Malleefowl Monitoring in Victoria: 2022/23

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! The VMRG visited 1412 malleefowl mounds during the 2022 breeding season (Table 1) including 2newly listed mounds. Only 15 regular mounds were neither sought nor found during the season and these were scattered through 6 sites, although most (8 mounds) these occurred at including at Annuello v07 possibly due to monitors using old maps or GPS data. Only 2 regular mounds were searched for but not found. Overall, the VMRG managed to find over 99% of the mounds that we set out to monitor, another outstanding result as usual for the VMRG.

Table 1. Performance of the monitoring effort in 2022 season. '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. More detail is shown in Appendix A.1.

	Total	*Regular*	*Optional old*	*Optional new*	*Omitted*
<u>Monitored</u>					
Sought and found	1410	1261	138	9	2
New survey	0	0	NA	0	NA
New incidental	2	2	NA	0	NA
<u>Not monitored</u>					
Sought, NOT found	4	2	2	0	0
NOT sought or found	182	15	160	7	0
Total	1598	1280	300	16	2

Last season (2021), 9 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 316, or 20% of the mounds registered for monitoring.

5-year mounds are scheduled for mandatory monitoring every 5 years and are optional in intervening years. 2022 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, a similar effort to last season. 5-year mounds will be optional again next season, with the next mandatory monitoring of 5-year mounds in 2025.

Greg Davis, Paul Leigh, and John Fraser once again did a fantastic job setting up, posting out and receiving equipment, and then uploading and validating the data, with minimal assistance from Graeme and I at the national team. This is a considerable logistic challenge that requires lots of time and dedication and makes a substantial contribution to the VMRG and our efforts to monitor and conserve malleefowl.

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

Of the mounds that were monitored in Victoria, 209 were active in 2022 compared with 136 last season and 149 in the season before that (2020). This is only a little lower than the highest number of active mounds ever recorded in Victoria which occurred 2012/13.

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 1.5% across several decades. However, in 2022 average breeding trend increased to 18% above the long-term average (LTA) which is the highest value recorded for a decade.

The 3 regions within the Mallee CMA that we traditionally examine in the monitoring report show divergent trends. In the Eastern Big Desert (Figure 2), there has been a long-term decline in breeding numbers of about 3% per year. In 2022, breeding numbers bounced back but were still 15% below the LTA for this sample of 15 sites and site parts. The burning of Bronzewing in 2014 caused a large decline in malleefowl and is largely responsible for the current breeding numbers being below the LTA, although even at the Bronzewing sites breeding numbers were higher than they have been for the past 5 years (a few malleefowl still breed in small unburnt patches). Apart from Bronzewing, several long-term sites in the Eastern Big Desert showed welcome increases in breeding numbers (particularly v01 Dattuck, v02 Torpeys, v03 Wathe SW, v20 Lowan). On the other hand, breeding numbers at v23 Moonah and v34 Paradise were similar to, or slightly below, their respective long-term averages.

In the North-west (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 (2099-2012). Similarly in 2022, following the last three years of La Nina above average rainfall, the breeding index shows a strong response almost as spectacular as that which occurred in 2012 with numbers more than doubling compared with averages over the previous decade. The long-term trend for the North-west sites is slightly positive.

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 2022, the average trend values were on par with the LTA.

