# Malleefowl Monitoring in Victoria: 2021/22

*Report to the Victorian Malleefowl Recovery Group*

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## Appendices

# 1. Monitoring performance: how did we do?

Table 1 shows a breakdown of the performance of the monitoring effort, yet another great result! (More detail is shown in Appendix A.1). The VMRG visited 1387 malleefowl mounds during the 2021 breeding season (Table 1) including 3 newly listed mounds.

A total of 23 regular mounds were neither sought nor found during the season (Table 1) and these were scattered through 9 sites (several of these missed mounds were due to an administrative error). There was only 1 regular mound that was searched for but could not be found although it was found in previous years.

Overall, the VMRG managed to find over 98% of the mounds that we set out to monitor, another excellent result!

**Table 1**. Performance of the monitoring effort. 'Optional old' mounds are those that were categorised as optional (5yr) before the season, whereas 'Optional new' are mounds that were added to the optional list last season. Omitted mounds are those removed from monitoring lists last season.

| | *Total* | *Regular* | *Optional old* | *Optional new* | *Omitted* |
|---|---|---|---|---|---|
| Monitored | | | | | |
| Sought and found | 1384 | 1244 | 129 | 11 | 0 |
| New survey | 0 | 0 | 0 | 0 | 0 |
| New incidental | 3 | 3 | 0 | 0 | 0 |
| Not monitored | | | | | |
| Sought, NOT found | 1 | 1 | 0 | 0 | 0 |
| NOT sought or found | 181 | 23 | 153 | 5 | 0 |
| Total | 1569 | 1271 | 282 | 16 | 0 |

Last season (2020), 16 mounds that were monitored as regular mounds were reviewed and downgraded to optional (5-year mounds) for subsequent seasons; these mounds show up in the tables as new optional mounds this season. The number of mounds on the optional list is now 298, or 19% of the mounds registered for monitoring.

5-year mounds are scheduled for mandatory monitoring every 5 years and are optional in intervening years. 2021 was an optional year, but the VMRG volunteers nonetheless revisited 47% of these degraded mounds this season thereby removing any uncertainty in their activity status. 5-year mounds will be optional again next season, with the next mandatory monitoring of 5-year mounds in 2025.

Once again, Greg Davis, Paul Leigh, and John Fraser did a wonderful job sending out equipment and managing, checking and validating the data, with minimal assistance from Graeme and I at the national team.

## 2. Malleefowl Breeding numbers: how did the birds do?

Of the mounds that were monitored in Victoria, 136 were active in 2021 compared with 149 last season (2020); in the season before that (2019) 132 active mounds were recorded but does not include V44 Neil MacFarlane site in Annuello in which 15 to 17 active mounds were recorded in the last two years. These numbers are much lower than the unusually high of 218 active mounds set in 2012.

The following charts and discussion are presented according to the NRM (Natural Resource Management) regions they are located in. The NRM regions are important because they are administrative zones that have federal obligations concerning malleefowl management. NRMs that have malleefowl in Victoria are the Mallee, Wimmera and North Central CMAs. In line with VMRG reporting tradition, we'll also break down the Mallee CMA into 3 regions: Eastern Big Desert (Wyperfeld, Paradise, Bronzewing and Wathe); North West (Sunset Country and Hattah sites); and North East (Wandown, Annuello, Menzies and O'Brees).

### *Mallee CMA*

Figure 1 shows the trend in active mounds at sites within the Mallee CMA (encompassing the Big Desert, Sunset Country, Annuello, Wandown and O'Brees) and shows a general decline of about 2% across several decades. In 2021, average breeding trend was 28% below LTA (Long Term Average) and was also lower than in the previous two seasons; the trend index for 2021 was the 4$^{th}$ lowest of 38 seasonal monitoring events.

The 3 regions within the Mallee CMA that we traditionally examine in the monitoring report show quite divergent trends. In the Eastern Big Desert (Figure 2), there is a a long-term decline in breeding numbers of about 3% per year. The burning of Bronzewing in 2014 caused a large decline in Malleefowl, but this has had only a minor effect on the overall trend. Apart from Bronzewing, several long-term sites in the Eastern Big Desert have also shown pronounced declines over the past three decades (particularly v01 Dattuck, v02 Torpeys, v03 Wathe SW, v20 Lowan). On the other hand, 2021 breeding numbers at v23 Moonah was on par with, and v34 Paradise only slightly below, their respective long-term averages.

In the Northwest (Figure 3), sites appear to have been severely affected by the millennium drought between 1997 and 2007 with trend values well below LTAs but bounced back strongly when the drought broke. Consequently, the long-term trend is slightly positive (Figure 4). 2021 numbers were lower than those in the previous 2 years but only slightly below LTA.

In the North East (Annuello, Wandown, Menzies and O'Brees; Figure 4), the trend suggests a stable populations over the past few decades, largely due to the stability of the large populations at Annuello and Wandown. In 2021, the average trend

values were 16% below zero, indicating that breeding numbers were down but not alarmingly so considering they were close to the LTA the previous year.

