration out of these islands.

Radio-tracking of adults surviving in the islands revealed that, although they showed a consistent preference for the least fire modified habitats in most seasons, they nevertheless utilized the burnt habitats extensively (Figure 4). Many of the malleefowl foods were found predominantly in the burnt areas due to the emergence of herbs after the fire. There was a strong correlation between where the birds spent their time in burnt areas and the seasonal availability of their potential foods. These foods sources however may be unreliable in the longer term. Herbage pulses after fire in the mallee are short-lived and the abundance of herbs

Table 1 *Predicted effects of fire-frequency regimes on malleefowl breeding density (from Figure 2b).*

| Fire-frequency (years) | 10 | 20 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|
| % max carrying-capacity of habitat | 0% | 6% | 15% | 31% | 45% | 54% |

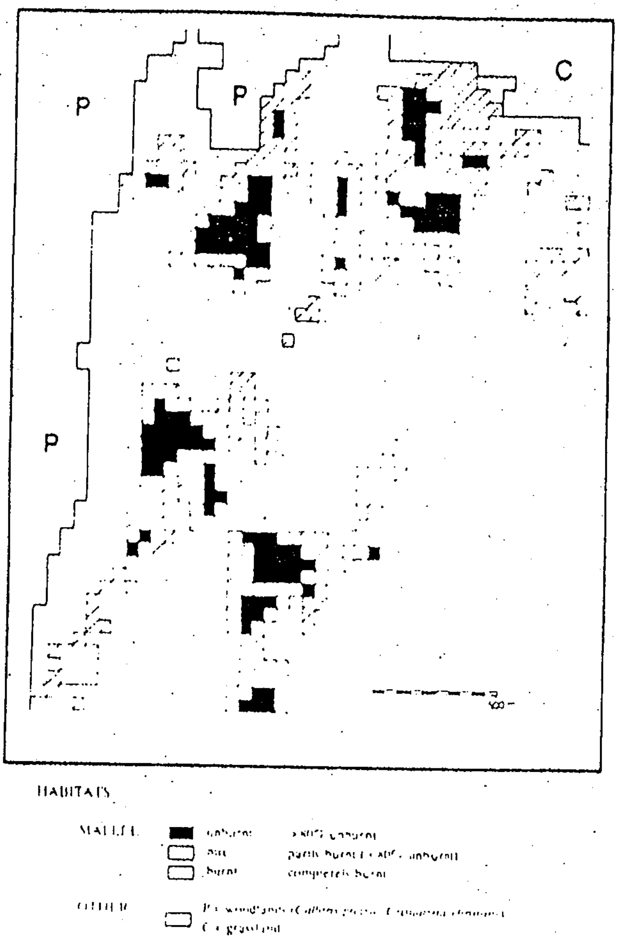



**Figure 3** *Islands of unburnt habitat after the fire in the study Site at Wyperfeld National Park.*

declines markedly after 1-3 years (Cheal *et al.* 1979, Specht 1981, Noble 1989). The usefulness of burnt habitat for foraging therefore will probably decline, at least until *Acacia* and other shrubs mature to produce a regular supply of seed. Even then, food may be abundant in burnt areas only in summer.

In short, this study demonstrated the potential of even small unburnt islands to support malleefowl, although the viability of these insular populations was uncertain: the foods the birds utilised in burnt country were short-lived, and such reproduction as was achieved was dissipated to surrounding habitats. Larger islands would reduce the dependence of malleefowl on the uncertain foraging value of the recently burnt surroundings, and a higher frequency of islands would increase both the total number of malleefowl surviving a fire and the chance of dispersing chicks recolonising islands where malleefowl have become extinct.

*Mosaics: Do they improve malleefowl habitat?*

Brickhill (1987) suggested that a fine scale, fire-age mosaic would actually improve malleefowl habitat, as a high diversity of habitat ages increases the abundance and diversity of foods, particularly herbs and food-bearing shrubs. Evidence for or against this idea is scant. At Brickhill's study site at Yalgogrin (N.S.W.), *Eucalyptus* harvesting produced a fire-age mosaic. The site contained a high breeding density, although this was still below the average density recorded by Frith (1962a) in similar though unmodified habitat (Frith's type-II mallee, now almost entirely cleared).

If malleefowl were advantaged by access to recent burns, then higher breeding densities may be expected in immediately adjacent 'mature' habitats. I found no evidence for an increase in nest density in 'mature' mallee adjacent to 1-4 year old burns in nest searches in Wyperfeld (Benshemesh, unpubl. data). There was however an indication of an increase in breeding density in those portions of the 'mature' sites immediately adjacent to 'young' sites in the paired comparisons described above: more than two thirds of active nests were found in the half of 'mature' sites closest to the 'young' sites. Nonetheless this increase in density was offset by the much lower breeding density in 'young' sites.

