4.   The national Malleefowl database: making excellence easier

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Abstract

The notion of a centralised, national database for monitoring of Malleefowl breeding numbers arose at the Malleefowl forum in Mildura in 2004, and its urgent need was illustrated when monitoring information was collated from across Australia in 2006. Despite everyone's cooperation, the records were surprisingly difficult to track down, and much of the data was also difficult to interpret. Given the enormous effort that volunteers contribute to the monitoring, and the immense importance of these data in conserving Malleefowl, we simply can't afford to allow our data to accumulate unchecked again, or for it to be poorly stored; it is unacceptable that data management is a major weakness of the monitoring system.

The web-based database for Malleefowl monitoring is up and running and addresses these concerns. While the primary rationale for the national database was to centralise data and reduce duplication in data handling, the new database has also been designed to conduct many of the routine tasks that were previously done manually to manage the monitoring processes, and to provide a means for feedback and reporting in a secure environment. Because it's web-based, these services are available to all contributors across Australia with an internet connection, although tight controls ensure the security of data.

In this presentation, we will guide you through the database and show how the system works. While there are many benefits in store for those who collect monitoring data, we will also show how your data are screened and processed 'behind the scenes' each year.

The web-based database is proving to be as popular as it is powerful. It has streamlined data handling, and provided a high degree of transparency and control of people's data. Development of the database is continuing, funded by Government and mining offset grants, while the maintenance costs are currently funded through annual subscriptions by supporting NRMs across Australia.

Introduction

The monitoring data set provides fundamental information on trends in Malleefowl breeding abundance at over one hundred sites across Australia. These data are essential to assessing the conservation status of the species across a range of geographical settings. Critically for this threatened species, monitoring breeding numbers also provides a means of measuring the effects of environment and the effectiveness of management actions on Malleefowl numbers (Benshemesh et al. 2007), and an opportunity to learn how to manage and conserve the species (Nichols and Williams 2006; Benshemesh and Bode, this volume). Without a system in place to measure how Malleefowl are faring and responding to on-ground interventions, management would be blind and impotent.

Monitoring Malleefowl breeding densities in the southern parts of the species' range, where Malleefowl densities are relatively high, is well suited to volunteer involvement and volunteers have made, and continue to make, an enormous contribution to Malleefowl conservation through monitoring programs. In fact, most monitoring that occurs across Australia is undertaken by volunteers, often supported by state departments and NRMs, and in many areas volunteers are responsible for all aspects of organizing and conducting the monitoring, including data storage, vetting and analysis: data management tasks that volunteers are generally not well equipped to take on. Employing project officers to help the volunteer

community with these tasks may provide a solution of sorts, but this has not often been possible and is entirely dependant on securing recurrent funding. Moreover, this does little to remedy inefficiencies in data management and may have the downside of making the monitoring program increasingly reliant on paid personnel and vulnerable to the fickle nature of funding approvals. While there are obvious advantages of paid personnel contributing to the monitoring program, especially in regard to resolving technical or other difficult issues, there is also a clear need to make the routine processes involved in monitoring Malleefowl as simple and easy as possible in order to ensure the program's durability and independence. Building these fundamentals into the Malleefowl monitoring program has been the main focus of developments in the monitoring system for a number of years, and the national database is one of the most recent and empowering examples of this approach.

Plans for a national database were outlined at the last Malleefowl forum held at Katanning, WA in 2007 (Benshemesh 2008), but the idea had its beginnings in aspirations voiced at the Malleefowl forum in Mildura in 2004 to standardize, consolidate and analyse the monitoring at a national scale. As the reorganisation of the monitoring program neared completion, the need for a national database became all the more apparent in order to secure the level of organisation that had been achieved and to build capacity among monitoring groups across the nation. Initial funding was secured in 2007 from the Commonwealth Government Department of the Environment and Water Resources to begin development of the national Malleefowl monitoring database (henceforth NMMD), and additional funding has been provided through mining offset grants in Victoria to further its development. Maintenance of the NMMD on the internet (including web-hosting and technical support) is provided through modest annual subscriptions by several NRM/CMA bodies that wish to support the otherwise free services provided by the NMMD and Malleefowl volunteers in their region.