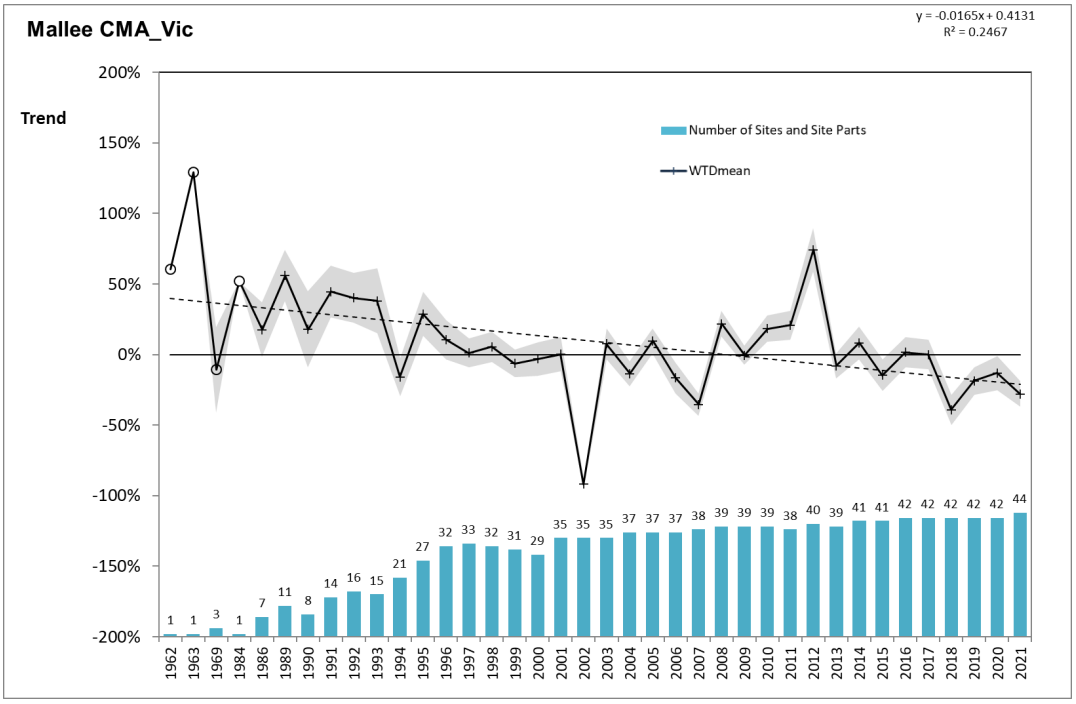
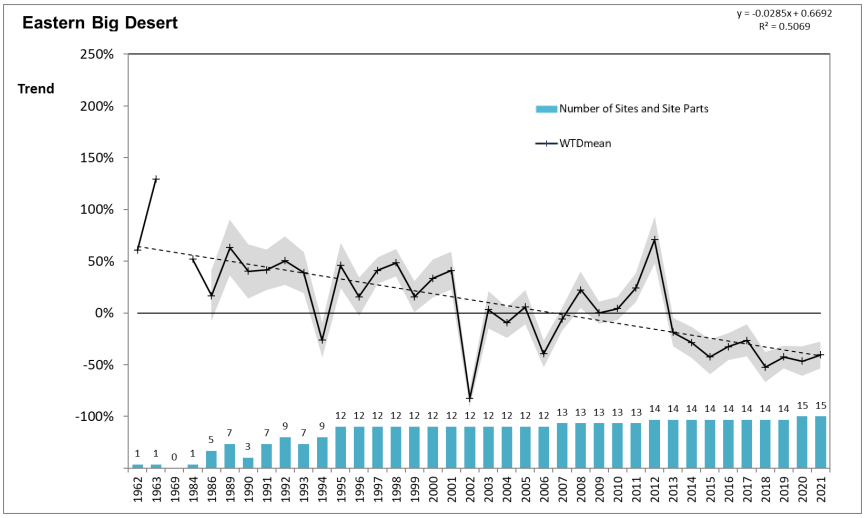
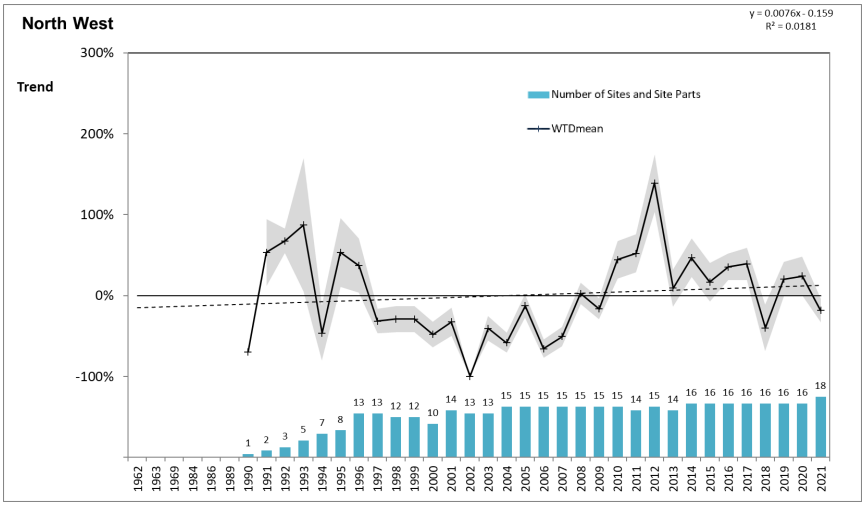
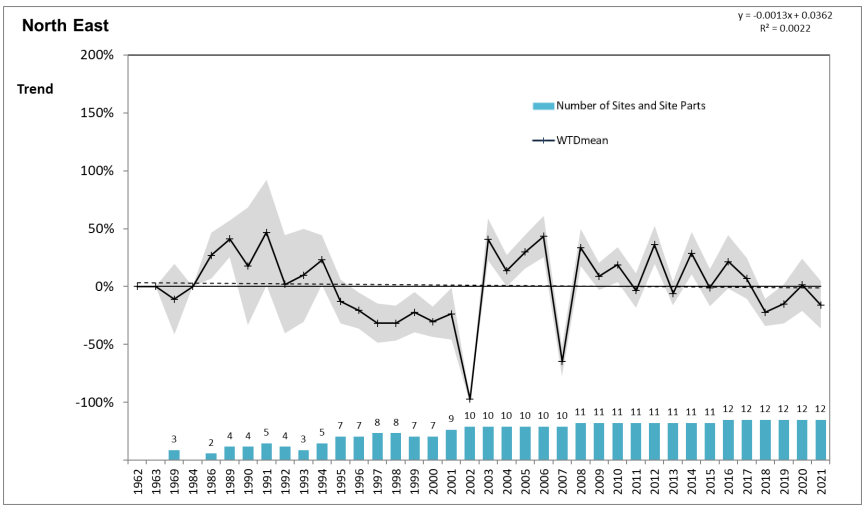



Figure 1. Trends in malleefowl breeding numbers at 44 sites and site parts represented by 38 monitoring seasons spanning 60 years (including historical survey data from some sites in the 1960s). Each point (cross) shows the degree to which breeding numbers were above or below the long-term average (LTA) for the sites monitored (trend). Shading indicates the standard error about the mean where multiple sites were monitored in a season. The number of sites monitored in a breeding season is shown by the histogram. The dashed line indicates a simple linear trend.



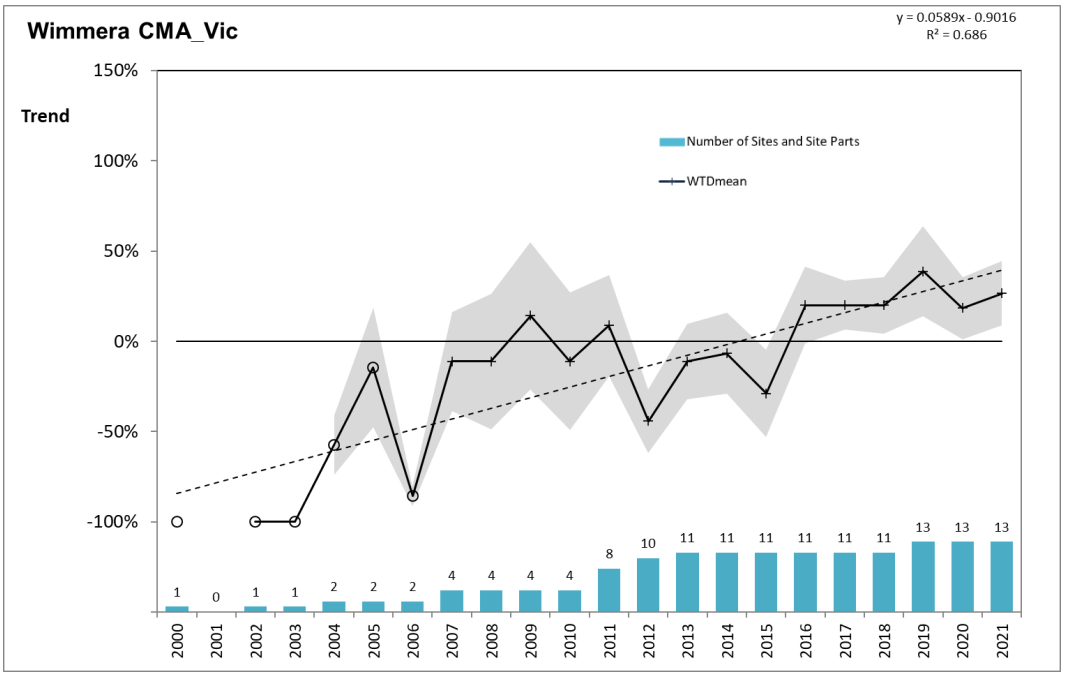




Figures 2, 3 and 4. Trends in malleefowl breeding numbers in the Eastern big Desert (top), North west (middle) and North east (bottom) sub-regions of the Mallee CMA (see Figure 1).

