Malleefowl Monitoring in Victoria: 2020/21

Report to the Victorian Malleefowl Recovery Group

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Contents

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 1518 malleefowl mounds during the 2020 breeding season (Table 1) including 76 newly listed mounds.

A total of 39 regular mounds were neither sought nor found during the season (Table 1) and these were scattered through 8 sites. There were also 2 regular mounds that were searched for but could not be found although they were found in previous years.

Overall, we managed to find 99% 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*
Sought and found	1451	1183	257	11	
New survey	67	67			
New incidental	9	9			
Sought, NOT found	4	2	2		
NOT sought or found	39	18	20	1	
Total	1570	1279	279	12	0

Last season (2019), 11 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 291, 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. 2020 was one of those mandatory years and the VMRG did a great job revisiting the 5yr mounds, inspecting 92% of these degraded mounds this season. 5-year mounds will be optional again next season, with the next mandatory monitoring of 5-year mounds in 2025.

Once again, Greg, Paul and John did a wonderful job sending out equipment and managing and checking the data, with minimal assistance from the national team.

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

Of the mounds that were monitored in Victoria in 2020, 149 were active compared with 133 last season (2019) and 100 in the season before that (2018; these totals include active mounds outside strict site boundaries). The higher number of active mounds in 2020 compared with 2019 was largely due to 15 active mounds being recorded at a new site, v44 (Annuello New), rather than increases at established sites. While it is welcome that breeding numbers across the state did not decline over the past year, it is worth noting that these numbers are much lower than the unusually high record of 218 active mounds set in 2012.

To assess the trends in each region more accurately, the following graphs display the number of active mounds in each region in terms of 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 calculated weighted averages of these trend values for all the sites; how reliable these averages are is also shown in the graph (the 'weighted standard error'). Thus, each graph shows a line depicting the average of all the trend values for the group of sites, and a shaded area about the average line showing the degree of uncertainty in that value (the average plus and minus the standard error). In general terms, the grey zones around each trend value indicate how much the individual sites varied in their response: smaller grey zones indicate that the sites trended similarly, whereas larger grey zones indicate that they differed quite a lot.

This approach uses virtually all the data collected in the past (29,873 mound visits resulting in 3,473 active breeding records!). We used a similar approach last season to depict trends except that last season we did not weight the statistics (for an explanation of why we weighted the statistics, see Appendix 3). By weighting the calculations (in regard to long-term averages) this season, we better represent the trends.

The charts 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 across several decades. Breeding numbers across the region were higher than in the previous two seasons, but nonetheless were 15% below the long-term averages (LTAs) for sites.

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), breeding numbers a long-term decline 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 two decades (particularly v01 Dattuck, v02 Torpeys, v03 Wathe SW, v20 Lowan). On the other hand, breeding numbers at v23 Moonah and v34 Paradise were on par or above 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. Consequently, the long term trend is slightly positive (Figure 4). 2020 numbers were in line with this trend and 23% higher than the LTA; this was welcome news as breeding numbers were down 40% in 2018.

In the North East (Annuello, Wandown, Menzies and O'Brees; Figure 4), the weighted trend suggests a stable populations over the past few decades, largely due to the stability of the large populations at Annuello and Wandown. In 2020, the average trend values were close to zero, indicating that breeding numbers were approximately on par with the past few decades.