In this paper (and associated presentation at the forum), we provide a guide through the NMMD and show how the system works. While there are many benefits in store for those who collect monitoring data, we also outline how the system works 'behind the scenes' and the sorts of facilities that are available for screening and processing the large volumes of data that are collected each year in an effort to monitor trends in Malleefowl populations.

Why a national database?

Malleefowl monitoring data have been collected in most states since the early 1990s and in some cases earlier, and for most of this time these data were stored locally. Why, then, go to the trouble of constructing a new national database? There are in fact many reasons, the most important of which are provided below:

- Improving data management

Poor data management has been a major problem for the Malleefowl monitoring program, and this was made very evident when previously collected data from across the continent were collated and analysed in 2006 (Benshemesh 2006, Benshemesh et al. 2007). Despite the cooperation of data custodians throughout Australia, the data sets were fragmented and often inaccessible even within individual organisations and regions. Much of the data was still on paper and had never been examined or reviewed. Even where data were entered on local databases, there was often little attempt to correct mistakes that novices may have made, or improve processes. In short, the data that had taken volunteers and departmental staff thousands of hours to collect were neglected, fragmented and in disarray. Major improvements in data management across Australia were clearly needed if the monitoring program was to achieve its central objective of reliably assessing the stability of Malleefowl populations.

The situation was a little different in Victoria where a review of the monitoring program in the mid 1990s (Benshemesh 1997) provided an opportunity to thoroughly vet data, improve processes and develop a purpose-built database to manage monitoring data and produce detailed annual reports. That database was an idiosyncratic juggernaut and while it had been made freely available to other states, it was not user-friendly. Consequently, the developments that occurred in Victoria were not readily transferred to other states.

The NMMD rectifies this geographic inequality by making appropriate processes and systems for managing Malleefowl monitoring data available nationally and without cost to registered users. While modelled on the functionality of the Victorian database, the NMMD is in contrast well-designed, user-friendly, private and secure. It provides a sophisticated means of managing all aspects of the monitoring program and is free from institutional constraints and dependencies, existing in cyberspace under the auspices of the National Malleefowl Recovery Team.

- Maintaining consistency and standards

Numerous volunteer groups and individuals, as well as government and non-government agencies, are involved in the Malleefowl monitoring program around Australia. Even though monitoring standards are now in place (NHT National Malleefowl Monitoring Project 2007), maintaining these standards in the face of this diversity of data collectors is a major challenge. A centralised database can help maintain standards by requiring that the data be represented in a specific form and tracking the performance of groups and individuals that submit data.

- Reducing unnecessary duplication

Data custodians across Australia struggle every year with similar issues of: organising volunteers; downloading, vetting, and summarizing data; reporting back to supporters and filing the data in a secure form. Rather than each state, region or group developing their own ways of achieving these tasks, it makes sense to centralise data and provide to everyone a series of tools and facilities to make these jobs easier. Any improvements to the system would then be available to everyone, and because everyone is using the same system and can learn from each other, institutional knowledge is vested in the community rather than an individual (who might not always be available).

- Increasing transparency and accountability

Information on the processes and results of the monitoring program is required or wanted by a variety of stakeholders. Organisations that support the monitoring effort usually require reporting and confirmation that the provided funds have been put to good use. Volunteers and others expend great effort in collecting the monitoring data and deserve to see it appropriately treated, used and stored. Managers, researchers and stakeholders in general require information on population trends. And data custodians need to know that data are properly managed. A central database can facilitate these diverse requirements by providing tailored information to the various interest groups, and is also uniquely able to place this information in a wider, regional or national context. The timely provision of information to stakeholders will increase the accountability of the monitoring program, help detect errors and problem areas, and encourage participation and investment in the monitoring program.

Outline of the new database: What it can do for you

The new national Malleefowl monitoring database (henceforth NMMD) is designed to be simple to use, secure and 'safe' in the sense that general users can't corrupt data or damage the system. Of course any system can be a bit intimidating at first, but it is important for new users to realise that they can't do anything 'wrong' and that they should feel free to look around inside the database, 'play' and discover how the database might serve them. Understanding how the database works and how it is structured in terms of user access will also alleviate some concerns, and may even entice people who are involved in the monitoring program, but have an aversion to technology, to have a go.