In summary, there are inadequate data to ascertain whether a fire-age mosaic may improve habitats for malleefowl. Considering the long time required before burnt habitat regains its general suitability for malleefowl, a cautious approach to the use of fire is needed. It is clear however that 'mature' habitats are essential and their protection should be the focus of

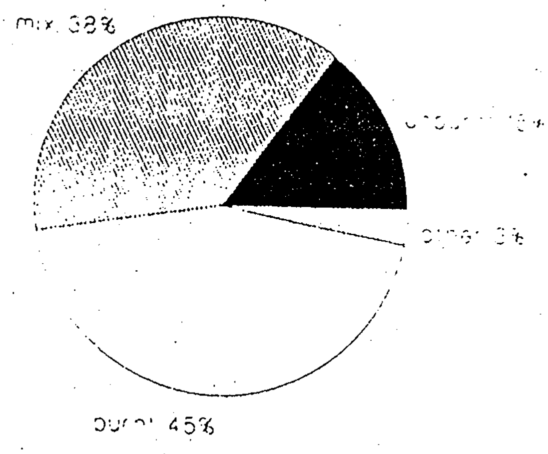



**Figure 4** *The Average proportions of habitat-types in the home-range of birds following the fire. With the exception of 'unburnt' all habitats were modified by fire to some degree (see legend of Figure 3.) All birds (12) and all seasons (7).*

for malleefowl conservation, and thus the major role of fire in the management of malleefowl is to lessen the effects of wildfire. A similar argument may apply to other bird species found only in mallee. Most of these mallee endemics (listed in Schodde 1981) are restricted to habitats that have not been burnt for at least 15-20 years, and bird species richness in mallee increases for at least 60 years after fire (Cheal *et al.* 1979, Meredith 1984). The conservation of these species in each reserve will depend on the continual presence of long-unburnt habitat. Given the potential size of mallee fires in relation to even the largest reserves the continual presence of long-unburnt mallee can no longer be assured. The development of management methods that limit fires or encourage them to burn more patchily warrants urgent attention.

## Acknowledgments

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APPENDIX 2

*To my father*
*Duncan Rowley*
*who kindled my interest in birds*

APPENDIX 2

THE AUSTRALIAN NATURALIST LIBRARY

# Bird Life

IAN ROWLEY



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over until one bird manages to stay on top and peck at its defenceless victim below. Despite the violence of the battle, Michael Ridpath found only a few of his birds suffered serious damage. Such fights may last as long as fifteen minutes but most are only one to two minute bouts. During his study 2,335 encounters were seen; not all of these ended in fights, of course.

The banded native hens at Hunting Grounds were watched for many hours and it was possible to record the outcome of 1,122 fights between the owners of territories and either trespassing established groups or roving young birds. All such fights were started by the owners who won 77 per cent of them; 22 per cent of fights were stalemates and in only one per cent of cases was the owner forced to retreat. Most of the stalemates occurred between established groups and usually they took place right on the territorial boundary. Analysis of these fights showed that ownership of territory and the attacking role were more important than either age or numbers of group members.

Both spontaneous roving by one-year-old birds and greatly increased territorial behaviour by group members reduced the density of the population at the start of each breeding season. Surplus birds, that roved out of the optimal territorial habitat into less favourable areas such as neighbouring farms, suffered a heavy mortality from hunting by dogs, shooting and poisoning. Adult mortality was very low amongst established groups in natural situations.

So, the native hen, evolving in the safety of an island habitat has become highly social and flightless and has special habitat requirements. In consequence, living space of the right sort is at a premium and requires constant defence from less fortunate, aspiring neighbours.

# 13 The Mallee Fowl LEIPOA OCELLATA

The megapodes, or mound-builders, of the family Megapodiidae are confined to Australia and the islands to the north and consist of six genera, all of which have evolved remarkable arrangements to incubate their eggs. They all bury their eggs in the ground and rely on heat from the sun, from rotting vegetation, or even from volcanic activity, to provide the necessary warmth. Although there are thirteen species in the family, only one, the mallee fowl, *Leipoa ocellata*, has been studied in sufficient detail for its life history to be well understood and for sensible conservation measures to be planned and implemented.

Many of the megapodes are jungle dwellers and use large piles of forest debris, such as would delight any compost-gardener, to incubate their eggs as the vegetable material rots down, generating heat in the process. The mallee fowl is a megapode that has adapted to a much drier environment than the rest of the family. It lives in a particularly Australian form of scrub, the mallee, which grows in areas with less than 430 mm of rain per annum, and which is dominated by various multi-stemmed eucalypts seldom more than 8 m high. It also occurs in many other sorts of semi-arid scrub possessing a light soil, a dense shrub undergrowth or complete canopy, and one or more abundant *Acacia* shrubs (Plate 2).

The mallees shed leaves, bark and twigs which appear harsh and dry at first glance and most unpromising material for a compost heap. Just how wrong first impressions can be was clearly and painstakingly shown by Harry Frith during the seven years that he studied the mallee-fowl near Griffith, in N.S.W. His results are contained in four papers (Frith 1956, 1957, 1959 and 1962) and in a most readable book, *The Mallee Fowl* (Frith 1962).