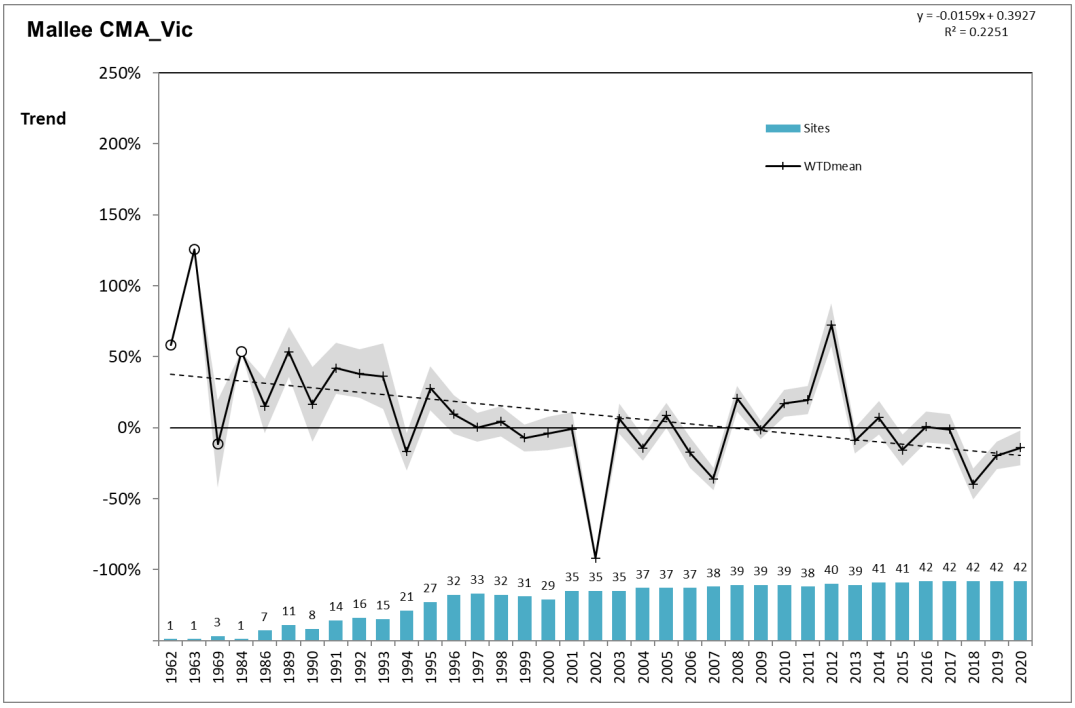
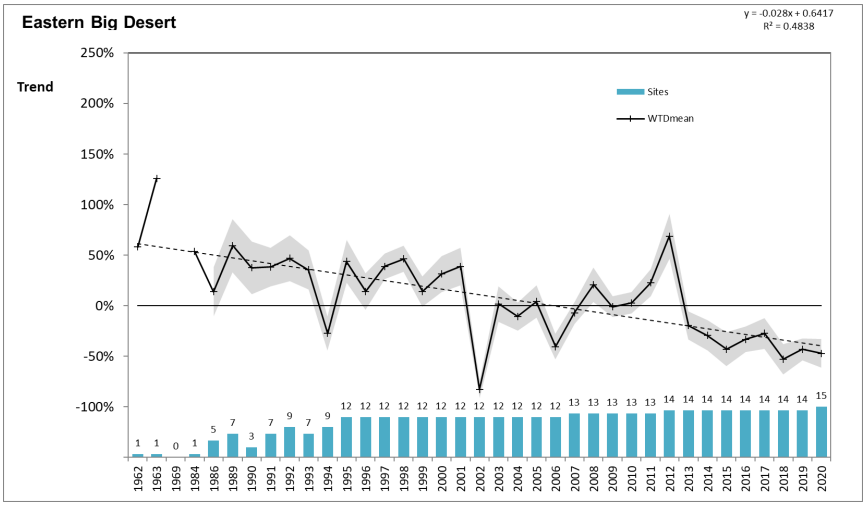