Logon
The NMMD is a secure environment and requires a registered user name and password in order to log on. On the Logon page, some information is available to anyone who accesses this page, including the general public: a short video of Malleefowl working a mound, and a chart showing how much of the expected monitoring data has been 1) loaded onto the database, and 2) adequately processed and finalised for storage. Progress charts are displayed in the interests of accountability so that people who collect the monitoring data can

see how the processing of the data in their state or region is progressing, even if they have not logged on to the database.

Roles

The NMMD has three levels of user access, all of which are required to logon using a name and password:

1. Contributor: one who collects data in the field (or contributes in another way)
2. Coordinator: one who uploads contributor's data onto the NMMD and/or organises people for monitoring
3. Ecologist: one who vets data each year

Apart from these three main roles, there is a further role termed the 'administrator', whose sole responsibility is to allocate the above roles to people.

The database automatically recognises the role that has been allocated to each user, and only shows parts of the database that the user is allowed to access and that are relevant to that user. While all registered users have access to the Contributor pages and options, access to Coordinator and Ecologist parts of the database is restricted in the interests of privacy and data security.

Contributor (Access level 1)

Contributors, the role that describes most people involved in the monitoring, are the lifeblood of the monitoring program and have access to:

- Records - Review Cybertracker Records: Data that has been collected in the field can be examined here in the form of a table showing the most important data for each mound at the given site. Note that the actual GPS location of each mound is not shown at this access level, but that the distance from the known position of the mound to where the record was collected (GPS Δ) is displayed instead.

  More detail on a particular mound, and the photograph of the mound taken during the monitoring, can be obtained by clicking 'review' in the table record for each mound. Although contributors are not permitted to change the data (even if they had collected it), they are encouraged to leave notes to alert the coordinator and ecologist of errors or additional information. Ideally, everyone who collects data in the field would examine these data on the database before the data are processed and finalised for the season, and leave a note to point out any errors. But notes should be used sparingly and only where a correction is required.

- Records - Review Mound Photographs: A list of mounds from the selected site will be displayed, and selecting 'photographs' of a mound will display the last five years of photos for that mound (if they exist).

- Kit - Monitoring Forms: This is where you can download information, forms and the most recent version of the Cybertracker sequence.

- Registration - List-Coordinators/Reset Password/Update registration: Users can update their details, change passwords, and obtain a current list of people who have been assigned the role of coordinator and are available to help with queries.

- Maps - Sites and Mounds: Clicking on this link opens a Google Maps page showing the location of registered monitoring sites across Australia. Whether or not a site is shown on the map is controlled by the coordinator so that privacy is protected even among registered users. Clicking on a site that is shown on the map will bring up information about that site, such as the number of mounds routinely monitored, and how many mounds were active the previous season. Links to further information about the site are also provided, including pages showing the history of mound activity at the site, and the history of other animal signs such as prints and scats of various animals noted at mounds.

  Zooming in further, individual mounds at the site are shown colour coded to indicate whether or not they were monitored during the previous season, and whether they were active. For security reasons, we have introduced a random error into the location of each

mound, so these maps can't be used to find mounds in the field. Clicking on a mound will bring up a small photo of the mound, and links further information such as a summary of the data collected at last visit, and a photographic history of the mound's activity over the past decade.

- Inspection, Activity and Environment Reports: Nine technical reports available to contributors and have been modelled on the monitoring reports produced in Victoria for over a decade. These reports provide a thorough breakdown of the data collected in terms of the success of the monitoring as an operation, the activity of Malleefowl mounds, and the trends in signs of other animals at mounds (such as fox scats and prints). Users can choose to view reports for any previous season. If selected, the Mound Inspection Report is particularly useful to view the progress of the monitoring in the current season and to see how much of the data has been processed for each site in selected State.

Coordinator (Access level 2)
Coordinators are the main intermediary between the field and the database. In terms of data management, their main role is to extract data from handheld devices and send it through to the database. However, they also have a vital role in managing the large number of volunteers involved in the program and keeping track of each person's contribution, contact information, and experience in the monitoring program.