Unlike most other birds, *Leipoa ocellata* lay as many as 33 eggs in a clutch and the interval between the eggs may vary from 5 to 10 days. In years when food was abundant, the interval between eggs was shorter. An egg may require anywhere from 50 to 90 days' incubation before it hatches, eggs laid late in the season taking longer to hatch. This means that a female laying an average-sized clutch of 19 eggs at intervals of 6.4 days (the mean interval) would require 115 days to lay the eggs and a further minimum of at least 50 days to hatch the last laid egg; a total of 5½ months when the eggs require to be incubated.

The southern part of the continent where these birds live has a mainly winter rainfall and a hot dry summer. To achieve incubation for 5½ months, mallee fowl use both the sun's heat and the heat generated by the fermentation of organic material. The eggs are laid in a large carefully constructed mound, as shown in Fig. 15. How the temperature in these mounds is regulated over such a long period of varying climate was discovered after many hours of careful observation and measurement and confirmed by experimentation.

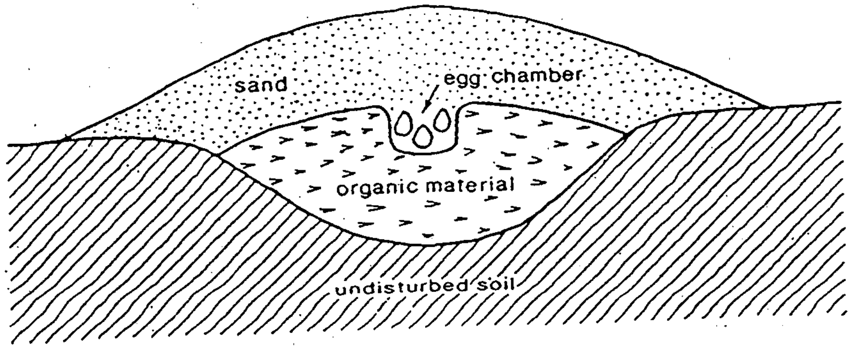



FIG. 15 Section through a mallee fowl mound (from Frith 1962).

*The yearly cycle*

The sequence of events at the mound is shown in Fig. 16. Mallee-fowl start to show an interest in their mounds in April or May. Either they excavate new sites or, more usually, they open up old ones and remove all the spent vegetable material. Provided some rain falls, the pair keep digging the site at intervals throughout the autumn and winter until they have a pit some three metres across and more than one metre deep (Fig. 16a). At first they may work at several mounds but soon concentrate on one. When the pit is deep enough they begin



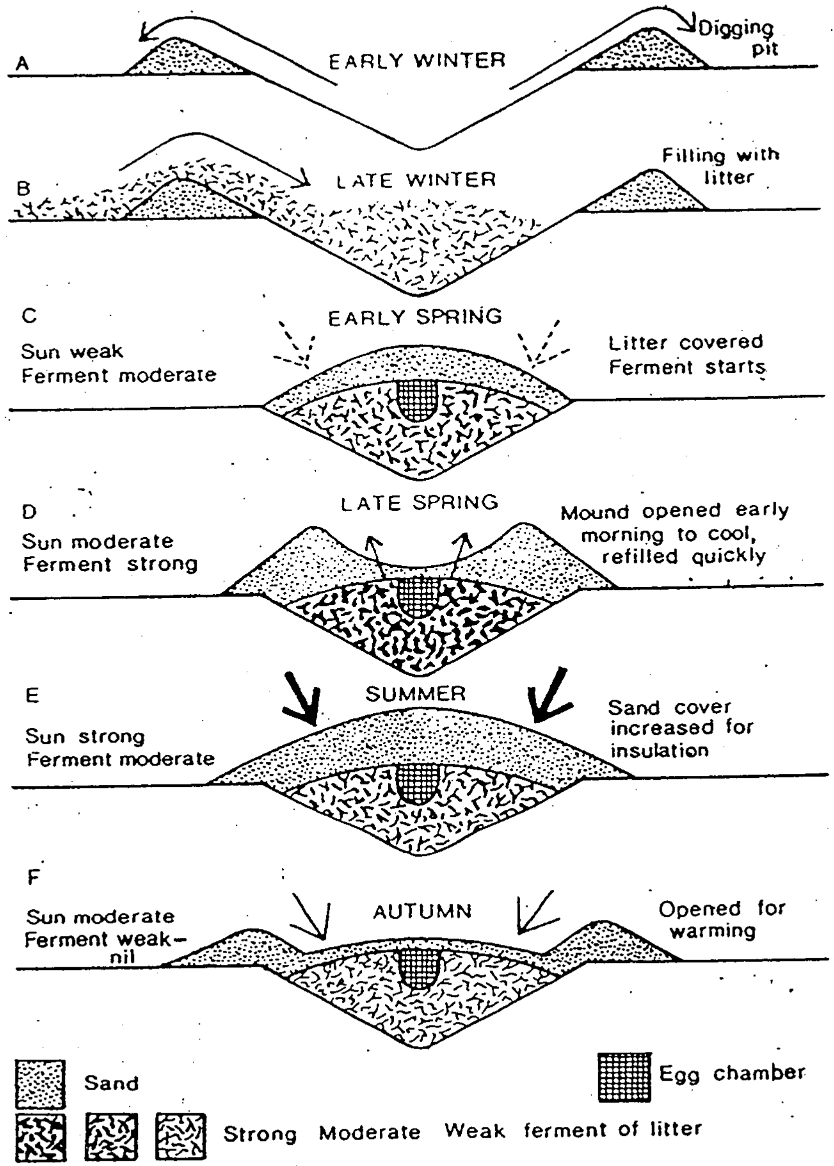



FIG. 16 The sequence of events at a mallee fowl's mound.