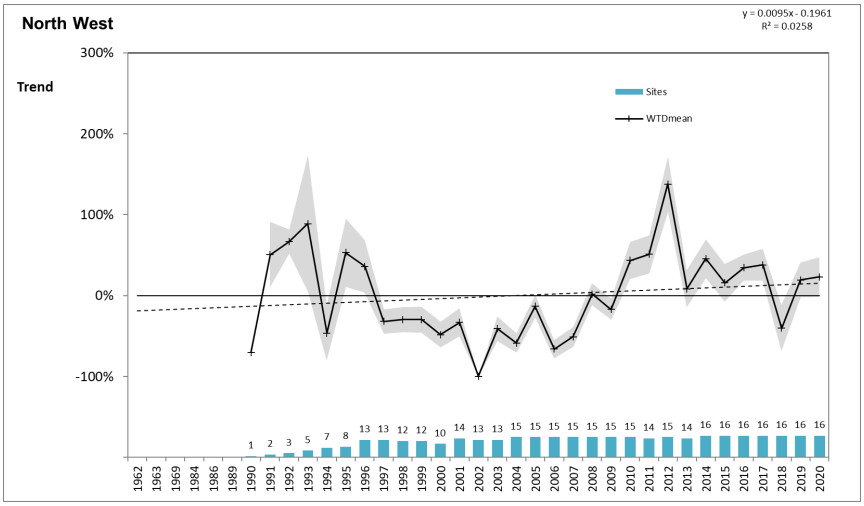
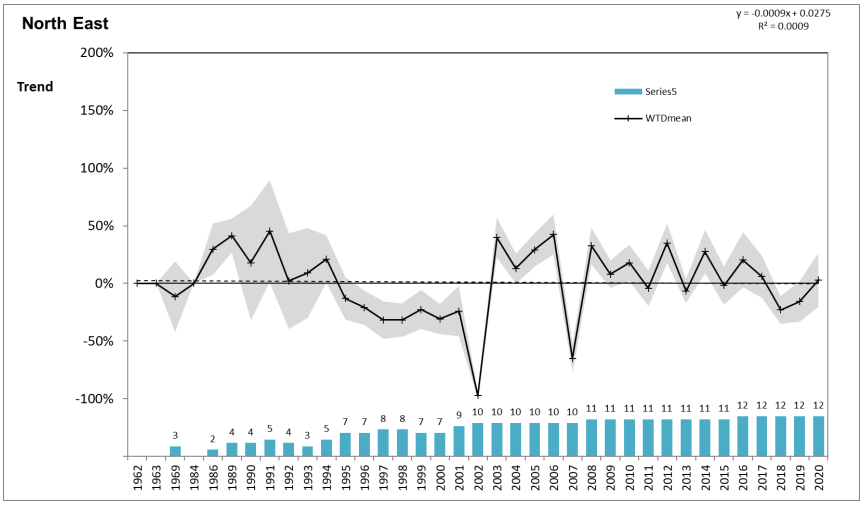