In order to help Coordinators in their tasks, they have access to various facilities in the NMMD designed to help them upload data and photographs onto the NMMD, register and manage the volunteers involved in the program, and keep track of the amount of time spent by volunteers in various activities involved in monitoring Malleefowl (an important statistic that is of interest to supporters of the monitoring program, especially in regard to grant applications and reports). The database is designed to make these tasks as simple and efficient as possible.

- Upload Cybertracker Data: Uploading data to the NMMD from handheld devices such as the Mobilemappers or Palm devices, and photos from digital cameras, is accomplished in several steps. Data on the handheld devices is first imported into Cybertracker on a PC, from where it is then exported to the NMMD without changes. This is usually a simple and quick operation, allowing data to be viewed on the NMMD by the people who collected it within a day or so of the Coordinator receiving the handheld device.

  On the other hand, photographs take longer because they must be processed before being uploaded onto the NMMD, and is a task currently shared between the Coordinator and Ecologist roles. Processing involves renaming each photograph so that it is recognised by the database and linked to the appropriate mound and season, stamping each photograph with the date and time, and shrinking the photographs down to a reasonable size (about 100kb; space is limited on the NMMD for the thousands of mound photographs each year). We have developed ways to process the photographs efficiently, but it still takes time and consequently there are more likely to be delays in uploading photographs than there are in uploading data.

- Reviewing Data and Photographs: Coordinators can view and leave comments on data in a similar way to Contributors. The main differences are that Coordinators have access to the actual GPS locations, and can see whether the record has been inspected and finalised by the Ecologists. As with Contributors, Coordinators can't change data, they can only leave notes pointing out possible errors.

- Managing documents available for download: as well as being a repository for monitoring data, the NMMD is also a useful place from which Contributors can download documents in a secure environment. Coordinators can upload virtually any files onto the NMMD to make them available to the monitoring community in the 'Kit' area of the Contributor pages. Such documents include the activity history of all the mounds in the site to be monitored (a fascinating reference in the field!), as well as instructions and manuals, safety information and forms, and permits. The most recent version of the Cybertracker monitoring sequence is also available here.

- People management: Volunteers are the critical asset of the monitoring program and managing and keeping private people's contact details, training, experience, and contributions (measured as time), is an important job of Coordinators. The NMMD is designed to help Coordinators keep track of these details as simply as possible. Centralising and securing this information on the NMMD will also facilitate the transfer of the Coordinator roles in each state/region to new people who can then learn the ropes from other Coordinators across the nation. This will provide a more flexible and collaborative solution than the current situation where people who organise the monitoring in each state/region feel isolated and locked in to their responsibilities due to the complexity or ad hoc nature of their local system.

Coordinators also have access to special reports designed for NRM bodies and State organisations that subscribe to the database. These reports provide aggregate information on trends in Malleefowl breeding numbers and signs of other animals at mounds within the region of interest, as well as providing a breakdown of volunteer hours that demonstrates the contribution made by the community to Malleefowl conservation.

Ecologist (access level 3)
Ecologists have unmatched access to the data, and consequently have unmatched responsibility to be diligent and rigorous in their tasks and to annotate any changes they make. The Ecologist tasks require judgement and documentation, and are best accomplished by as few people as possible in order to make them accountable and their judgements consistent.

- Validating data: The Ecologist's primary role on the NMMD is to validate the data, which means to ensure the accuracy and correctness of the monitoring data collected by Contributors. It is the Ecologist's responsibility to check and correct errors, annotate any changes they make, register new mounds and sites, and make changes to the status of individual mounds (such as removing a spurious mound from monitoring lists, or demoting ancient or dubious mound to the five-year monitoring list). In a sense, the Ecologist may be regarded as the data-janitor whose main task each year is to ensure the dataset is clean, accurate and orderly.

  Every mound record must be validated every year. Validating records is a small investment in time compared with actually collecting the data in the field, but it is essential if the data are to be relied upon. Even so, given the thousands of detailed monitoring records that come in each year, the Ecologist's role in validating data would be daunting if it were not for facilities on the NMMD that have been designed to make the job easier.