raking in the very sparse unpromising litter that is available in the mallee. By the time enough bark, leaves and twigs have been gathered, the scrub may be bare of litter for as much as sixteen metres all round the mound (see Plate 15). Rainfall determines mound activity at this early stage; showery days prompt the birds to work regularly whilst both dry weather or soaking heavy rain calls a halt to progress (Fig. 16b).

Once the material is piled up in the hole the birds wait until the next rain saturates the heap and then they dig an egg chamber in the top about the size of a four gallon drum. This chamber is cleared of all large sticks and filled with leaf material, bark, twigs and sand. By now it is August and the heap of moistened vegetable material has begun to ferment and to warm up; the sand excavated from the pit that was dug in the autumn is now kicked back over the pile of litter and may reach a thickness of nearly a metre by the summer (Fig. 16c). This layer of sand not only helps to keep the heat in, but serves to shed water when it rains, preventing the compost heap from becoming either saturated or desiccated.

Opinion is divided as to how much the male and female contribute to the building of the mound; probably this means that there is considerable individual difference between pairs. Young birds are very inefficient in their first mound-building efforts and not until their third or fourth year do they perfect the skills of building and temperature control. However there is no disagreement that once the eggs begin to be laid it is the male who dominates the mound and who is responsible for temperature regulation. And rightly so, when one considers what the female has to do in producing the eggs.

Few birds lay eggs that are more than 5 per cent of their own body weight. The mallee fowl whose hatchlings have to burrow up through maybe a metre of sand and then be able to run, and who can fly 24 hours later, need to be very well developed when they hatch. The eggs are therefore very large (av. 190 g) and each one is more than one-tenth the weight of the bird producing it. To produce an egg of this size every five days or so for more than three months is a major physiological task and means that the average mallee hen produces more than twice its weight in eggs each season. Not surprisingly then, her job once laying starts, is egg production and to this end she just feeds and rests, rarely spending more than one hour a day at the mound.



When the female is ready to lay an egg she approaches the mound hunched up in a characteristic way and uttering a continuous low call. The male, if he is not already there, hurries up and starts to open the mound while the female remains crooning nearby. Now and again she approaches the mound to see how the male is getting on and she may even give a few helpful scratches before retiring again. At last the male reaches the organic material and gives a series of sharp loud grunts which brings the female hurrying in to scratch and probe at the litter. She is seldom satisfied with the first place the male exposes and so leaves the pit to let the male try again. She may reject several sites before finally accepting one and taking command of the situation. The male stands on the rim of the excavation and both birds croon whilst she scratches vigorously into the packed organic material in the egg chamber. The actual laying of the egg appears to need considerable physical effort; the egg is deposited directly into the hole prepared by the female, after which she may lie there gasping for several minutes before walking out of the hole panting and with wings drooping, to stand in the shade nearby and rest. The male, who has been standing quietly by all this time, now gently covers the egg and finally replaces all the excavated sand; this may take two to three hours.

The male has a hard life and I can do no better than quote Harry Frith (1962, p. 63) '. . . the mallee fowl does seem to have little to live for. From the time these birds are born, deep underground, they are faced with a life of constant toil under a scorching sun. This life of labour clearly shows in the birds' movements; every move they make is cautious, slow and deliberate, as though it was carefully thought out beforehand to save wasting energy that must be conserved for more important things'.

How many cubic yards of sand a male mallee fowl moves in the course of a year has not been calculated but it must amount to many truck-loads (see Plate 15). Certainly it keeps him busy for most of the day throughout the major part of the year, until he retires to roost close by for the night. What he achieves by all this earth-moving is shown in Fig. 16 and described below.

By inserting into the mound instruments that would automatically record temperature on a chart in a hide some distance away, Harry Frith was able to monitor the changes in temperature that took place in the mound throughout the year. To help interpret these results he also monitored two artificial mounds that he and his helpers constructed near the natural mound. One of these was as similar to the natural mound as the men could make it; the other was filled with sand instead of organic material. In this way he was able to separate the effects of heat from fermentation and heat from the sun and to compare these with the temperature maintained in the natural mound managed by the birds (see Fig. 17).