### *Wimmera CMA*

In the Wimmera, malleefowl breeding numbers in the 2021 season were slightly above the previous season and well above the LTA; the trend has been strongly positive since monitoring started in the early 2000s, and since 2012 when monitoring involved most of the current sites (Figure 5). The relatively low trend values before 2008 may reflect the effects of the Millennium Drought; coming off a low base has enhanced the general positive trend in breeding activity. Since 2008 after which the drought broke, breeding numbers have fluctuated but also suggest a positive trend at our monitoring sites.

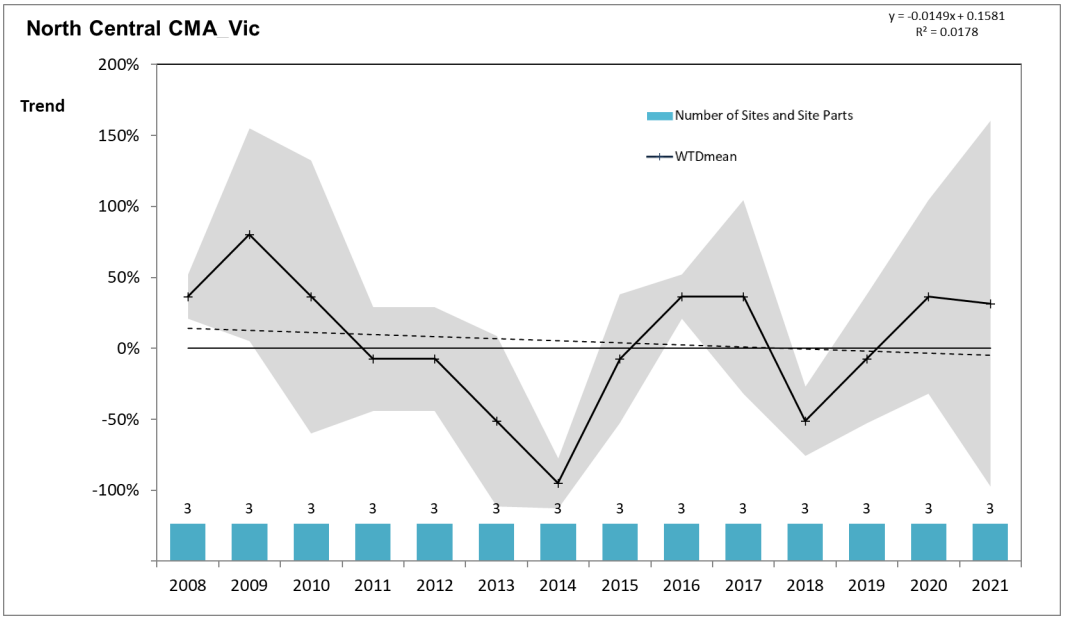



Figures 5. Trends in malleefowl breeding numbers in the Wimmera CMA (see Figure 1).

### *North Central CMA*

The North Central CMA is represented by 4 sites in the Wychitella group of reserves near Wedderburn. Although the VMRG started monitoring the Wedderburn block in 2005, it was not until 2008, after the Millennium drought, that the other 3 blocks were monitored. As most malleefowl appear to occur in these more recent sites (especially the Wychitella and Korong Vale blocks), it makes sense to consider the breeding population trends from 2008 (Figure 6). These data suggest the breeding population has been stable but fluctuates widely from year to year. Part of the reason for the fluctuations and uncertainty (grey shading) is that the number of sites and the absolute numbers of active mounds are both low (only about 2-3 active mounds on average per year across the 4 sites), so a small change can have large effects. Nonetheless, in 2021 there were positive signs with 3 active mounds recorded, including one in the Wedderburn Block where no breeding has been recorded since 2005.

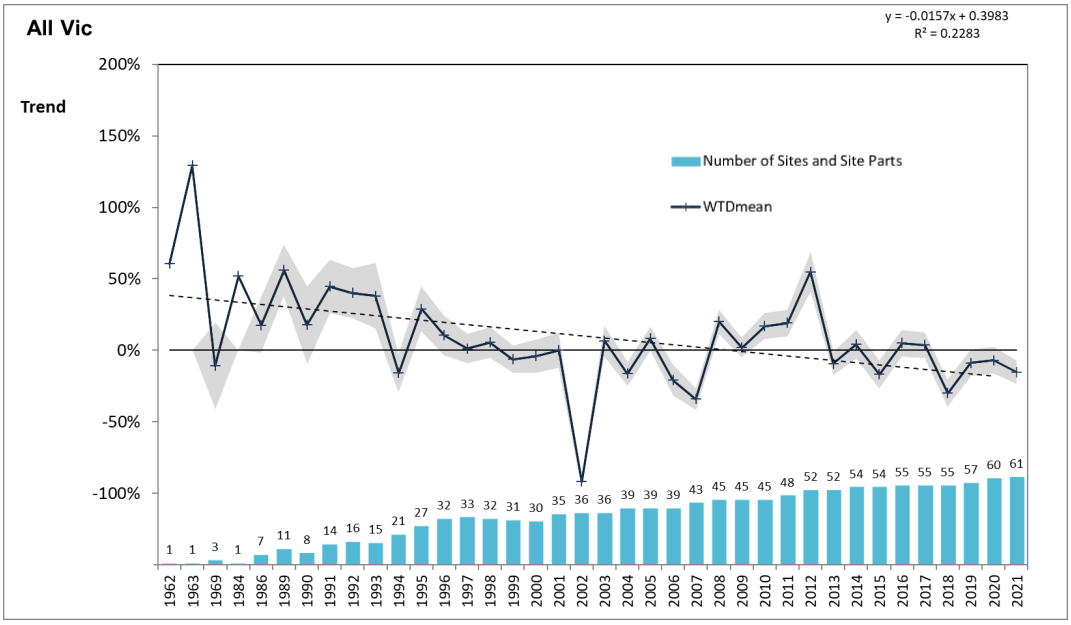
Despite efforts by the VMRG and others to locate mounds in the Wychitella reserves, we have a poor understanding of the number of malleefowl inhabiting the area. This is due largely to the difficulty in searching the area as the vegetation is often very difficult to walk through where malleefowl occur. The monitoring by the VMRG has established that there are at least 3 breeding pairs in the area, but there may be others. The Wychitella reserves contain the most isolated malleefowl populations in Victoria and understanding the population size is critical information for management. With such a small, isolated population, inbreeding is a major threat; mitigation of this threat and undertaking a breeding population count (e.g. using Lidar) are feasible and should be regarded as urgent priorities.