  The Ecologist's tasks begin after all the records for a particular site have been loaded onto the database and the data collector and coordinator have had a chance to leave comments (if they choose to do so). The Ecologist will usually also wait until the photographs for the site have been processed and loaded onto the database, because these provide valuable information for the vetting process. For these reasons, the Ecologist may wait until the end of the monitoring season before vetting data.

  To understand the Ecologist's process, it important to understand that the original data collected in the field is never actually modified; it is saved in its original condition. Instead, the NMMD makes a copy the data which the Ecologist will work on and validate. The process is termed 'incorporating' as the validated data is incorporated into the final data tables from where it used to generate various types of reports.

  During the incorporating process, the data are automatically subjected to a number of tests, the results of which are inspected by the Ecologist. These tests involve identification of duplicate records (same site and nest number), missing records (expected records but are not represented in the data set, and records that require further scrutiny because they break any one of a dozen or so rules applied to the data. For example a monitoring record will be flagged for further scrutiny if:

  - A comment has been left by the data collector or Coordinator;

- o The mound is recorded as active but descriptive data are at odds with the typical characteristics of active mounds (e.g. shape/profile, scraped, no cross-sticks, eggshell, etc);
- o The mound is recorded as inactive, but descriptive data are at odds with typical characteristics of inactive mounds (i.e. shape/profile, not scraped, etc);
- o It's location is more than 20m from it's expected (registered) location;
- o It is a duplicate record, missing, or unregistered mound number for that site;
- o The date is outside the current monitoring season;
- o The location (Lat/Long) is missing or outside the range of Malleefowl.

The Ecologist mostly works from a table showing all the monitoring records from a site during the current season. Most monitoring records that have been carefully collected in the field pass these tests, in which case they will be automatically validated by the NMMB. However, many mound records are usually flagged for further scrutiny, often for minor issues in which case they may be swiftly validated at the discretion of the Ecologist (e.g. a comment may have been left that does not require further action, or the distance from the expected location may be just outside the 20m rule).

In other cases, such as where the activity status or identity of a mound is in question, Ecologists will open the record to scrutinise the data in full alongside the current photograph of the mound in question. Once again, many cases where rules have been broken are minor and can be quickly resolved; for example, a mound may have been recorded as active but not scraped, but the Ecologist may see from the photograph that the mound was indeed clearly active, and validate the record, perhaps with a short note. In other cases the data may require a minor correction, in which case the Ecologist should always leave an explanatory note.

There are usually some mound records that require more careful scrutiny. The ecologist has at their disposal several tools that are useful. For example, the NMMD will automatically identify the nearest mound to the location recorded with the data, and this is often a great help in cases where the wrong mound number has been recorded. The Ecologist may also compare the current mound photograph with those of previous years, and this will often help sort out issues of uncertain mound identity and/or activity status. For example, if an active mound that had been abandoned early in the season is described as inactive later in the season, its photographic series will often demonstrate that marked changes in mound shape and characteristics over the past year that could only be explained if the mound had been active early in the season.

All records must eventually be validated to be represented in the report tables and available for assessing population trends. While the monitoring system, from field collection to the NMMD, has been designed to provide ample opportunities for cross-checking the validity of data and detection of errors, doubt about the activity status and/or identity of mounds may occasionally occur. The Ecologist must eventually validate these records too, clearly indicating the remaining uncertainty and perhaps advising some remedial action (such as a follow-up check of the mound in the field). Fortunately such cases are nowadays rare.

- Registering sites and mounds: Ecologists are also responsible for the registration of new mounds and sites and managing the registration details, and have various forms and tools to manage these critical details. It is within the registration pages that the monitoring status of individual mounds is set (annual, 5-year or omitted from monitoring lists), and whether or not individual sites are represented on Google Maps.

- Outputting revised monitoring lists: Once the Ecologist has vetted and finalised the data, he/she can output mound locations for the next year's monitoring list from the NMMD in a form suitable for upload onto GPS or Mobilemappers (and similar devices) enabling navigation to mounds.