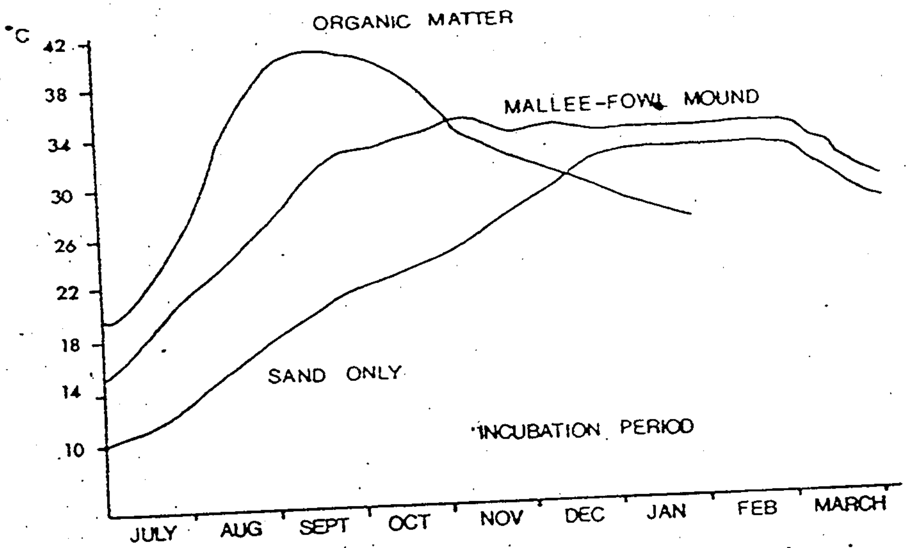



FIG. 17 A comparison of the temperatures recorded in a natural mound manipulated by mallee fowl, and those obtained from a mound of pure sand and from an untended artificial mound containing organic material (from Frith 1956).

The excavation and the filling of the pit by the birds has already been described above. Once the pile of organic matter is moistened by rain and covered by sand, fermentation starts and the temperature rises rapidly in early spring (Fig. 16c). In the artificial mound a temperature of 41°C was reached in September and held for most of that month, after which it slowly declined reaching the level of the sand-only mound in mid-December. After that date fermentation as a source of heat does not need to be considered further.

Once the natural mound reaches the required temperature of 33°C early in September the temperature remains steady at this level for the rest of the breeding cycle. Harry Frith found that the first eggs



were laid in September each year, generally just before the mound reached this temperature. Fig. 17 shows that in early spring the temperature in the mound containing sand only, was well below 33°C, and therefore the difference between this and the temperature of the natural mound must have been due to heat from fermentation of the incorporated vegetable material.

That the temperature of the natural mound did not soar to that of the artificial one was due to the activity of the birds. Early in the morning, before sunrise, the male opened the heap and immediately scraped the sand back in. The recording instruments showed a clear drop in the temperature of the nest chamber at this time, so that by manipulation of the sand the bird had cooled the heap (Fig. 16d).

As summer approached, less heat came to the eggs from below and the warmth of the sun was steadily increasing so that for a period the birds could take it relatively easy.

The male still visited the mound every day but he only opened it every two or three days and then he was in no great hurry to close it, leaving it only half filled in for most of the day. For a few weeks the mound could be said to almost look after itself – and its eggs – although the custodian was ready if required.

The installation of electrical heating equipment in a natural mound enabled the temperature to be artificially raised to 49°C, far above the normal range. Provided the bird began digging or scratching at the mound he quickly noticed the high temperature and took the steps necessary to achieve cooling by opening it up. However, sometimes the male visited without digging and then he did not always realize that all was not well. Of thirteen such experiments conducted during October-November, the male immediately recognized and corrected for the high temperatures on nine occasions. From these experiments and from field observations it appears obvious that the male bird can gauge temperature accurately when it uncovers the mound, but not otherwise. Most probably the tongue serves as a sensitive thermometer since the open bill is frequently thrust deep into the sand. Whatever his instrumentation he manages to keep the temperature remarkably constant around 33°C throughout the incubation period.

By December the days are long and hot, and shade temperatures frequently reach 37°C, while that of the ground may rise much higher. Heat is still coming from the fermentation below the eggs and so the thickness of the sand layer above the egg-chamber is increased to provide greater insulation from solar heat (Fig. 16e). Even though coarse dry sand is a good insulating material, heat is slowly conducted in waves downwards from the surface, so that even mounds more than a metre tall began to heat up. To cool this situation the male would dig out the whole mound early in the morning and after scattering and turning it thoroughly he would scratch it all back into the hole again. The flow of heat through the mound is sufficiently disrupted by this laborious process that throughout the summer the temperature of the egg-chamber never varied by more than a degree or two. It must be emphasized here that it is the male bird that controls activity at the mound. If, for example, a cold spell in November makes opening the mound impracticable he may even oppose the female and stop her excavating in order to lay the egg that is due.

Finally, with the approach of autumn, and the passing of the summer heat, the last phase of this complex incubation is reached (Fig. 16f). Fermentation has ceased to provide heat for some time, more due to the materials drying out than to their being used up, so that the sun is the only available heat source for the incubator and maximum use must be made of it. To this end the birds visited the mound late in the morning when the sun was at its hottest and shining directly on it. They removed all the covering sand except for 10 cm or so, letting the sun's rays fall into the centre of the mound. To make the most of the sun's heat they warmed up the rest of the sand too, by mixing it and turning it over; as each layer was warmed so it was kicked back into the hole until by late afternoon the mound was reconstructed full of warm sand.