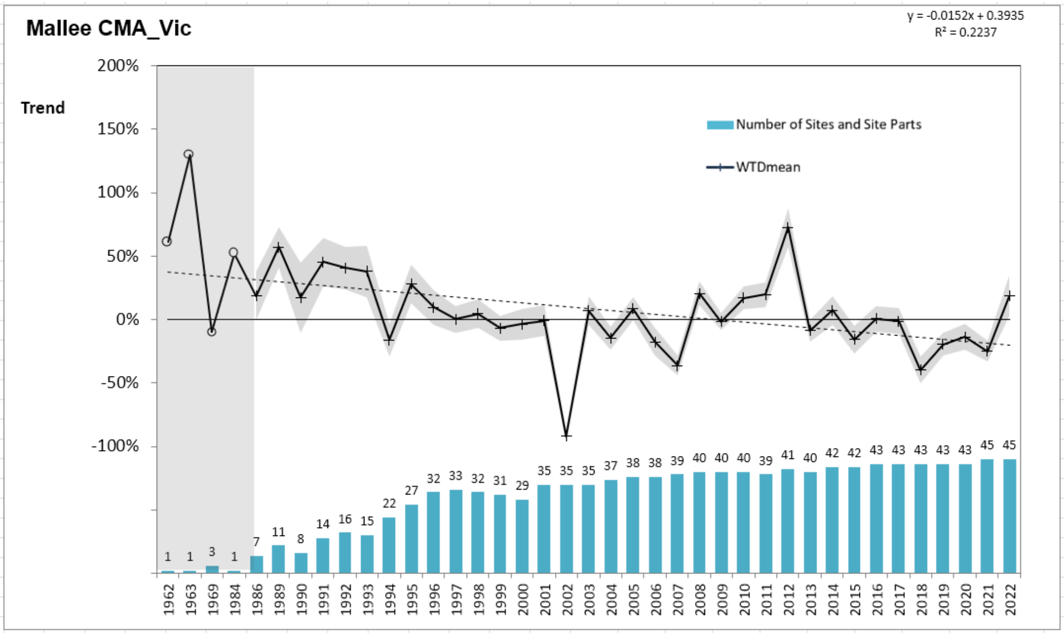
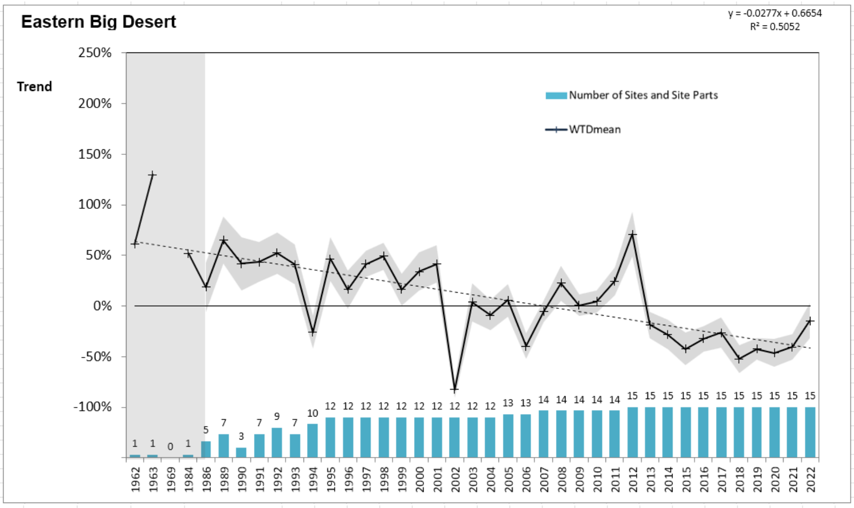
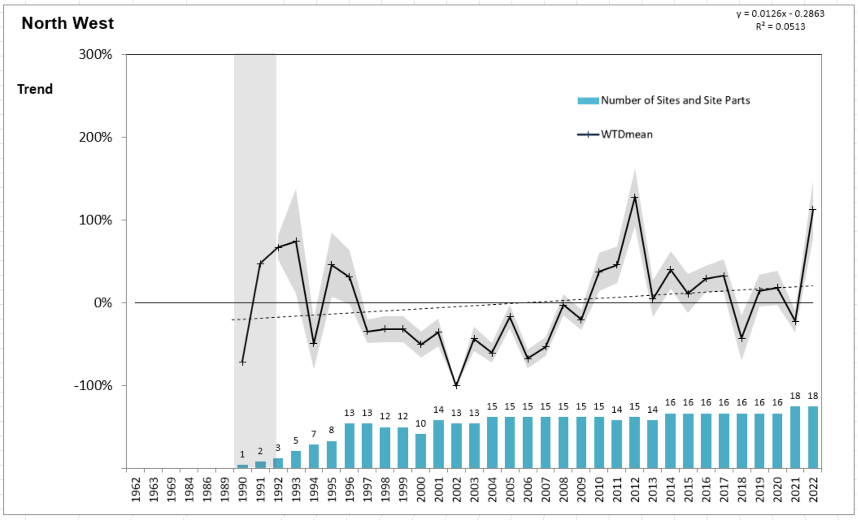
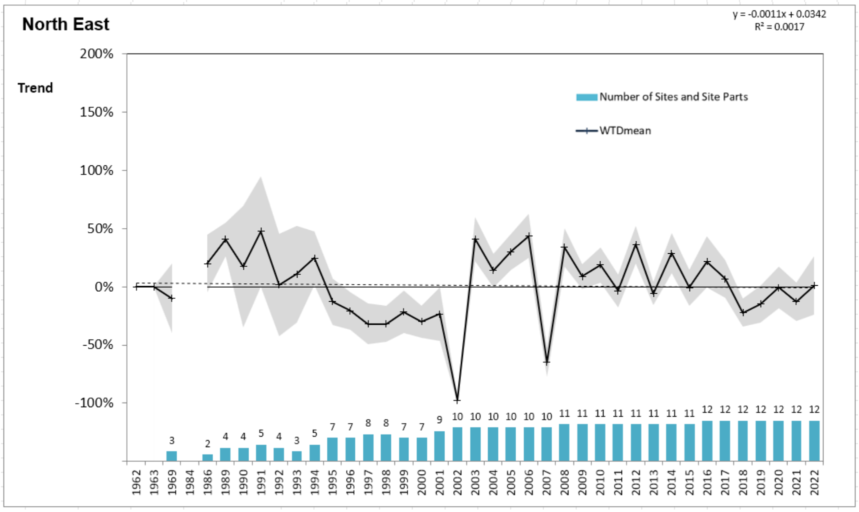


Figure 1. Trends in malleefowl breeding numbers at 45 sites and site parts represented by 39 monitoring seasons spanning 60 years (including historical survey data from some sites in the 1960s). Each point (cross) shows the degree to which breeding numbers were above or below the long-term average (LTA) for the sites monitored (trend). Shading indicates the standard error about the mean where multiple sites were monitored in a season; shading is extended where too few sites were monitored to reliably estimate the standard error. The number of sites monitored in a breeding season is shown by the histogram. The dashed line indicates a simple linear trend.