Overview of Data flow from field to NMMD

The NMMD may seem complex, but it is built around a simple series of steps that involve the collection of data, moving these data from the field to secure storage in the database where it can be efficiently checked and made available to management and research involved in the conservation of Malleefowl. Its many facilities and options are designed to simplify and streamline the essential steps for maintaining an accurate and orderly 'warehouse' of Malleefowl monitoring data.

Understanding how data typically moves from the field to its final version on the database provides a conceptual path through the NMMD, and also shows how the NMMD facilitates all parts of the monitoring process:

1. Organisation of monitoring

The first step is, of course, the organisation of the volunteers and others involved in collecting data in the field. This includes the training of data collectors, as well as allocating individuals to specific sites and providing them with all the information they need or want in order to do the job well. The NMMD already assists coordinators by providing the updated information they need to organise the monitoring at the click of a mouse including: volunteer's details and training, monitoring instructions, maps, lists of mounds to be monitored and locations of these for GPS and Mobilemappers. We are keen to develop the database to further suit the needs of coordinators over the next year.

2. Data collection

The most indispensible part of the monitoring program is the actual data collection, which is mostly done by volunteers. The introduction of Cybertracker on handheld computers (i.e. Palms, Mobilemappers, etc.) made recording data easier in the field and greatly simplified the movement of data from the field to computers. Transcribing thousands of paper monitoring records each year onto computers was a huge task, but one that was mercifully made obsolete by handheld devices. Moreover, because the data entry is closely controlled within Cybertracker, the data are in the correct form and require little verification (unlike data on paper that has to be checked for typographical and transcription errors).

3. Upload

Uploading data is a two-step process. Data are first uploaded by Coordinators to Cybertracker on a PC by physically linking the devices. This usually takes only a few seconds. Then, the data are exported from Cybertracker to a file that can be imported onto the NMMD, which also takes only a few seconds. The NMMD shows the uploaded data in the form of a table that also shows if data are not in the appropriate format (in which case the NMMD won't accept it until errors are corrected). Data from Cybertracker are always in the correct form, which is why even if data was originally collected on paper, it's best to later enter data on a handheld device before uploading to the NMMD.

As outlined above, photos are treated separately, but we may be able to integrate and streamline these processes in the future.

4. Online inspection of data

Once on the NMMD, the Cybertracker data collected in the field becomes available to Contributors and Coordinators for comment. These comments provide a means of Contributors in particular to correct data that they can see was incorrectly recorded. This is not an essential step, but can be very useful for the next step.

5. Validation

The Ecologist now works through the data collected in the field by making a copy ('incorporating the data') and validating all records. All comments left by others are read and considered, and changes are made as required and are carefully documented. For example, comments may indicate that the monitoring status of a particular mound should change from annual monitoring to 5-yearly or even not at all (if it's considered not to be a mound). The Ecologist would consider the mound satisfies the criteria for changed status (these have to do

with the condition and height of the mound, and a measure of discretion) and provide a written decision that can be viewed by Contributors. It is at this stage also that missing records are dealt with, first by checking if a photograph exists for the missing record (sometimes people photograph but forget to record old mounds), in which case the Ecologist will create a record for the mound and examine the photo for information on activity, etc. If there is no photograph, the Ecologist will create a record for the missing mound but pronounce the mound as not found.

Once all mound records from a particular site are validated, the data processing is complete: the data are represented in the report tables, stored for later use in management and research, and monitoring lists and locations for the following season are available for download.

Concluding comments

The past few years have seen a number of important developments in monitoring Malleefowl. About a decade ago, GPS became precise enough to enable navigation to mounds, and digital cameras and handheld PDAs became more available. These technologies heralded in a new era of electronics facilitating the monitoring effort and empowered volunteers to take control of the endeavour. One of the most important developments in the monitoring program at this time was to move from recording data on paper to recording on electronic devices in the field, a move that led to substantial improvements in data accuracy and, most importantly, in the efficiency of managing data. The multi-regional project in 2005-7 provided an opportunity to consolidate, standardise and refine the monitoring program further, and volunteer groups and departmental staff involved in the collection of Malleefowl monitoring data from across the range of the species' collaborated in the production of a national monitoring manual (NHT National Malleefowl Monitoring Project 2007) that for the first time detailed mutually agreed upon standards and procedures. For the first time also, the type of data collected in the monitoring program was reviewed (Benshemesh 2007) and combined in a simple database where it was vetted and analysed at a national level (Benshemesh et al. 2007).