By mid-autumn even these efforts were not enough to keep the egg-chamber warm and by April most mounds are abandoned and the pair enjoy a brief respite before beginning the cycle all over again.

Perhaps because most humans associate digging in the sand with seaside holidays as a child, shovelling sand around may not seem to be a very highly developed skill. To put this in perspective I would like to quote from Harry Frith's book again (1962, pp. 37–38):

> The work at the mound, though laborious, is done quickly and efficiently. I need about half an hour, with a shovel, to expose the eggs. The male mallee fowl takes an hour and a half, using only his feet. He pants heavily and finds it necessary to rest frequently in the shade before the job is finished, but except in emergencies his rate of work is steady and unhurried. Digging out, he stands facing the centre and kicks backward with powerful strokes, four or five with the left leg, then with the right. The sand is thrown a clear three feet, and although not much is moved at a time the constant rate soon tells and the hole rapidly deepens.
>
> The way the bird goes about the digging suggests some knowledge of what work is needed: if it is to be a narrow shaft, as in the spring, just to expose the egg-chamber, he begins in the top of the mound and digs rapidly downward: if it is to be a broad opening, as in autumn, he begins part way up the side and circles the mound, marking out the broad hole, then gradually works to the centre.
>
> As the cavity deepens, a single kick is not enough to move the sand over the rim, so he adopts a system of double handling by lifting the sand half-way with one kick and then moving up to lift it over the edge. If the female is present, one bird may be stationed half-way up the slope and they work in unison, one lifting the sand to the other who puts it over the edge.
>
> If the slope becomes so steep that the sand begins to run back and impede their work, they leave the bottom and go to the top to remove the spoil and widen the shoulders of the hole, which, of course, is the only thing to do.



This chapter has been mainly concerned with the complicated procedures carried out by the mallee fowl to maintain a constant and suitable temperature in their incubation mound - activities which keep them busy for most of the year. To fill in the gaps of their life-history I shall return to the large egg laid with such effort by the female, and which remains deep in the mound for the fifty to ninety days until it hatches. This big difference in the length of time taken for the eggs to hatch appears to be due, at least in part, to the falling temperature of the mound late in the season. Eggs laid in January and February took longer to hatch than those laid earlier, averaging sixty-two days, whilst eleven eggs incubated in a mound from which Harry Frith had removed the fermenting organic matter all required more than sixty-eight days and one hatched successfully after ninety days!

Young mallee fowl hatch from the egg unaided by either parent, in fact it is most unlikely that they will ever see their parents for once they have burrowed up through the sand they totter off into the bush and appear to positively avoid contact with others of their species. In order to see how the young hatched and escaped from the mound Harry Frith incubated some eggs artificially. When the eggs were ready to hatch he placed them in a heated, glass-sided box full of sand, in a darkened room and watched the whole process. He found that the young scramble free of the egg within two hours of the first crack appearing and then with bursts of activity, each lasting five to ten minutes, they struggle upwards through the coarse sand. One hatchling, later found to be deformed, survived for twenty-two hours in the sand before dying, which is quite incredible when one considers that the only air available is from the pore-space between the sand grains.

Successful hatchlings may take anything from two to fifteen hours to reach the surface after leaving the egg, probably depending on the degree of compaction of the sand, although exhaustion in hot weather may also prolong the journey.

From the observer's point of view there is little warning before a chick emerges from the mound. Because the chick burrows upwards with its neck bent and head close to its chest, the back of the neck or a claw are the first to break the surface. The rest soon follows and the chick opens its eyes for the first time (Plate 15). Exhausted by its exertions the chick may rest on the mound for a while but more often it staggers off the mound and into the bush where it rests for the remainder of the day. At dusk the chick emerges and begins to feed, scratching the ground and snatching up any insects disturbed. Even on its first night above ground the chick usually manages to scramble into a bush and to roost off the ground. By the second night it can fly strongly to roost where it pleases, thanks to the well-developed primaries with which it leaves the egg.

No one has ever recorded any instance of adult mallee fowl caring for the chicks – or even taking notice of them. Once Harry Frith watched a remarkable instance of this lack of parental interest:

> On a memorable occasion one morning we saw a male bird opening the mound for the female to lay. When he had penetrated about a foot deep, he uncovered a chick coming to the surface. He did not miss a stroke, and ejected the chick in a shower of sand. It fell on the mound and rolled down the edge under its mother's nose, but she gave it no more than a passing glance as it struggled away into the scrub (Frith 1962, p. 121).

Not only are adult and chick never seen together but the chicks live completely solitary lives. Even under the unnatural crowding of aviary conditions, young birds keep apart from each other.