Figures 6. Trends in malleefowl breeding numbers in the North Central CMA (see Figure 1).

## *All Victoria*

Figure 7 provides an overview of the trends in malleefowl over Victoria as a whole and is based on 31,260 mound visits resulting in 3,609 active breeding records. These data suggest the Victorian malleefowl population has been declining over the past five decades at an average rate of 1-2% per annum. The breeding trend index in the 2021 season was 15% below the LTA and was also lower than the previous two seasons. However, on a more positive note, the trend since 1994 when there were at least 20 monitoring sites, has been neutral. This suggests that the inclusion of the earlier years, when monitoring involved few sites and was less geographically representative, may skew the results and be less representative of the current situation.




Figures 7. Trends in malleefowl breeding numbers across Victorian monitoring sites (see Figure 1)

## *Rainfall profiles in 2020*

Indicative rainfall charts for Victorian malleefowl areas are shown in Figure 8; Mildura rainfall records were incomplete for 2021 so Irymple records are shown instead.

2021 was characterised by drier than usual autumn conditions, but most regions appear to have had average or above average rains over winter, although August was relatively dry. Wet winters probably suit malleefowl as they need winter rain to moisten leaf litter which then decomposes to produce heat to incubate eggs in spring, as well as providing herbaceous food.

However, in the Mallee region, malleefowl breeding numbers declined in 2021 despite the apparently favourable rainfall at the representative towns. The reasons for this decline are unclear but do not appear to be related to winter rainfall. In 2025 we hope to perform a detailed analysis of the monitoring data in relation to more detail rainfall data (as we did a few years ago) as well as vegetation condition as determined from satellite data (Alys Young's research demonstrated the utility of satellite data in understanding malleefowl trends, showing that it was a better predictor of breeding trends than rainfall).

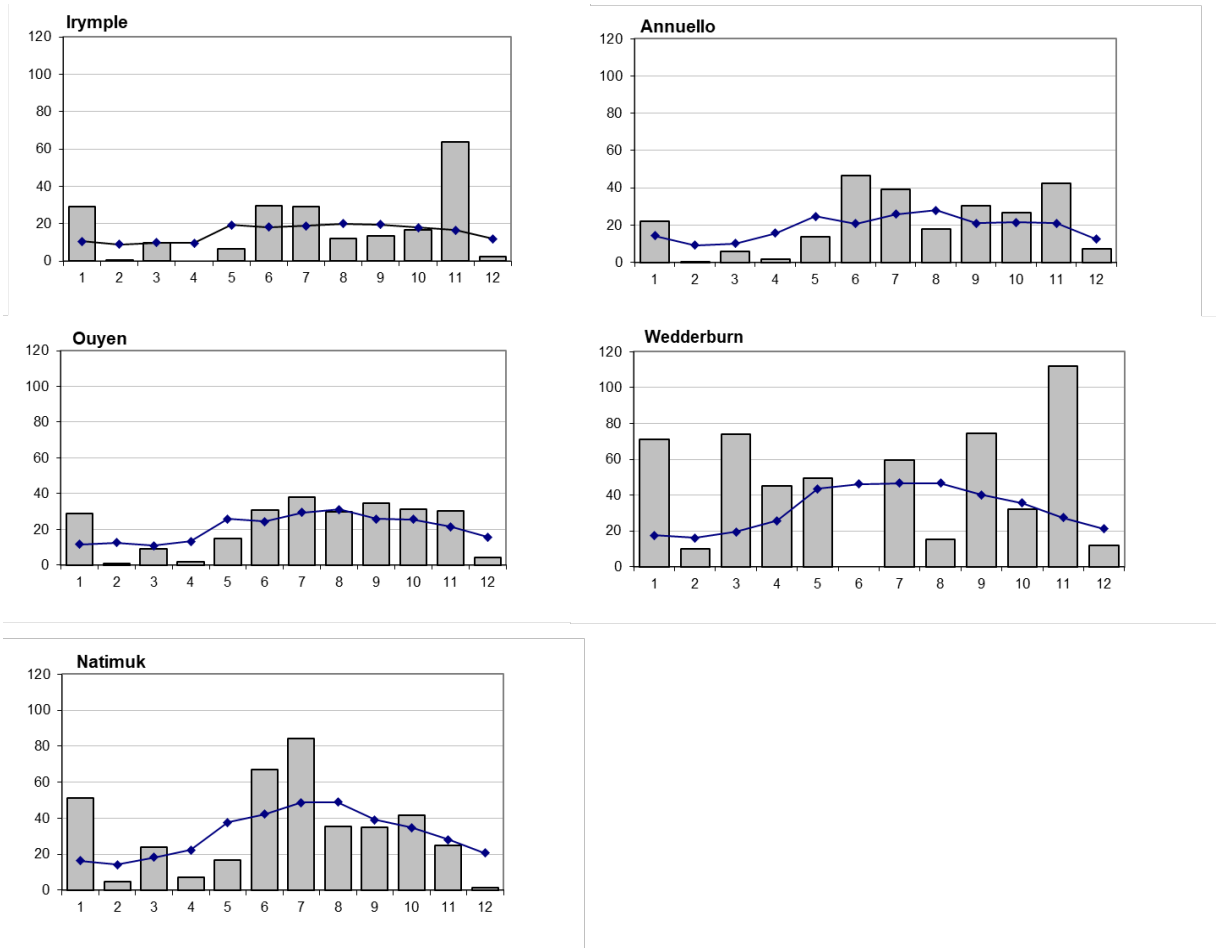



**Figure 8.** Rainfall at Irymple (Mildura data was incomplete), Ouyen, Natimuk, Annuello and Wedderburn in 2021 (bars) and median rainfall since early 1900s (line). Data from the Bureau of Meteorology website.

### *Individual Site trends*

Histograms showing site trends will be available for download from the NMMD (National Malleefowl Monitoring Database) along with all the usual database reports that comprise the appendices of previous monitoring reports.

## 3. Changes to data recorded in the field

There were no major changes to the Cybertracker sequence this season and everyone used the Samsung smartphones successfully.

## 4. Lerp

Lerp abundance on mounds was very low in 2021 (Figure 9) with only 3% of mounds monitored in Victoria showing lerp when mounds were monitored (mostly October-December 2021). Lerp abundance was also very low in each region (Figure 10). In 2020 lerp was most abundant on mounds at North east sites where 'some' lerp was

recorded at 33% of mounds, and 10% showed 'lots', compared with 2021 where only 7% of mound had lerp and no mounds were recorded with lots.