Figure 1. Trends in malleefowl breeding numbers at 42 sites and site parts represented by 37 monitoring seasons spanning 59 years (including historical survey data from some sites in the 1960s). Each point (cross) shows the degree to which breeding numbers were above or below the long-term average for 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.



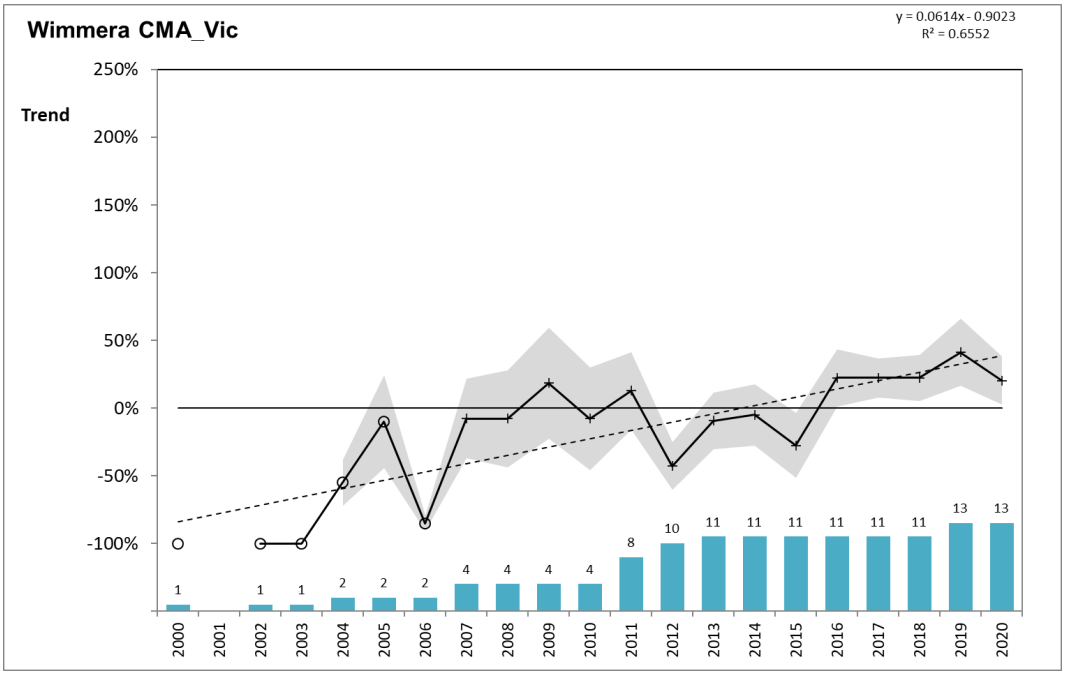




Figures 2, 3 and 4. Trends in malleefowl breeding numbers in the Eastern big Desert (top), North west (middle) and North east (bottom) sub-regions of the Mallee CMA (see Figure 1).

Wimmera CMA

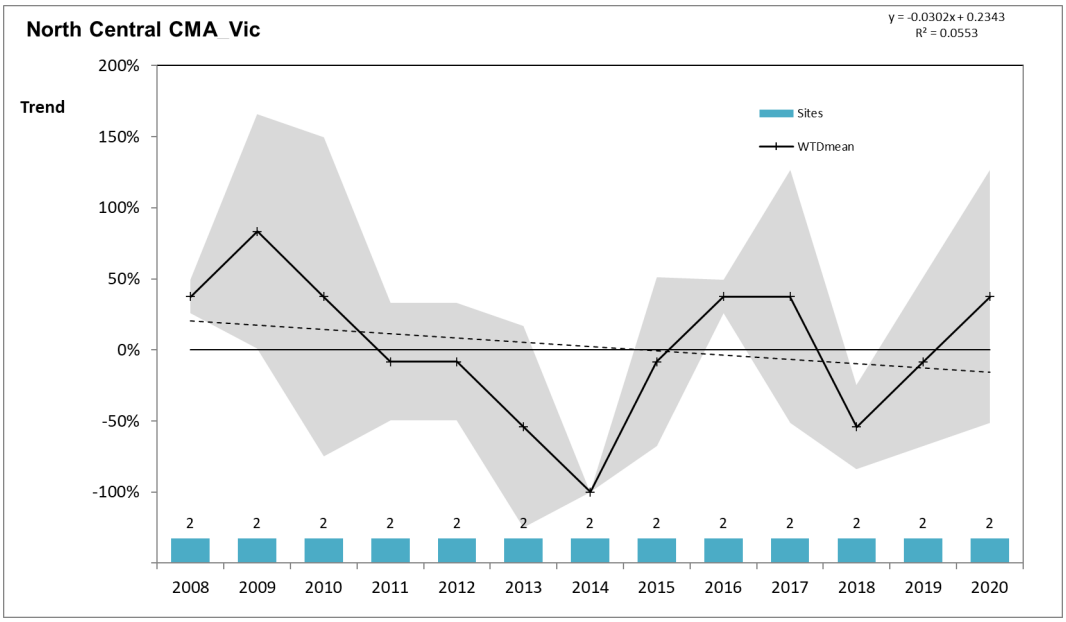
In the Wimmera, malleefowl breeding numbers in the 2020 season were 20% above the LTA and the trend has been positive since monitoring started in the early 2000s (Figure 5). The relatively low trend values before 2008 may reflect the effects of the Millennium Drought; in any case coming off such a low base has resulted in the general positive trend in breeding activity. Since 2008 when 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