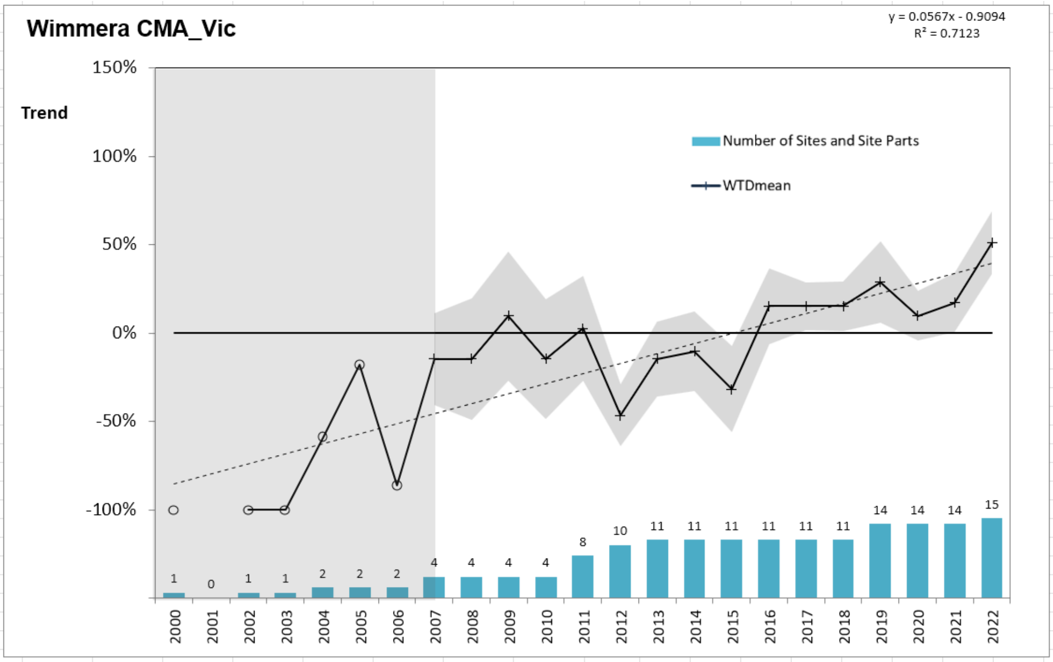




Figures 2, 3 and 4. Trends in malleefowl breeding numbers in the Eastern big Desert (top), North-west (middle) and North-east (bottom) sub-regions of the Mallee CMA to 2022 (see Figure 1).

Wimmera CMA

In the Wimmera, malleefowl breeding numbers in the 2022 season were the highest recorded and 50% higher than the LTA; the trend has been strongly positive since monitoring started in the early 2000s, and especially 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, although few sites were monitored at the time and the trend values are consequently not robust. Nonetheless, 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.

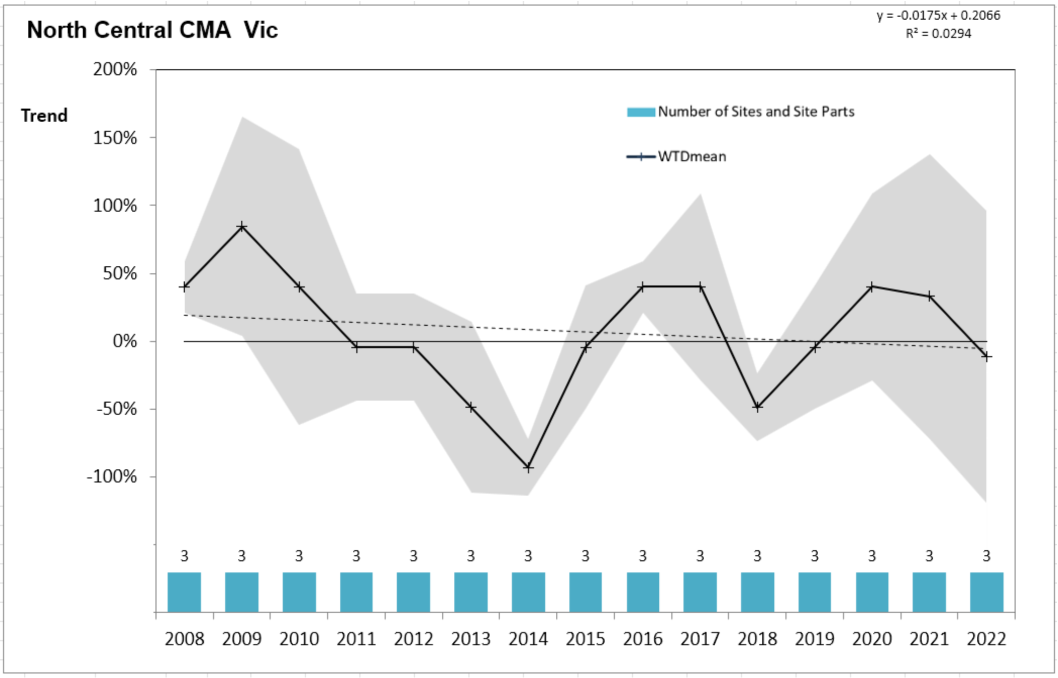


Figures 5. Trends in malleefowl breeding numbers in the Wimmera CMA to 2022 (see Figure 1).

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 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. In 2022 there were only 2 active mounds recorded.