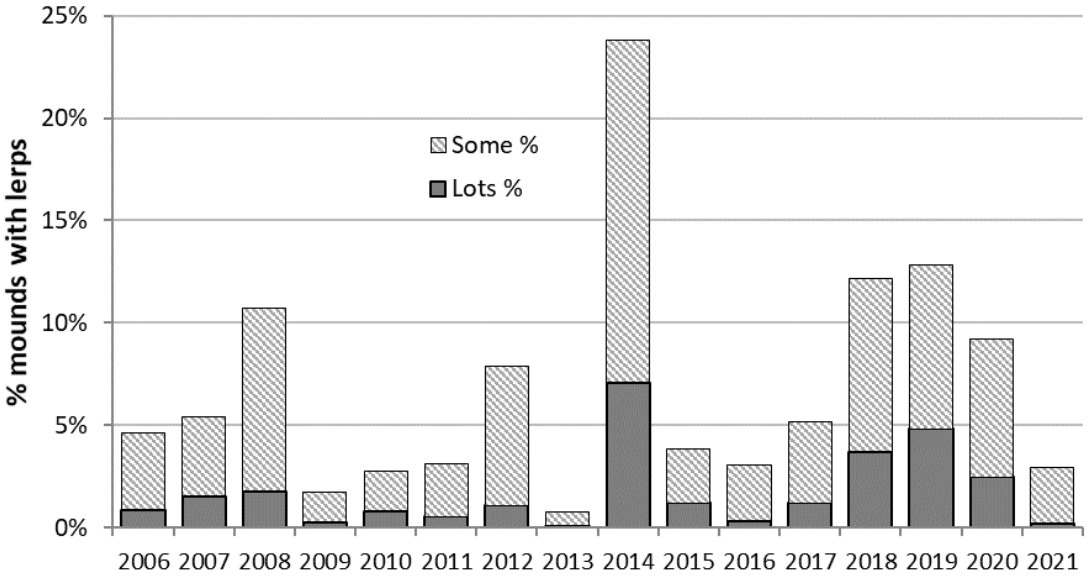



**Figure 9.** Proportion of mounds on which lerp were detected in each season since 2006.

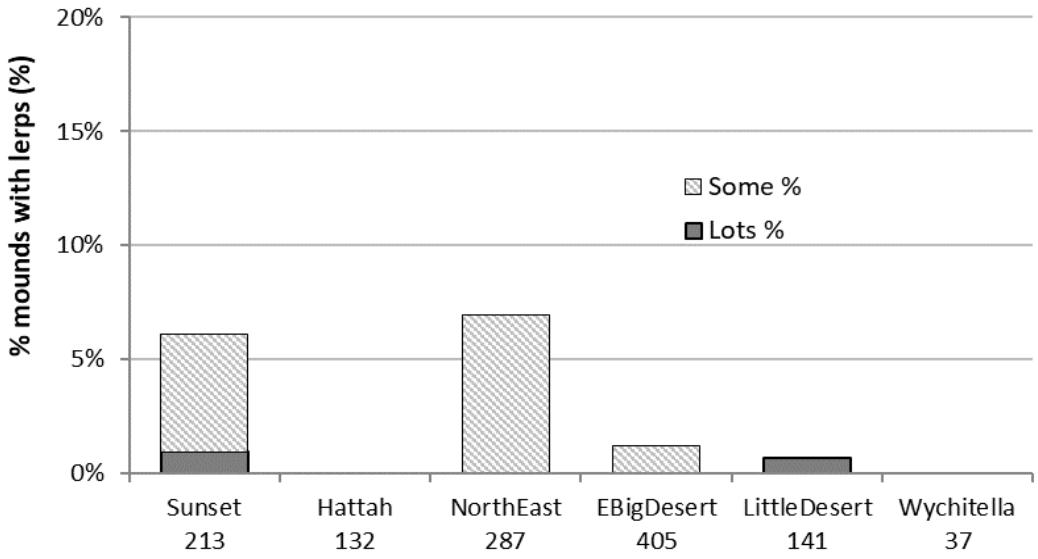



**Figure 10.** Regional breakdown of lerp occurrence on mounds in the 2021 season. The number of mounds inspected is indicated under the region.

## 5. Fox scats

Fox scats were collected from 35 sites in 2021, totalling 5.2 kg of scats collected from 386 mounds (Table 2).

Figure 11 shows the average weight of fox scats collected per mound monitored since the mid-1990s for the same set of 20 sites and provides a better comparison across the years of data during which many sites have been added. The graph shows that there was a steep decline in fox scat weights between 1996 and 2000 coinciding with the decline of rabbits due to RHD and consequent adjustments to fox populations. Since 2000, there was an increasing trend peaking in 2012, after which the amount of fox scat per mound declined and appeared to have stabilized at 5-6g per monitored mound. In 2021, only 4.4g of fox scat per monitored mound was collected at these 20 reference sites, the lowest figure since 2008.

Direct comparison of the 2021 results with the previous season are difficult as some fox scats appear to have gone missing last season. However, one notable difference was that far fewer fox scats were recorded at v34 Paradise in 2021 that 2020.

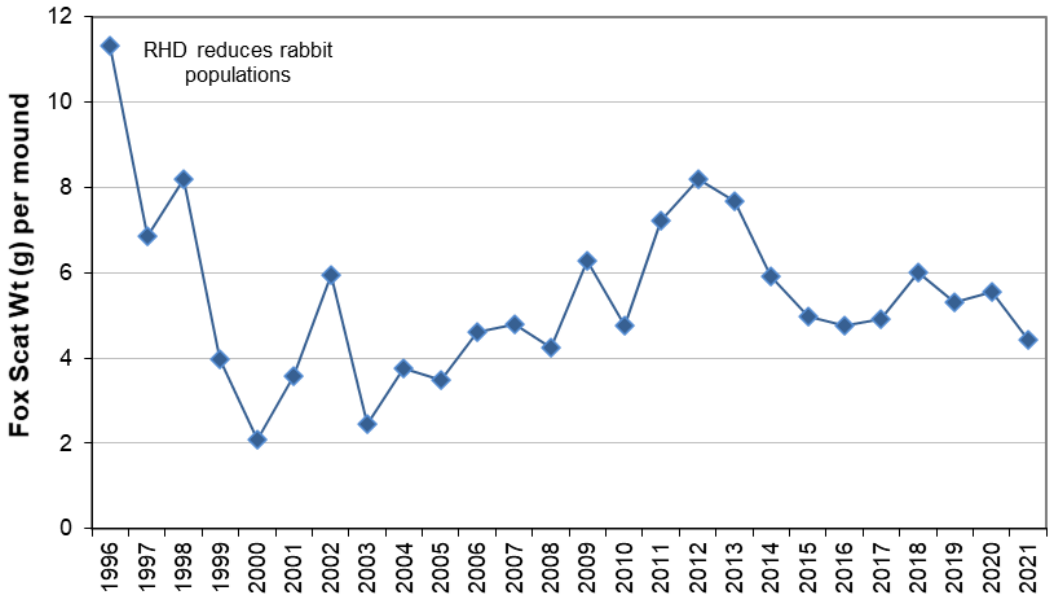



**Figure 11.** Trends in the average fox scat weight per monitored mound at 20 sites over 25 years. No attempt has been made to control for biases due to variations in the proportion of active mounds (more likely to be marked with fox scats) or changes in the proportion of very old and inconspicuous mounds.

Which brings us, as always, to reiterate:

⌘ ⌘ ⌘

Please be systematic with fox scat collection.

Search each mound surface very carefully for a full minute to be sure we get all the scats (as emphasised in the manual and at training weekends).