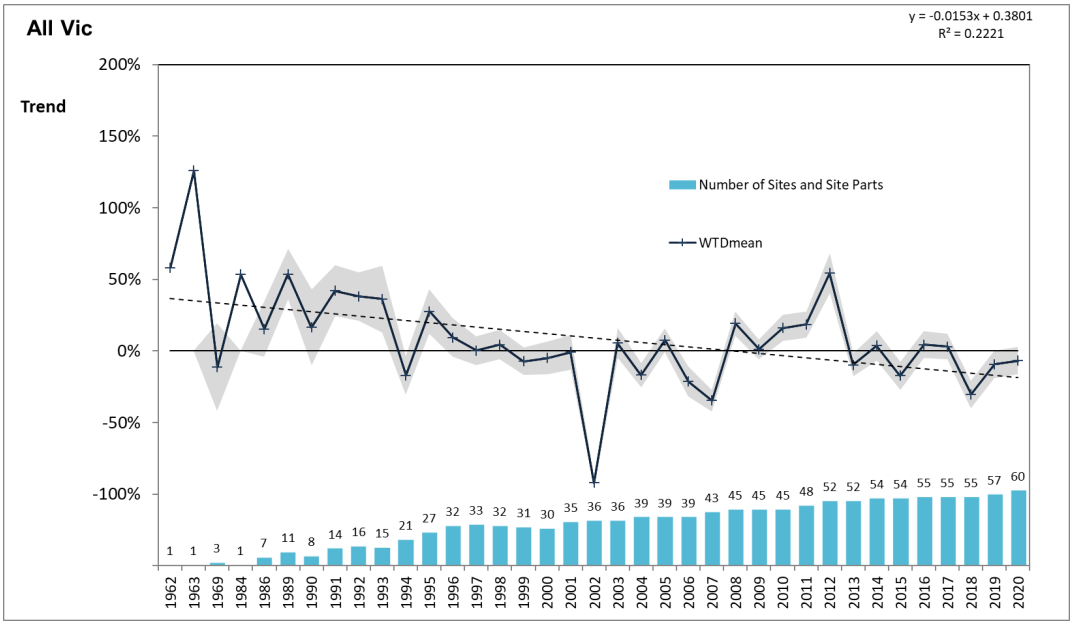
The North Central CMA is represented by 4 sites in the Wychitella group of reserves near Wedderburn. Although the VMRG started monitoring the Wedderburn block in 2005, it was not until 2008, after the Millennium drought, that the other 3 blocks were monitored. As most malleefowl appear to occur in these 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 is declining, but also 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 active mounds on average per year across the 4 sites), so a small change may have large effects.



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

All Victoria

The new approach to charting malleefowl trends makes it possible to combine data to obtain state-wide trend representing all the data we have collected (Figure 7). As most of the data has been collected in the Mallee CMA where malleefowl are most abundant, the charts for Victoria and the Mallee CMA are similar. Nonetheless, this chart provides an overview of the trends in malleefowl over the state as a whole and suggests the Victorian malleefowl population has been declining over the past three decades. However, on a more positive more, breeding numbers across Victoria in the past two years have not been much below the long-term averages and the trend since the devastating 2002 drought has been neutral.



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; Horsham rainfall records were incomplete for 2020 so Natimuk records are shown instead. 2020 was once again characterised by dry late autumn and winter conditions in the Victorian mallee, but heavy rain in April and October across the mallee resulted in annual rainfall across most areas being on par with long term median values. May to July rainfall was generally low: rainfall during this period was down 57% at Mildura, 25% at Ouyen and 40% at Natimuk. However, in most areas malleefowl breeding numbers in 2020 were on par or better than long term averages (see above) and the dry late autumn-winter period did not appear to have a pronounced negative effect on breeding numbers. The exception was the Eastern Big Desert where breeding numbers have not recovered since the drought conditions in 2018 despite improved rainfall. It is possible that monitoring sites in the Eastern Big Desert missed out on rain, and that rainfall at Ouyen was a poor indicator for this region. Alternatively, other factors may be involved in the virtual collapse of the malleefowl populations at Lowan (v20) and Wathe (v02, v03).

At Wedderburn, near the Wychitella cluster of sites (v29, v31, v32, v33), June and July were relatively dry but there was torrential rain in April and above average rain in May providing a good start for both herb growth and malleefowl breeding. Rain returned in August and continued through September and this appears to have suited malleefowl: there were 3 active mounds recorded in the Wychitella reserves in 2020 compared with 2 last season and only 1 in 2018.