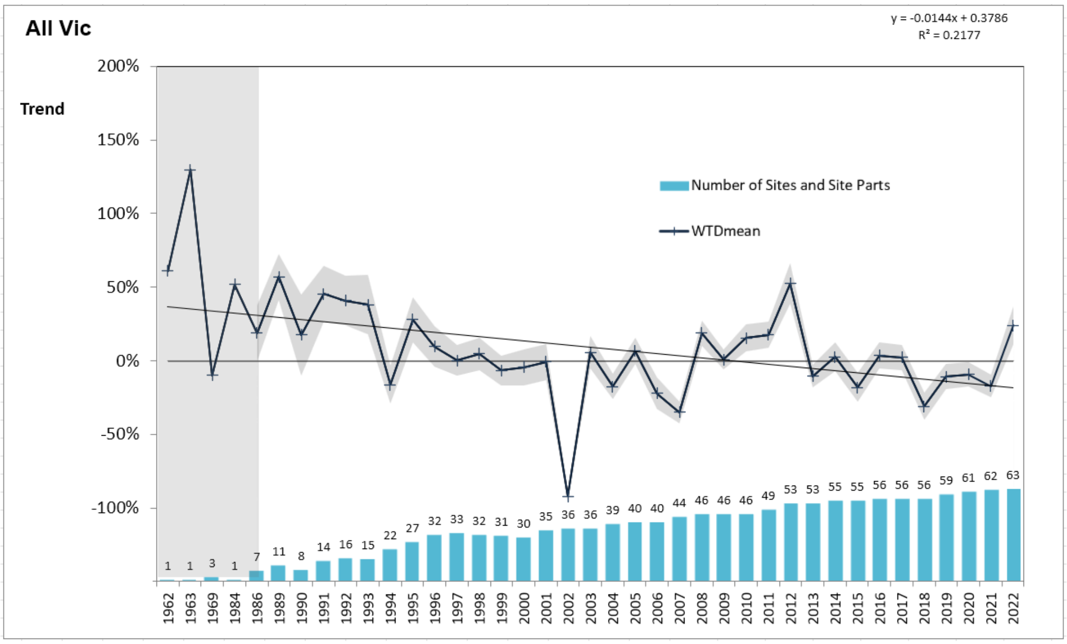
Despite efforts by the VMRG and others to locate mounds in the Wychitella reserves, we have a poor understanding of the number of malleefowl inhabiting the area. This is due largely to the difficulty in searching the area as the vegetation is often very difficult to walk through where malleefowl occur. By monitoring the VMRG has established that there are at least 2-3 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 32,672 mound visits resulting in 3,795 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. However, in 2022 the breeding trend index was 24% above the LTA, representing the highest value for a decade. 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, might 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 2022

Indicative rainfall charts for Victorian malleefowl areas are shown in Figure 8.

2022 was characterised by much wetter than usual autumn and spring conditions, and average rains over winter, although July was relatively dry. Wet autumn-winters probably suit malleefowl as it promotes herbaceous food, as well as providing moisture for their incubator mounds. While the wet spring in 2022 is unlikely to have affected breeding numbers (mounds are usually completed by September), the La Nina conditions over the past three years would have increased food supplies and increased both the condition of adults and the recruitment of young.

We hope to perform a detailed analysis of the monitoring data in relation to rainfall data and other variables (as we did a few years ago) in 2025 to better understand the effects of environmental and variables and management actions.

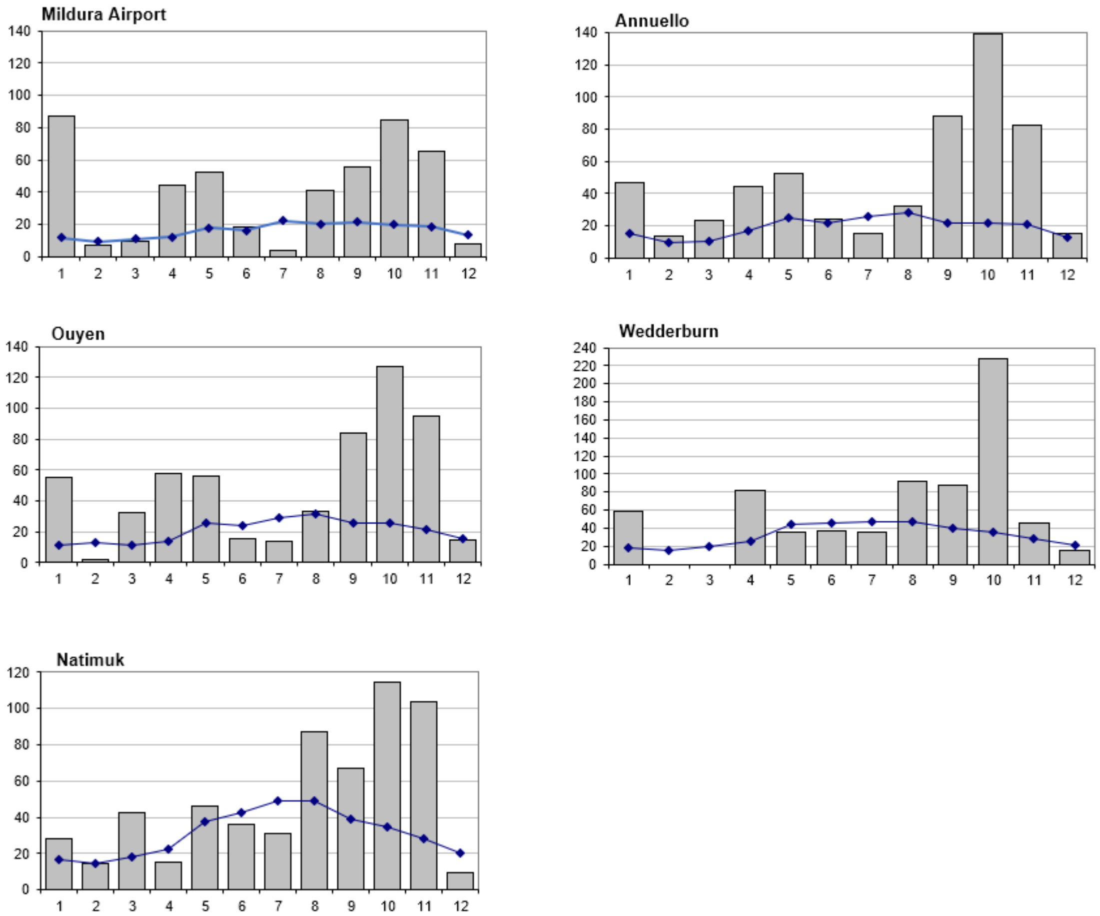


Figure 8. Rainfall at Mildura, Ouyen, Natimuk, Annuello and Wedderburn in 2022 (bars) and median rainfall since early 1900s (line). Data from the Bureau of Meteorology website.