⌘ ⌘ ⌘

Table 2. The total weight of fox scats, the number of mounds at which fox scats were collected, for both 2021 and the previous year (italics). Malleefowl scats and feathers were also collected but are not tabulated here.

| Grid | Name | | 2021 Wt (g) | 2021 Count | *2020 Wt (g)* | *2020 Count* |
|---|---|---|---|---|---|---|
| v01 | Dattuck | | 69 | 12 | | |
| v02 | Torpeys | | 115 | 11 | | |
| v03 | Wathe SW | | 571 | 29 | | |
| v04 | Bronzewing | - | 397 | 33 | *487* | *33* |
| v05 | Stokies (Colignan) | + | 16 | 3 | *101* | *5* |
| v07 | Annuello | | 124 | 9 | | |
| v08 | Powerline | | 41 | 4 | | |
| v09 | Mt Hattah | | 91 | 4 | | |
| v11 | Mopoke | | 69 | 8 | | |
| v12 | Pheeneys | - | 23 | 1 | *69* | *5* |
| v13 | Bambill | | 284 | 14 | | |
| v14 | Menzies | + | 194 | 8 | *217* | *10* |
| v15 | Wandown | ++ | 501 | 26 | *398* | *35* |
| v16 | South Bore | | 219 | 22 | | |
| v17 | OneTreePlain | -- | | | *23* | *2* |
| v18 | WashingMachine | + | 95 | 8 | *72* | *7* |
| v19 | Underbool | - | 44 | 6 | *17* | *1* |
| v20 | Lowan | + | 139 | 10 | *27* | *1* |
| v21 | Dumosa | - | 67 | 5 | *134* | *17* |
| v22 | Dennying | | | | | |
| v23 | Moonah | -- | 850 | 50 | *880* | *52* |
| v24 | Kiata | | | | | |
| v25 | LDL Sanctuary | | | | | |
| v26 | Hattah Tracks | | 87 | 9 | | |
| v27 | O'Brees | | 134 | 5 | | |
| v28 | Nurcoung | | 150 | 14 | | |
| v29 | Wedderburn | + | 34 | 4 | *34* | *3* |
| v30 | Hattah South | -- | 26 | 3 | *37* | *5* |
| v31 | Skinners Flat | | 24 | 2 | | |
| v32 | Wychitella | + | 12 | 4 | *67* | *5* |
| v33 | Korong Vale | | 11 | 2 | | |
| v34 | Paradise | +++ | 334 | 29 | *1589* | *53* |
| v35 | Broken Bucket | - | 48 | 6 | *60* | *6* |
| v36 | Boughtons WH | | 5 | 2 | | |
| v37 | Wisemans | | 104 | 9 | | |
| v38 | Tooan | | 9 | 2 | | |
| v39 | Oldfields | | | | | |
| v41 | Mali Dunes | - | 44 | 8 | *36* | *6* |
| v42 | Cooack | | 76 | 6 | | |
| V44 | Neil Macfarlane | | 173 | 18 | | |
| | | | 5180 | 386 | *4248* | *246* |

## 6. Participation and in-kind contribution

From the number of mounds monitored, we estimate that the VMRG totalled about 1,226 monitoring hours in the field, 770 hours driving to and from monitoring sites (including passenger time) and about 400 hours in support activities (i.e., preparing data and equipment, posting equipment, uploading and managing data on the NMMD, installing, checking and downloading camera traps and processing photos, attending committee meetings, and reporting back meetings). Thus, we estimate a total of about 2,396 hours contributed by VMRG in 2021. While the VMRG donated their time voluntarily, the replacement value for this work is $137,900 (estimated using pay rate for grade 1 research assistant @$54.72/hour; this is a low rate compared to what consultants may charge).

In addition, VMRG members travelled a total of over 39,000 kilometres over the year getting to and from monitoring sites and meetings, adding at least another $25,350 to the replacement value of VMRG activities (vehicle expenses calculated at $0.65/km).

Thus, we conservatively estimate the replacement value of the VMRG activities in 2021/22 to be about $156,470.

## 7. Concluding comments

The VMRG collects excellent data and makes a critically important contribution to malleefowl conservation. The information collected makes it possible to assess trends in malleefowl populations and measure the effectiveness of management interventions. The impressive scale and on-going nature of the monitoring program would make it exceedingly difficult and expensive to achieve without the dedicated and diligent efforts of the voluntary VMRG workforce. Indeed, in the past year alone the replacement value of the work undertaken by the VMRG was estimated as $156,470.

Without question, the VMRG has also led the way in malleefowl monitoring and conservation, and the efficiency and accuracy of the works collectively undertaken, and the efforts contributed by so many individuals, are a credit to the VMRG volunteers and an inspiration to other citizen science groups.

This season, breeding numbers were lower than last season despite apparently good winter rains throughout western and central Victoria. Both 2020 and 2021 were La Nina years and higher malleefowl numbers were hoped for. Fox numbers, as indicated by the number of mounds with fox scats, and the dry weight of scats collected, was low compared with previous seasons. We have not yet analysed the camera-trap photos collected in 2021 (see below) but it will be interesting to see if the lower fox scat index is confirmed by the camera-trap data.

The data collected by the VMRG will be included in larger analyses of the conservation status of malleefowl across Australia. This information will help inform management decisions to improve the trajectory of malleefowl across their range.

- *Update on the motion-sensitive camera project*

In the Mallee CMA, the VMRG has 48 cameras traps that were installed with solar panels and sealed lead acid batteries in 2015/2016 at six sites in the Vic mallee (Wathe v03, Menzies v14, Wandown v15, Lowan v20, Dumosa v21, and Paradise v34). These camera-traps have done great service over the years, but more are failing as they age and require increasing maintenance, particularly the power supply. We now also have 10 solar powered cameras installed in 2019 at v07 Annuello as part of the AMPE project, and more recently at v44 Neil MacFarlane site (see below).

In addition, there are 10 camera-traps installed at each of 4 monitoring sites in the Wimmera in and near the Little Desert, although these were installed by PV and are managed by Wimmera CMA and the NMRG as part of the AMPE project.

Cameras provide invaluable insights into the trends in various animals that might affect malleefowl numbers such as foxes, cats, goats, pigs, rabbits and kangaroos. As I outlined at last years reporting back meeting, the results from the camera-traps have been transformative in terms of understanding the abundance and likely effects of these animals on malleefowl. For example, we while sites with stable malleefowl populations often have high numbers of foxes, there is some evidence that high numbers of herbivores may be detrimental. Camera-traps provide us with information that could otherwise not be obtained.

In the Mallee CMA, Mick Webster and Tony Murnane have done terrific job of keeping the camera-traps operating despite the mounting failures. To do this, they visited cameras with failed solar panels every 6 months to replace internal AA batteries and keep them going, replace failed cameras, undertake repairs, and retrieve the memory cards. The VMRG, the AMPE project, and malleefowl conservation in general have benefitted enormously from their dedicated effort over the past few years. However, <u>they require help and are looking for assistance from interested people to keep the program going</u>.

To lessen the requirement for 6 monthly visits to camera-traps, Graeme Tonkin, through the NMRG, has designed a D cell battery pack for the cameras that will require only annual visits to replace the batteries and swap the memory cards. The D cell battery packs are also much easier to maintain than the solar system and we will be rolling them out this year.