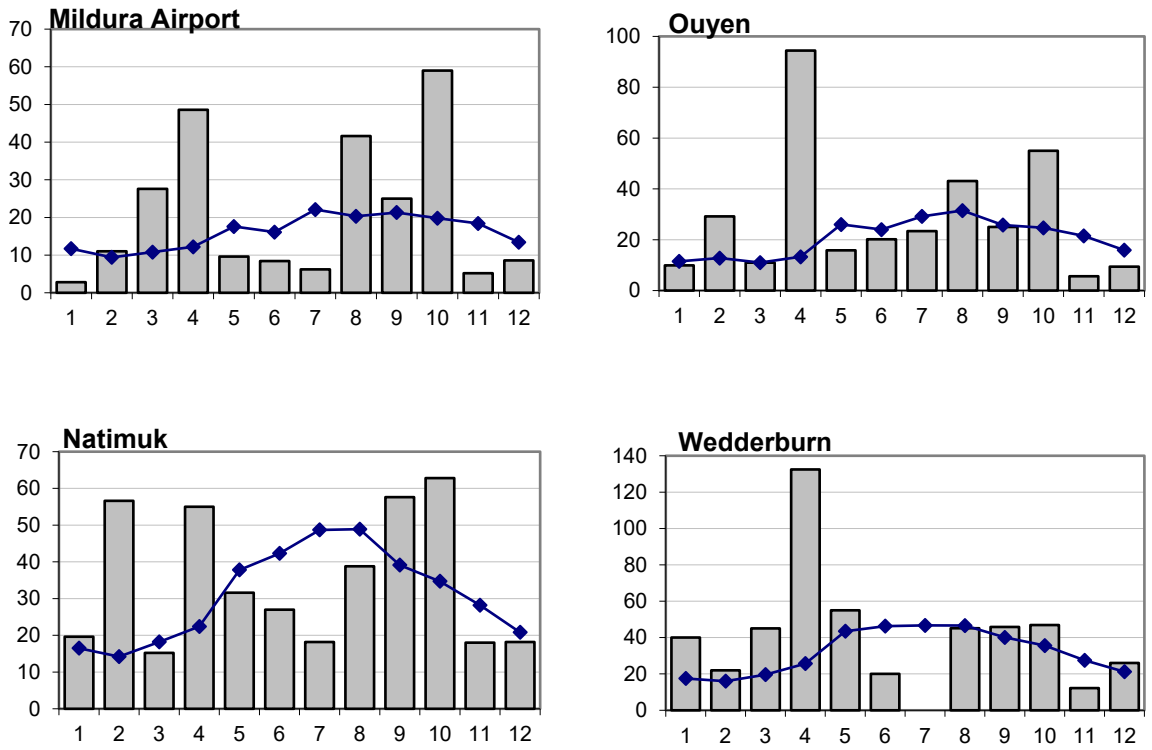


Figure 8. Rainfall at Mildura, Ouyen, Natimuk and Wedderburn in 2020 (bars) and median rainfall since early 1900s (line). (Data from the Bureau of Meteorology website).

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 lower in 2020 than the previous two seasons (Figure 9): 9% of mounds had lerp on them when mounds were monitored (mostly October-December 2020). However, there was a shift (again) in where lerp was most abundant, with mounds in the North east sites showing the most lerp (Figure 10)

where lerp were recorded on 33% of mounds. Last season (2019), lerp were most abundant at Hattah sites where they occurred on about 40% of mounds, and the previous year lerp was most abundant on mounds in the Sunset Country sites (33% of mounds). In each case, lerp numbers were much lower in other regions.