Unfortunately, the legs of mallee fowl chicks are so much thinner than the adults' that it was impossible to band them in any way that would have allowed the leg to grow normally. This means that little is known about how the young disperse from their birthplace. Perhaps few data would have come from banding such birds even if a method was available, for very few half-grown birds were ever encountered. It would seem that the mortality of young mallee fowl is high and this

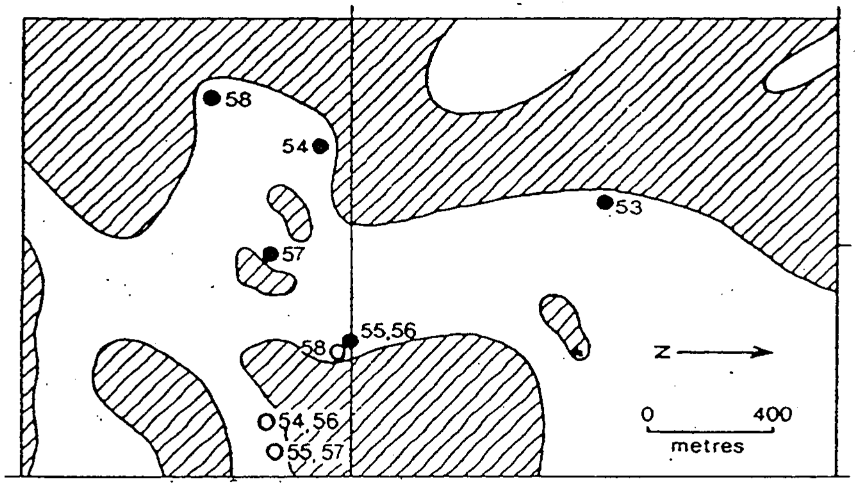


is not really surprising for the adults are long-lived normally and need to produce only two young that reach maturity, in their lifespan, to maintain the species' *status quo*.

Nothing is known about the immature phase of the mallee fowl's life. We can only guess that they mature fairly quickly as do most of the pheasant family, who are related and have members of similar size. In all his hours of watching, Harry Frith never saw anything that could be called a courtship display – nor has anyone else, so we don't know how pairs are formed. But we do know, from his studies, that mallee fowl remain together, once paired, so long as both partners are alive. His particular favourites, Joe and Josephine, remained together for six years; six other banded pairs remained unchanged for at least four or five years, depending on when they were first trapped and banded.

Although the pair-bond once formed remains constant, the birds roost apart, and for most of the year forage and rest separately, meeting only on the mound to dig, copulate or lay eggs. The birds defend a territory in the sense that they attack other mallee fowl that come too close to the mound during the breeding season, but once autumn comes interest in the mound (and territory) wanes and sometimes several pairs have been seen feeding together. During the time that Harry Frith was studying the mallee fowl, a lot of the mallee was being cleared and his study area was severely reduced. This may have affected the density of birds in the remaining scrub, but one year before devastation struck twenty-one occupied mounds were found in 770 hectares (one mound per 36.7 ha) which is probably a reasonable figure for that country. Later, on his reduced area (162 ha) the highest density recorded was one mound per 18 hectares and the lowest, one mound per 40.5 hectares.

After the autumn-winter 'walkabout' during which territories are abandoned, the pairs resume mound activity and with it territorialism. The interesting thing is that there appears to be very little consistency in the choice of successive mound sites. It is rare for the same pair to re-use the mound that they used the previous year but quite common for some other pair to use it so that there can be nothing intrinsically wrong with re-use. One might expect young and inexperienced pairs to start off with poor sites and progress to better ones and this does appear to happen, but older pairs still frequently change mounds, sometimes moving hundreds of yards. Fig. 18 shows the different sites




● Successive mounds used by Joe and Josephine.

○ " " Max and Maxine.

FIG. 18 Location of successive mallee fowl mounds, heavier soil shown hatched, (from Frith 1959).

used by Joe and Josephine over six years. The first move was forced on them because their previous mound had been destroyed by clearing, but for the third year they moved 600 m east and after staying there for two years they shifted 400 m southwest where they stayed for one season before moving 540 m further southwest. Another pair was more conservative and for four years alternated between two sites only 100 m apart, before moving to the site used by Joe and Josephine two years previously.

These and the movements of other pairs have led Harry Frith to conclude that the selection of any particular mound is largely at random. In good years the birds tended to move less, and in all years they preferred the lighter, better drained soil types. To me this emphasizes the unique central role played by the mound in the lives of these birds. In other species of resident territorial birds, food and water supplies together with roost and nest sites are all important and familiarity with these resources over a particular territory is considered to be one of the advantages of this way of life and tends to perpetuate the same spacial distribution year after year. With the mallee fowl, once the mound site for the year is decided the territory automatically sur-



rounds it; roosts are legion in mallee scrub and the food supply is at the mercy of the season yet to come. However, it does seem strange that, for a species that prefers to use old mounds rather than start new ones (H.J.F. only found two new mounds in seven years) a tradition of ownership has not developed. Perhaps variation in this regard, with some individuals preferring a change and others staying put, makes the species flexible towards environmental changes.