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 2022 (Figure 9) with less than 2% of mounds monitored in Victoria showing lerp when mounds were monitored (mostly October-December 2022). Lerp abundance was also very low in each region (Figure 10).

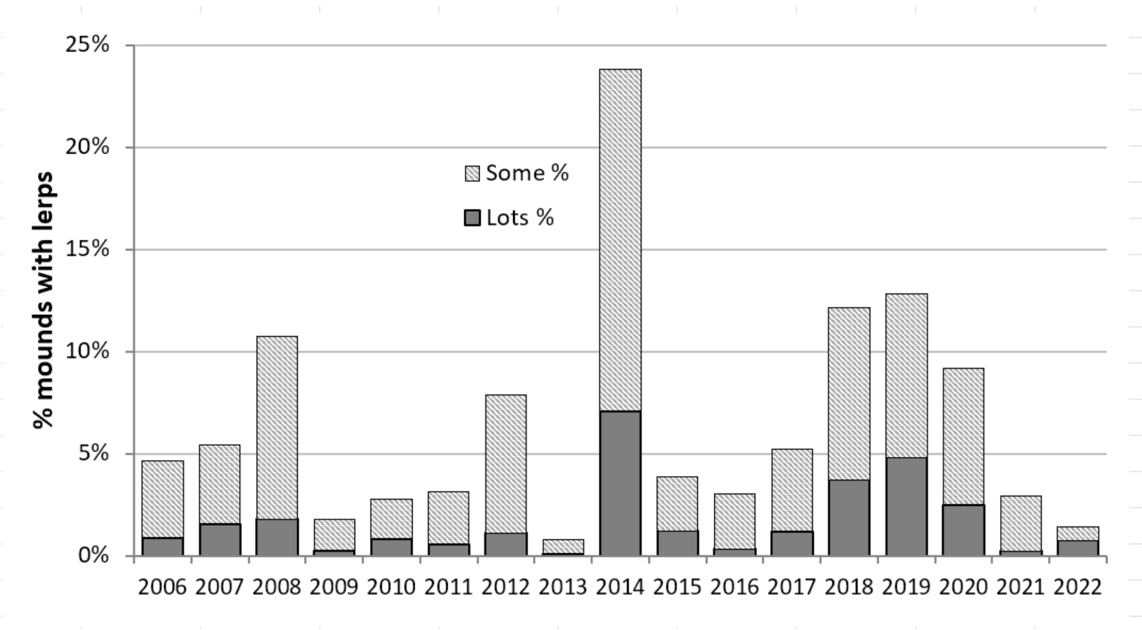


Figure 9. Proportion of mounds on which lerp were detected in each season since 2006.

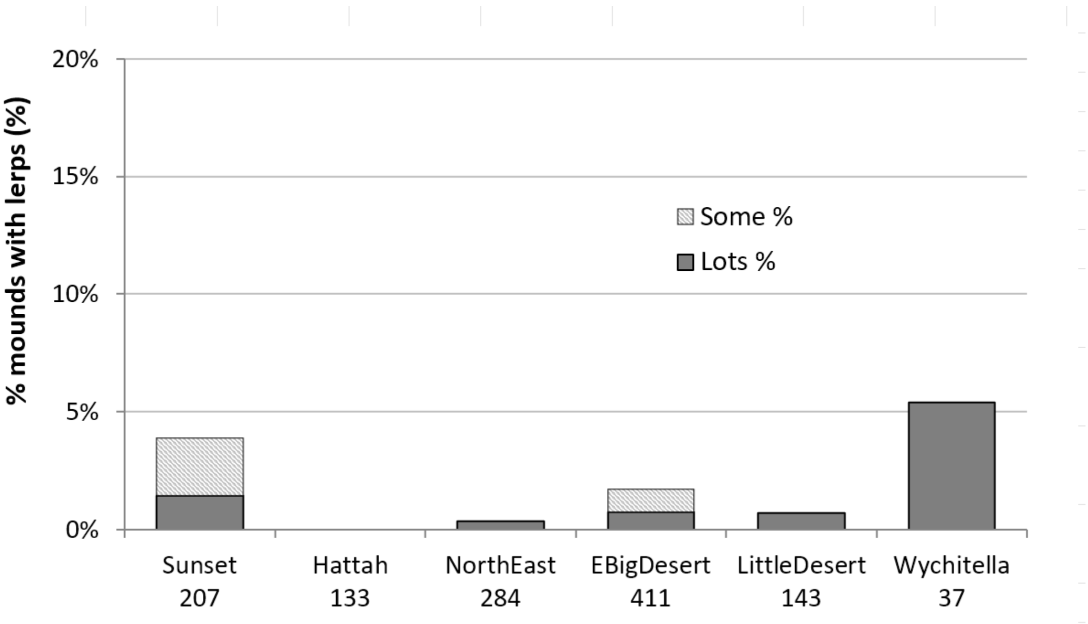


Figure 10. Regional breakdown of lerp occurrence on mounds in the 2022 season. The number of mounds inspected is indicated under the region.