These developments have all paved the way for the construction of a purpose-built national database for the Malleefowl monitoring program. Our focus has been on efficiently moving uploaded data through various steps to ensure its validity and completeness, before analysis and archiving. The resulting NMMD is a multi-purpose platform that facilitates many aspects of the monitoring program and provides national data aggregation and management, centralised reporting and active support services for data collectors and managers.

Its many facilities and options in the NMMD are designed to simplify and streamline the essential steps for maintaining an accurate and orderly 'warehouse' of Malleefowl monitoring data. For maximum benefit from the NMMD, it is vital that data are processed and finalised soon after they are collected each year. Timely action by Coordinators and Ecologists will allow errors to be rectified while the field experience is still fresh in people's minds, and will avoid backlogs that become increasingly difficult to deal with. Moreover, prompt processing of data will enable volunteers to see the data they collect and confirm it has been appropriately managed.

The NMMD has also been constructed to ensure the security and, if need be, the privacy of data collected by volunteers and others. The issue of privacy is important because some monitoring sites occur on private land and in some cases the owners or leaseholders may not want the general public (or even government departments) to know the locations of their populations of Malleefowl. Nonetheless, these people often want the trends in their populations to be considered in the local and national effort to conserve Malleefowl, and to have their data securely stored for future reference. The NMMD provides this privacy as access to data is controlled by the people/organisations that collected it. The NMMD exists under the auspices of the National Malleefowl Recovery Team rather than government departments, and is independent and free of organisational constraints. Only aggregated data is reported, and the location of mounds and sites is regarded as confidential.

The independence of the NMMD has allowed great freedom in designing the database and securing its contents, and this has been possible only through funding from government and private sources. However, the drawback of this arrangement is that being outside government infrastructure, the NMMD requires some ongoing funding to pay for server hosting and general maintenance. Fortunately, the National Malleefowl Recovery Team has approached regional NRM/CMA bodies to help cover these costs by annually subscribing to the NMMD in return for aggregate data in the form of reports on the performance of the monitoring and trends in Malleefowl numbers. While one-off grants have paid for the development of the NMMD, the relatively modest subscriptions from concerned NRM bodies provide the ongoing costs that enable users to access the database through the internet.

Future

While we have come a fair way down the track towards developing an appropriate database for the Malleefowl monitoring program, we're not quite finished yet. Our current focus is on facilitating the tasks that Coordinators are mostly concerned with, such as organising people for the monitoring and tracking their experience and contributions. We are also looking at ways in which the database can help organise re-searches of established sites, and process the data collected during such searches. Monitoring sites need to be re-searched every 5-10 years in order to include newly built mounds in the monitoring effort, but searches can be difficult to organise and the ensuing data currently requires more effort to interpret than regular monitoring data. However, the NMMD has the potential to make these re-searches easier by providing GPS directions for search transects, keeping track of the search history of each site, and efficiently vetting, analysing and reporting on the results of each search.

While our focus has necessarily been on the operational aspects of the NMMD, it should also be noted that the end use of the monitoring data has also been considered in the design of the database. By providing reliable and timely information on the trends in populations of Malleefowl and other animals, the NMMD is an important step towards a more dynamic phase in which monitoring may be used not only to establish population trends, but also to assess and improve the effectiveness of management at benefitting Malleefowl conservation. In particular, plans to develop an Adaptive Management program for the hundred or so Malleefowl monitoring sites across Australia, as recommended in the National Malleefowl Recovery Plan (see also Benshemesh and Bode, this volume), has the potential to greatly increase the effectiveness of Malleefowl management. The NMMD will play a central role in adaptive management, and indeed any other attempts to utilise the monitoring data for Malleefowl conservation, and every effort will be made to ensure that the NMMD provides researchers and managers with the data they need to improve the prospects of Malleefowl in the uncertain times ahead.

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