Last year I announced that we intended to send out photos again, but that did not happen so apologies for the let-down! The reason was there turned out to be an unusually large number of photos (Figure 12xx), largely due to Mick and Tony's efforts to repair and maintain camera-traps, and the new camera-trap sites at Annuello where the new model cameras take lots of null photos! Also, our experience with Microsoft Megadetector showed that we can reduce the number of nulls by about 80% without losing information on animals. It seemed absurd to needlessly send out large numbers of photos to volunteers when through Megadetector we could reduce the workload by 80%! However, there have been some teething problems and other delays as we have been testing the Megadetector software.

We are once again expecting to send out photos for sorting this winter but only about 20% of the unsorted numbers that are represented in Figure 12 once we run them through Megadetector.

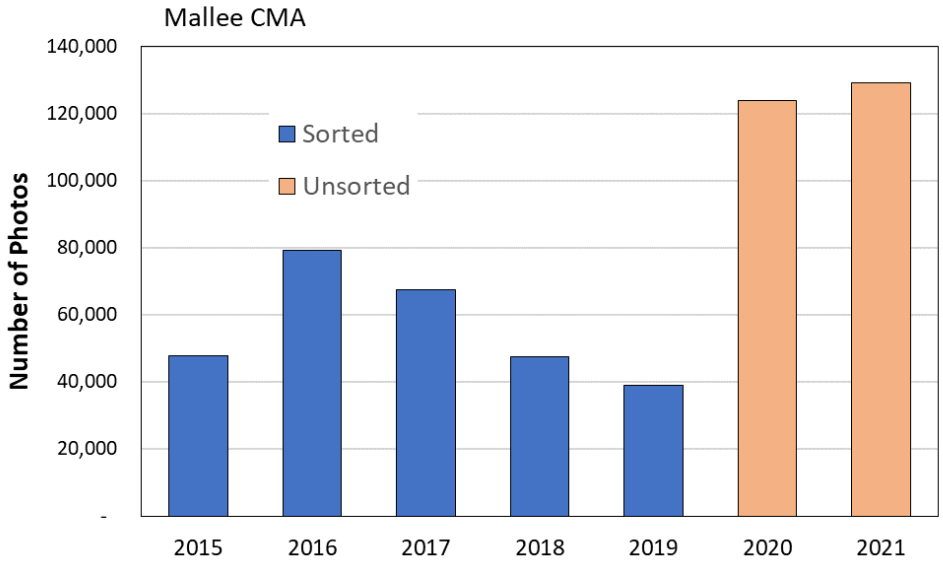



**Figure 12.** Number of photos collected at camera-traps in the Mallee CMA since their introduction in 2015.

- *v44 Neil Macfarlane site in Annuello*

The new site in the eastern section of Annuello that was established last year has been named V44 Neil Macfarlane in honour of one of the VMRG's founders and staunchest supporters. V44 is unbaited and is now part of the AMPE cluster that includes v07 Annuello and v15 Wandown.

The Mallee CMA funded the purchase of 10 camera-traps for this site and the national team installed them in late May 2021. These cameras are powered by 4 D-

cell batteries enclosed in a case made of PVC pipe (designed by Graeme Tonkin) and the D cells only need to be replaced annually; the cameras also have AA batteries as backup within the camera itself (usually these do not need to be replaced every year). We chose to use replaceable batteries to minimise maintenance and for ease of use. At other sites, while the solar panels and dry-cell batteries have done great service, most of these power sources have now failed and the cameras are now running on AA batteries that need to be replaced every 6 months (see above).

- *AMPE (Adaptive management predator experiment)*

In Victoria, we have 2 AMPE clusters, one in the North east (Annuello/Wandown) and the other in the Little Desert area incorporating Cooack, Nurcoung and Tooan; there are several other clusters in WA, SA and NSW. In each cluster, there are one or more treatment sites that are baited for foxes, and untreated control sites that are not baited. The project was set up in collaboration with scientists at University of Melbourne and the National Malleefowl Recovery Group (NMRG), with funding from National Environmental Science Program (a federal initiative).

Unfortunately, our University of Melbourne colleagues lost their NESP funding last year. Nonetheless, the NMRG remains committed to the project and is being supported by the Australian Government Department of Agriculture, Water and Environment (DAWE). The project has at least another year to run before results are obtained (at least 4 years is required to see malleefowl chicks recruited to the breeding population) and the NMRG is pursuing funds to undertake an appropriate analysis.

## 8. Acknowledgements

This report draws on the labours of many dedicated volunteers who undertake the monitoring every year. Organising this depends on the behind-the-scenes efforts of Greg Davis, John Fraser, Paul Leigh of the VMRG, and Graeme Tonkin from the NMRG, who prepare the equipment each year, distribute it to volunteers, process and upload the data to the national database, and then spend hours checking and validating it. It's a logistically difficult job, done very well. Mick Webster and Antony Murnane have also done a fabulous job repairing and maintaining camera-traps and downloading the photos. Robyn Rattray-Wood and John Fraser weighed the fox scats without complaining. It is a pleasure to report on important data that is collected so diligently.

# Appendix 1. 2021/22 Mound Inspection Report for All Victorian Sites

**Mounds that will be included in future annual lists.**

| | Sites | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sought and found | 1243 | 47 | 47 | 71 | 90 | 15 | 47 | 17 | 16 | | 16 | 26 | 39 | 16 | 99 | 45 | 27 | 25 | 19 | 50 | 33 | 8 | 66 | 9 | 7 | 30 | 17 | 27 | 10 | 6 | 10 | 10 | 7 | 67 | 10 | 14 | 46 | 25 | 9 | | 14 | 28 | 13 | 66 |
| New | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| Sought, NOT found | 2 | | | | 0 | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | |
| NOT sought or found | 23 | 1 | | 1 | | | 8 | | | | | | | 3 | 1 | | | | | | | 2 | | | | | | | | | | 1 | | | | | | | 4 | | | 2 | |
| Total | 1271 | 48 | 47 | 72 | 90 | 15 | 55 | 17 | 16 | | 16 | 26 | 39 | 19 | 100 | 45 | 27 | 25 | 19 | 50 | 33 | 10 | 66 | 9 | 8 | 30 | 17 | 27 | 10 | 6 | 10 | 11 | 7 | 67 | 10 | 14 | 46 | 25 | 9 | 4 | 14 | 28 | 15 | 69 |

**Previously Marked Mounds that will be checked every 5th year.**

| | Sites | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sought and found | 128 | 1 | 9 | 12 | 19 | | 8 | 2 | | 1 | | | | 6 | 14 | 1 | 3 | 4 | | | 5 | | 5 | | | 2 | 3 | | | 4 | | | | 17 | | | 6 | 7 | | | | | | |
| New | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sought, NOT found | 1 | | | | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NOT sought or found | 153 | 29 | 1 | 20 | 1 | 1 | 2 | | | 3 | 2 | 3 | | 5 | 7 | | 2 | | 4 | 13 | 1 | 8 | 1 | 8 | 1 | | | 6 | 2 | | 9 | 8 | 3 | | 2 | 1 | 3 | 1 | 1 | 1 | | 3 | 1 | |
| Total | 282 | 30 | 10 | 32 | 20 | 1 | 10 | 2 | | 4 | 2 | 3 | | 11 | 21 | 1 | 5 | 4 | 4 | 13 | 6 | 8 | 6 | 8 | 1 | 2 | 3 | 6 | 2 | 4 | 9 | 8 | 3 | 17 | 2 | 1 | 9 | 8 | 1 | 1 | | 3 | 1 | |