5. Fox scats

Data at hand while compiling this report suggested that fox scats were collected from 21 sites in 2022, totalling 3.8 kg of scats collected from 267 mounds (Table 2).

In a change from previous reports, the trends in fox abundance is shown as the proportion of mounds on which fox scats were recorded each year from the monitoring data (Figure 11) rather than the average weight of fox scats collected. 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, the proportion of mounds with fox scats fluctuated and appears to have declined steadily since 2018. In 2022, the proportion of mounds with fox scats declined to 20%, the lowest value we have recorded.

The fox scat weight data at hand shows similar trends as the proportion of mounds with scats with about a 25% decline since last season of a site-site comparison. The reasons for the decline in fox scats on mounds is unclear and does not seem clearly related to environmental or management factors. One possibility is that the wet conditions over the past 3 La Nina years has simply degraded scats on mounds faster than is usual. The camera-trap data may shed further light on whether the fox activity has in fact recently declined by using a different means of assessment.

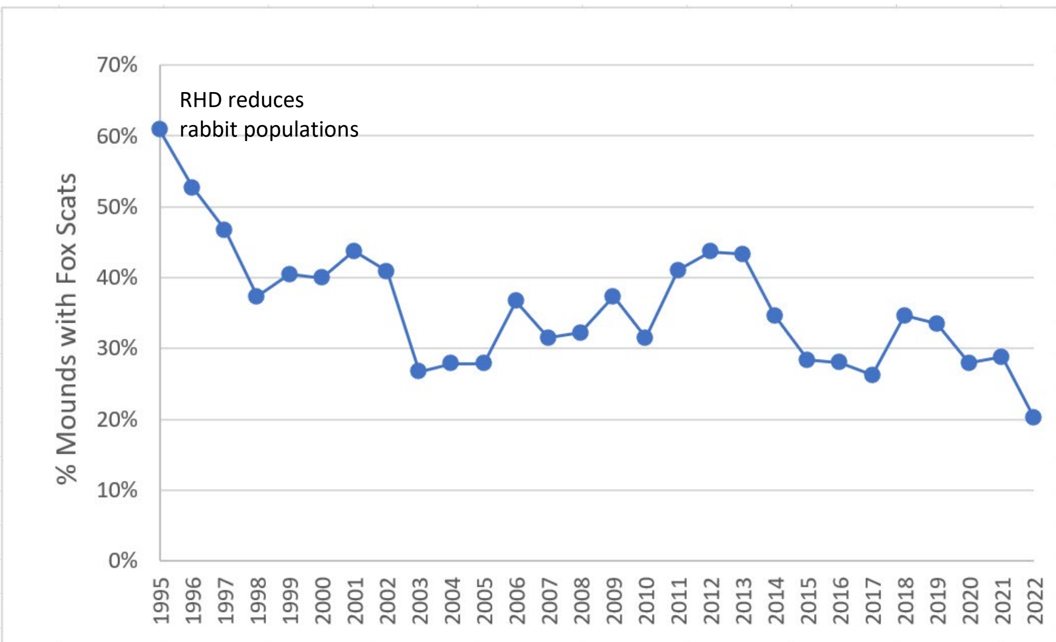


Figure 11. Trends in the proportion of mounds on which fox scats were recorded since 1996 from mound monitoring records.

Table 2. The total weight of fox scats, the number of mounds at which fox scats were collected (incomplete) for both 2022 and the previous year (italics). Malleefowl scats and feathers were also collected but are not tabulated here.

Grid	Name		2022 Wt (g)	2022 Count	*2021 Wt (g)*	*2021 Count*
v01	Dattuck	-	29	5	*69*	*12*
v02	Torpeys	-	54	5	*115*	*11*
v03	Wathe SW	-	220	14	*571*	*29*
v04	Bronzewing		269	24	*397*	*33*
v05	Stokies	+	39	3	*16*	*3*
v07	Annuello	-	21	3	*124*	*9*
v08	Powerline		35	4	*41*	*4*
v09	Mt Hattah		42	4	*91*	*4*
v11	Mopoke		6	1	*69*	*8*
v12	Pheeneys		28	1	*23*	*1*
v13	Bambill	-	137	14	*284*	*14*
v14	Menzies	-	64	6	*194*	*8*
v15	Wandown	-	169	15	*501*	*26*
v16	South Bore		236	15	*219*	*22*
v17	OneTreePlain					
v18	WashingMachine		93	5	*95*	*8*
v19	Underbool		8	1	*44*	*6*
v20	Lowan	-	92	5	*139*	*10*
v21	Dumosa		98	10	*67*	*5*
v22	Dennying		7	1		
v23	Moonah		572	43	*850*	*50*
v24	Kiata					
v25	LDL Sanctuary					
v26	Hattah Tracks	+	100	5	*87*	*9*
v27	O'Brees		39	6	*134*	*5*
v28	Nurcoung	-	44	4	*150*	*14*
v29	Wedderburn		10	1	*34*	*4*
v30	Hattah South		36	3	*26*	*3*
v31	Skinners Flat				*24*	*2*
v32	Wychitella		5	1	*12*	*4*
v33	Korong Vale		52	2	*11*	*2*
v34	Paradise	+	760	34	*334*	*29*
v35	Broken Bucket	-	5	1	*48*	*6*
v36	Boughtons WH				*5*	*2*
v37	Wisemans	-	40	3	*104*	*9*
v38	Tooan	+	44	1	*9*	*2*
v39	Oldfields					
v41	Mali Dunes	+	65	3	*44*	*8*
v42	Cooack	+	163	5	*76*	*6*
v44	Neil Macfarlane	+	208	17	*173*	*18*
v45	Cassinia Env.		20	2		
			3810	267	*5180*	*386*