A study of the food of mallee fowl was difficult for two reasons. Firstly, the standard method of collecting representative stomach samples throughout the year was out of the question for a rare and possibly endangered species. And secondly, the retrieving and examination of scats (droppings) was impossible as the birds excrete dust, so efficient is their water retention. The only method left was to observe and record patiently every occasion when he found the birds feeding; to try and identify the item eaten and to search the spot where the bird had fed to confirm the identification. This must have been a heartbreaking procedure with such a shy bird but eventually several of the pairs became well used to humans and tolerated their prying. It turned out that mallee fowl are largely vegetarian; in winter and spring they graze on the small buds and flowers of the abundant herb layer and this source lasts them until some of the small shrubs set seed and then these are eaten. From January onwards the cassia and acacia shrubs begin to shed their masses of seed and these keep the birds going until the autumn rains germinate the herbs again. As the birds foraged through the bush any ground-living insect encountered was quickly snapped up but they were never seen to search for them especially.

The mallee fowl's life is no sand-digging sinecure. Even before European settlement, Aborigines regularly used to harvest the eggs from the mounds and probably the dingo dug out eggs and snapped up young hatchlings. But this was as nothing to the changes of the last hundred years with extensive clearing of the mallee for wheatlands, the introduction of the fox and a large increase in the human population, that relished fresh eggs and a nice dressed fowl. Almost too late people began to realize that the mallee fowl was becoming rare and since humans hate to blame themselves they blamed the fox. Certainly foxes do consume a large number of eggs but there are still plenty of hatchling fowl reaching the surface and scuttling off into the scrub. Of 71 nests studied 34 were completely successful, 3 were abandoned before egg-laying and 34 were subjected to predation (one by motorists, 33 by foxes). Foxes accounted for 377 of the 1,094 eggs laid; 130 of the remaining 717 eggs failed to hatch and 111 of these were eggs laid early in the breeding season, perhaps before the incubator was functioning perfectly, or perhaps due to soaking rain. Fifteen eggs were broken, leaving 542 (49.5 per cent) to hatch successfully. It has been calculated that despite the foxes the average pair of mallee fowl produces 74 viable chicks during their lifetime, and that although clearing for agriculture and the consequent loss of suitable habitat is the main cause of the decline of the species, competition for food from sheep ranging through the mallee is an almost equally serious hazard facing the mallee fowl.

As a direct result of the work upon which this chapter is based, the study area has been created the Pulletop Fauna Reserve for the preservation of mallee fowl and other fauna. It is only 65 km from Griffith on a good road; I hope that many who read this book may visit this historic patch of mallee and make the acquaintance of these unique fowl – and remember the gallons of sweat that Harry Frith and his assistants shed as they accumulated the data that unfolded the mallee fowl story.

# 14 Two Parrots

In his recent book on Australian parrots, Joe Forshaw has listed fifty-four species in three separate sub-families: six lorikeets, eleven cockatoos and thirty-seven parrots. Nearly all of these nest in holes, most of them in trees, but several in termite mounds, and a few in rock crevices. The only exceptions are the ground and the night parrots that each build a nest on the ground amongst dense vegetation. Except for the lorikeets that feed largely on nectar and pollen, most of our parrots eat seeds. These two facets of parrot ecology, the need for a hole to nest in and their diet of seeds, have led to the development of special social systems to suit these requirements.

John Brereton and his students at Armidale in northern New South Wales have been studying the parrot family for many years. In particular they are interested in the means of communication developed by the different members of this large and diverse group which is so well represented in Australia.

The Armidale workers have also assessed the complexity of the communication systems evolved by the different parrots in terms of the number of distinct call patterns that are given by each species. The most complex system is that developed by the eastern rosella, whilst both the more territorial king parrot of the forest and the more gregarious budgerigar of the inland (Plate 19) each have far simpler vocabularies:

| *Species* | *Number of calls* |
|---|---|
| King parrot | 4 |
| Crimson rosella | 21 |
| Eastern rosella | 25 |
| Ringneck parrot | 16 |
| Galah | 11 |
| Cockatiel | 8 |
| Budgerigar | 8 |

(Brereton 1971)

# PROPOSED PERUP FAUNA RESERVE.

**Information held by Manjimup District.**

## PERUP NATURE RESERVE

**INFORMATION HELD**

**BURNING HISTORY**

| | | |
|---|---|---|
| 1. | Burning History | 1950 - 1960 by year. |
| 2. | Burning History | 1960's by season & year. |
| 3. | Burning History | mid 1960 to early 1070's by year. |
| 4. | Burning blocks | as of 1982 fuel ages. |
| 5. | Burning Plan | mid 1970's to early 1980 by season/year. |
| 6. | Burning Plan | Rotation & season. |
| 7. | Burning Plan | Master Plan mid 1970's. |
| 8. | Burning Plan | mid 1970's to early 1980's. |
| 9. | Burning Plan | Planned & actual mid 1980's to mid 1990's. |

10. Comprehensive records of both logging and burning history for Balbarrup, Dwalgan, Balban, Yendicup, Moppinup.

11. Logging records of the following forest blocks, Camelar, Yendicup, Chariup, Yackelup, Boyicup.

12. Ecology Working Plans - authentic,but no details.

13. Vertebrate Fauna in the Southern Forests of WA. A survey P Christensen, A Annels, G Liddelow & P Skinner.

14. The biology of Bettongia penicillata, Gray 1837, and Macropus eugeni in relation to Fire - PES Christensen.