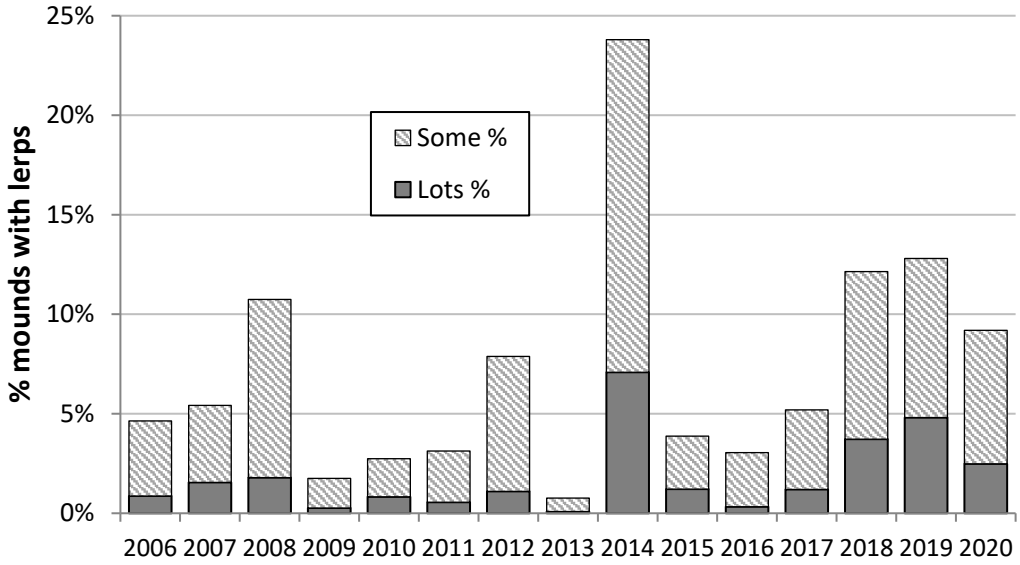


Figure 9. Proportion of mounds on which lerp were detected in each season since 2006.

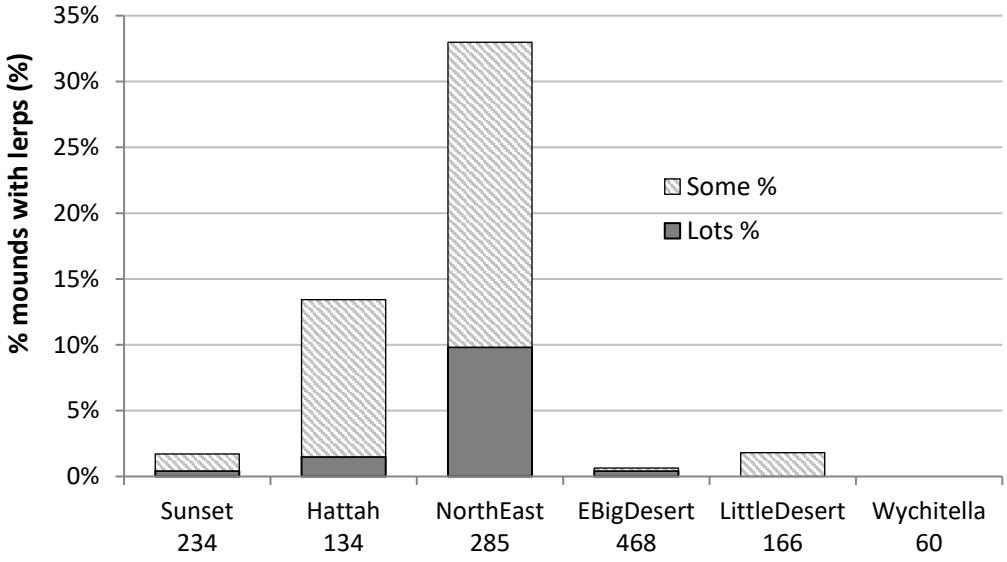


Figure 10. Regional breakdown of lerp occurrence on mounds in the 2020 season. The number of mounds inspected is indicated under the region.

5. Fox scats

At the time of writing this report I had only received fox scat data from 17 sites totalling 4.2 kg of scats collected from 246 mounds (Table 2). This is much less than usual, for example last season (2019) 28 sites were represented and a total of 6.5 kg of scats were collected from 452 mounds. Most likely the missing data exists but had not been sent to me and I had neglected to follow up and locate it before writing this report.

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. Unfortunately, only 10 of these 20 sites are represented in the graph this year due to the missing data. Nonetheless, I have calculated the 2020 season values from these 10 sites and the result suggests that there has been little change this past season in the amount of fox scat per monitored mound. More generally, 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 appears to have stabilized at 5-6g per monitored mound.

Both Wandown (v15) and Paradise (v34) showed marked increases in the amount of fox scat collected compared with last year (Table 2). Interestingly, both sites have shown high levels of breeding in recent years and have increased the number of active mounds since last season. Neither site is baited for foxes, and it will be important to see if the high breeding numbers are maintained at these sites despite the apparent increase in foxes.