6. Participation and in-kind contribution

From the number of mounds monitored, we estimate that the VMRG totalled about 1,249 monitoring hours in the field, 772 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, maintaining, checking and downloading camera traps and processing photos, attending committee meetings, and reporting back meetings). Thus, we estimate a total of about 2421hours contributed by VMRG in the 2022 season. While the VMRG donated their time voluntarily, the replacement value for this work is $132,477 (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 2022/23 to be about $157,830.

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 $157,830.

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 much higher than last season, likely in response the generally higher than usual rainfall throughout western and central Victoria during the past 3 consecutive La Nina years. While malleefowl breeding numbers last season were a disappointment, despite La Nina conditions, it is reassuring to see that a strong increase occurred this past season. 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. It will be interesting to see if the lower fox scat indices are corroborated 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*

There are over 100 camera-traps installed at 12 sites in Victoria that operate continuously through the year. most of these are involved in the AMPE project, but there are also 5 other monitoring sites with camera-traps (Wathe v03, Menzies v14, Wandown v15, Lowan v20, Dumosa v21, and Paradise v34). As explained in last season's report, we are progressively converting the power supply of the cameras from solar to disposable batteries to streamline maintenance and improve reliability.

Cameras provide invaluable insights into the trends in various animals that might affect malleefowl numbers such as foxes, cats, goats, pigs, rabbits, and kangaroos. The results from the camera-traps have been transformative in terms of understanding the abundance and likely effects of these animals on malleefowl. Camera-traps provide us with information that could otherwise not be obtained.

In the Mallee CMA, Mick Webster, Tony Murnane and Henry O'Connor have done terrific job of keeping the camera-traps operating and converting power supplies to our new D cell battery packs that will reduce the frequency of visits to replace the batteries and swap 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.

The national team is managing the photos and data from camera traps at AMPE and other monitoring sites. Many of you have already sorted photos following requests by Graeme Tonkin who is managing the project. Across Australia we have already collected over 2 million photos, and most of these have been sorted and the data collated and made available to Darren Southwell for analysis. Graeme's explorations with AI, particularly Microsoft's Megadetector, have been an outstanding success and enabled us to finally catch up with the flow of images. Megadetector enables us to reduce the number of nulls, and this sorting effort, by about 80% without losing information on animals.

The use of Megadetector also means that we will soon be able to include camera-trap results in annual reports.

- *v45 Cassinia Environmental site in Wimmera*

Cassinia Environmental established a new malleefowl monitoring sites in the Wimmera last year and began monitoring in 2022. The site is in a small (270 ha) and isolated remnant between the Western Hwy and the Big Desert and in 2022 contained 4 active mounds. Inbreeding, which can have devastating effects in reducing fitness of animals, is a major concern in such isolated remnants. The national team hoping to collaborate with Wimmera and North Central CMAs, and wildlife geneticists Professor Paul Sunnucks and Dr Alexandra Pavlova (Monash University), in developing a program to assess level of inbreeding at the Cassinia site and other small remnants (including Wychitella) and mitigating these effects by translocation where necessary.

- *AMPE (Adaptive management predator experiment)*

Dr Darren Southwell, previously of University of Melbourne and now at University of Newcastle, is currently performing an analysis of the AMPE data to date. In Victoria we have 2 AMPE clusters, one in the North-east (Annuello/Wandown) and the other in the Wimmera incorporating Cooack, Nurcoung and Tooan, and 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/or cats, and nearby untreated control sites that are not baited. Through careful comparisons of breeding numbers, camera-trapping and baiting levels across several seasons, we hope to understand if reducing predator abundance is advantageous to malleefowl populations (previous studies have not supported this hypothesis). The AMPE 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) and current support from the Australian Government Department of Agriculture, Water and Environment (DAWE; now Department of Climate Change, Energy, the Environment and Water (DCCEEW).

Darren’s analysis will be completed by June 2023. We remain hopeful that the results will be clear, but if this is not the case most of our partners are keen to see the experiment continue until a definitive result is obtained.

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, Tony Murnane and Henry O’Connor have also done a fabulous job again repairing and maintaining camera-traps and downloading the photos. Robyn Rattray-Wood, John Fraser and Paul Leigh weighed the fox scats without complaining. It is a pleasure to report on important data that is collected so diligently.