**Newly Marked Mounds that will be checked every 5th year.**

| | Sites | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sought and found | 11 | | | | | | 6 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | 3 | | 1 | | | | | | | |
| New | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sought, NOT found | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NOT sought or found | 5 | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 1 | | | 1 | 1 | |
| Total | 16 | | | 1 | | | 6 | | | | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | 3 | | 1 | | | 1 | | | 1 | 1 | |

**Mounds that will be omitted from annual lists (erroneous records, and mounds well outside grid boundaries).**

| | Sites | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sought and found | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| New | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sought, NOT found | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NOT sought or found | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grand Total | 1569 | 78 | 57 | 105 | 110 | 16 | 71 | 19 | 16 | 4 | 18 | 29 | 39 | 30 | 121 | 46 | 32 | 29 | 23 | 63 | 40 | 18 | 72 | 18 | 9 | 32 | 20 | 33 | 12 | 10 | 19 | 19 | 10 | 87 | 12 | 16 | 55 | 33 | 11 | 5 | 14 | 32 | 17 | 69 |

## Appendix 2. Map showing monitoring sites in Victoria

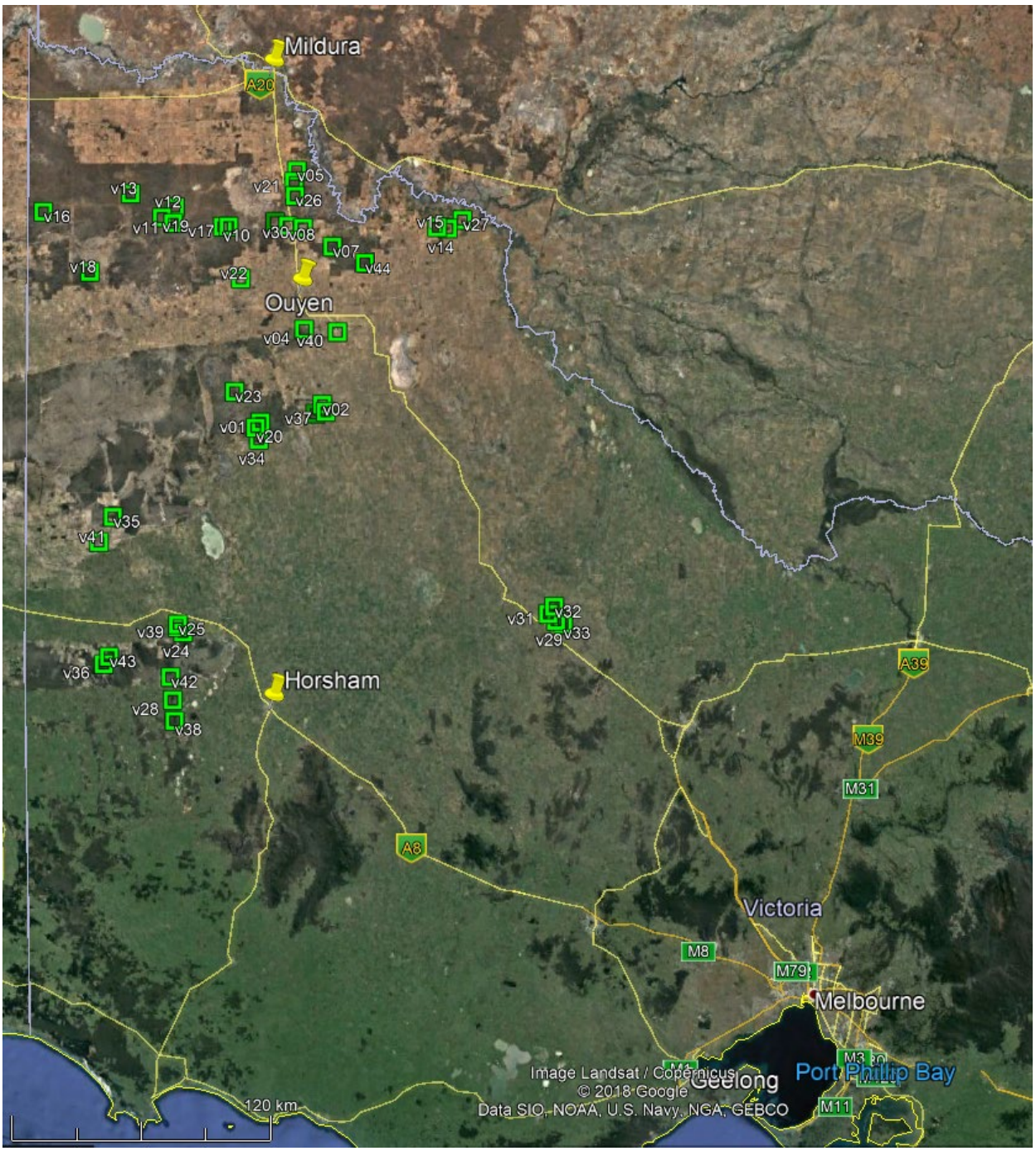



**Figure 9.** Location of the 43 malleefowl monitoring sites in Victoria managed by the VMRG (green squares). Over 1300 mounds are monitored each year over a total area of about 170 km2. Image from Google Earth.

## Appendix 3. Why we weight the trend statistics

In 2020, I introduced a better way of depicting trends in malleefowl breeding numbers. This involved calculating the annual deviations from the long-term average number of active mounds at each site. So, if a site had a long-term average of 10 active mounds, and in a particular year it had 11 active, this would be represented as a +10% trend value for that site in that year. To estimate trends across multiple sites in a region, we averaged these trend values for all the sites and show the degree of variation in these values by displaying a statistic called the standard error.

Since 2020, I have weighted the statistics so that the trend graphs represent the data and trends better.

To understand the improvement, consider 2 sites not far apart. Site A has 10 active mounds, as it always does, and site B has 2 as usual. Now consider what happens if a pair from site B moves over to site A, so B decreases from 2 to 1 and A increases from 10 to 11. There is no change overall, just a shift from one site to the other. When we calculate the trends, malleefowl have declined by 50% at B (-1/2= -0.50) and increased by 10% at A (+1/10= +0.10). If we average these values to estimate the general trend, we arrive at a decline of 20% (average of -50% and +10%). Yet overall, we know that there has, in fact, been no change. The problem here is that when we take an average of the trends, the small sample at B is given the same weight as the big sample at A.

The way to overcome this bias is to weight the statistics so that, for example, a site with an average of 10 active mounds is 10 times as important as a site with an average of only 1 active mound. To do this, we weight the trends according to the long-term average breeding numbers at the site. So, in the A and B example, the weighted average becomes 10 x 0.1 plus 2 x -0.5, divided by the sum of the weights: the overall weighted trend is zero, as it should be as there has been no net change in breeding numbers.

By introducing weighted statistics, the influence of sites to the overall trend is in proportion to the abundance of breeding malleefowl at those sites. This makes sense if we are interested in the overall trends of populations and leads to more accurate representation of trends and less fluctuation from year to year.