Appendix 1. 2022/23 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	45
Sought and found	1261	48	46	70	89	15	47	17	16		16	26	39	19	97	45	27	25	19	49	33	6	66	8	7	30	17	27	10	6	10	11	6	66	10	15	42	25	9		14	27	15	69	22
New	2		1																																						1				
Sought, NOT found	2																								1																				1
NOT sought or found	19						8								2							2				1							1	1											
Total	1284	48	47	70	89	15	55	17	16		16	26	39	19	99	45	27	25	19	49	33	8	66	8	8	31	17	27	10	6	10	11	7	67	10	15	42	25	9		15	27	15	69	23

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	45
Sought and found	138	1	10	15	17	1	8	2						9	14	1	1	1			6		5	1	1	2	3			4				18	2		9	6	1						
New																																													
Sought, NOT found	2			1																																			1						
NOT sought or found	156	29		17	2		8			4	2	3		2	7		4	3	4	13	1	8	1	8				6	2		9	8	3	1		2		2		5		4	2		
Total	296	30	10	33	19	1	16	2		4	2	3		11	21	1	5	4	4	13	7	8	6	9	1	2	3	6	2	4	9	8	3	19	2	2	9	8	2	5		4	2		

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	45
Sought and found	9			1	1		1															1												1			4								
New																																													
Sought, NOT found																																													
NOT sought or found	7			1											2					1		1		1																		1			
Total	16			2	1		1								2					1		2		1										1			4					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	45
Sought and found	2				1																													1											
New																																													
Sought, NOT found																																													
NOT sought or found																																													
Total	2				1																													1											

Grand Total	1598	78	57	105	110	16	72	19	16	4	18	29	39	30	122	46	32	29	23	63	40	18	72	18	9	33	20	33	12	10	19	19	10	88	12	17	55	33	11	5	15	32	17	69	23

Appendix 2. Map showing monitoring sites in Victoria

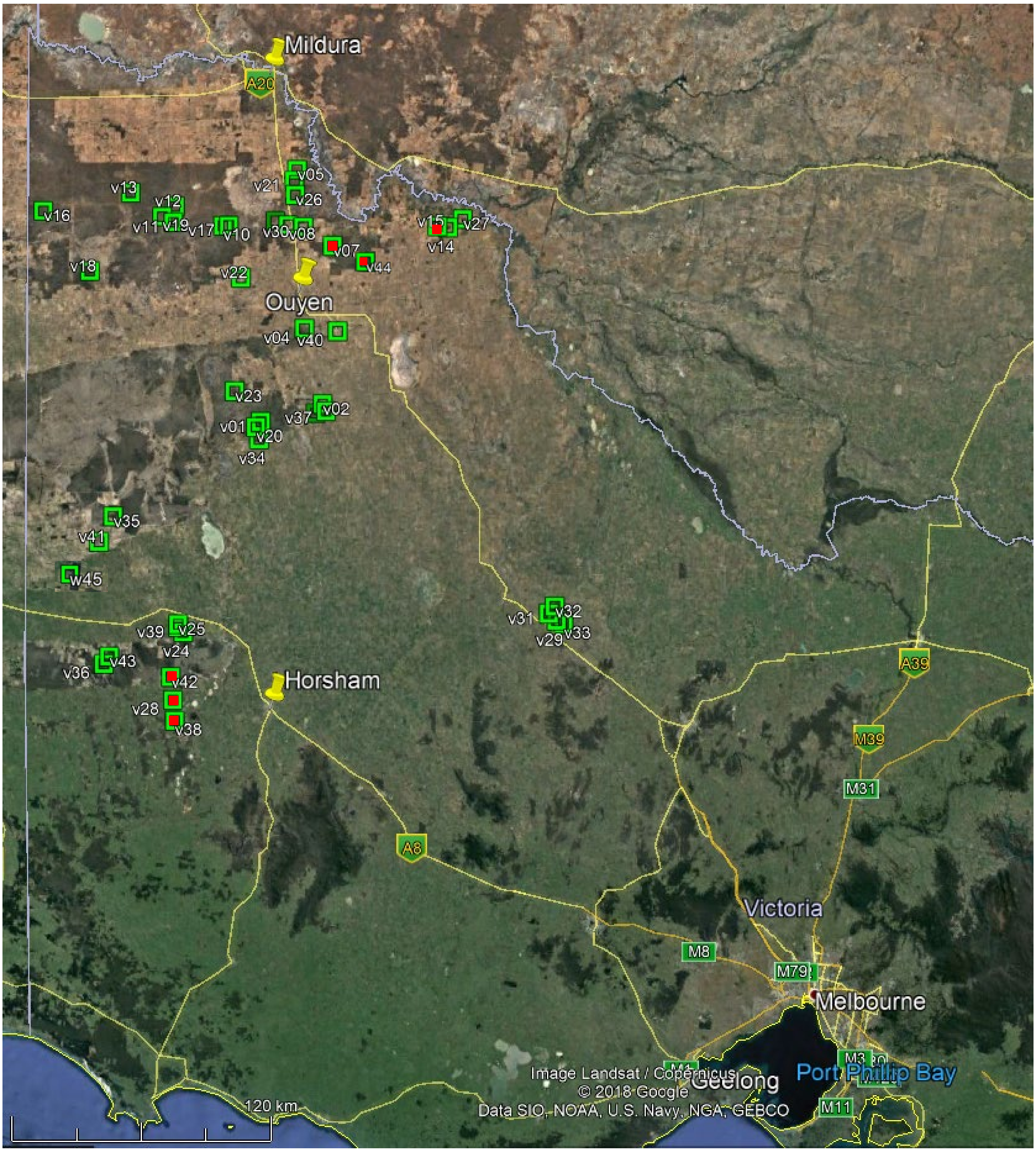


Figure 9. Location of the 44 malleefowl monitoring sites in Victoria in 2022 managed by the VMRG (green squares). Over 1300 mounds are monitored each year over a total area of about 172 km2. Vic APME sites are indicated as green squares infilled red. Image from Google Earth.

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.