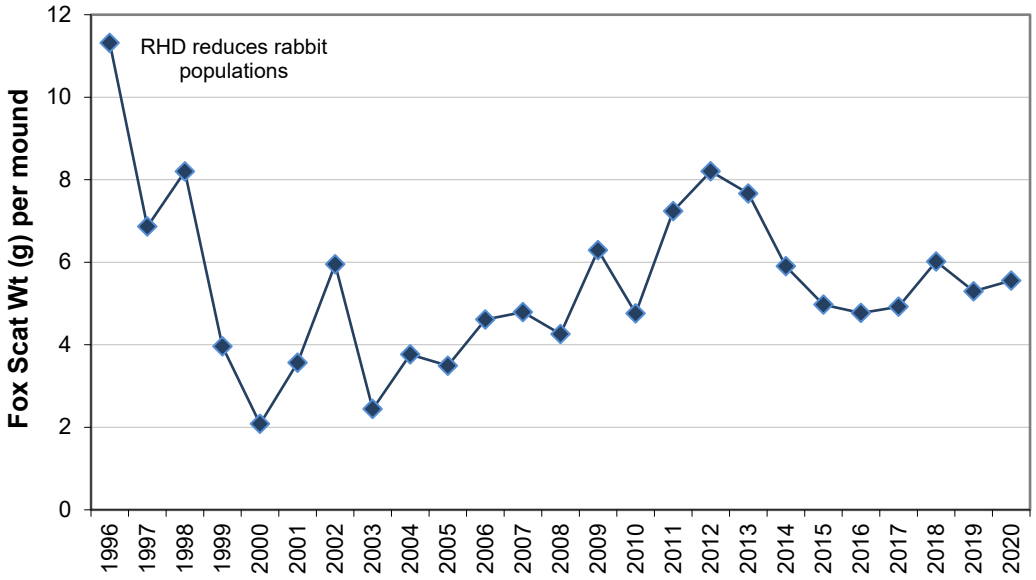


Figure 11. Trends in the average fox scat weight per monitored mound at 20 sites over 25 years. No attempt has been made to control for biases due to variations in the proportion of active mounds (more likely to be marked with fox scats) or changes in the proportion of very old and inconspicuous mounds.

Table 2. The total weight of fox scats, the number of mounds at which fox scats were collected, for both 2020 and the previous year (italics). Malleefowl scats and feathers were also collected in 2 but are not tabulated here.

Grid	Name		2020 Wt (g)	2020 Count	*2019 Wt (g)*	*2019 Count*
v01	Dattuck				*42*	*7*
v02	Torpeys					
v03	Wathe SW				*280*	*26*
v04	Bronzewing	-	487	33	*643*	*38*
v05	Stokies (Colignan)	+	101	5	*81*	*7*
v07	Annuello					
v08	Powerline				*104*	*6*
v09	Mt Hattah				*48*	*4*
v11	Mopoke				*84*	*5*
v12	Pheeneys	-	69	5	*740*	*6*
v13	Bambill				*291*	*25*
v14	Menzies	+	217	10	*208*	*12*
v15	Wandown	++	398	35	*187*	*26*
v16	South Bore					
v17	OneTreePlain	--	23	2	*112*	*5*
v18	WashingMachine	+	72	7	*23*	*4*
v19	Underbool	-	17	1	*41*	*3*
v20	Lowan	+	27	1	*19*	*2*
v21	Dumosa	-	134	17	*140*	*15*
v22	Dennying					
v23	Moonah	--	880	52	*1135*	*59*
v24	Kiata				*31*	*2*
v25	LDL Sanctuary					
v26	Hattah Tracks				*305*	*18*
v27	O'Brees				*80*	*10*
v28	Nurcoung					
v29	Wedderburn	+	34	3	*19*	*3*
v30	Hattah South	--	37	5	*128*	*4*
v31	Skinners Flat				*14*	*2*
v32	Wychitella	+	67	5	*35*	*4*
v33	Korong Vale				*22*	*1*
v34	Paradise	+++	1589	53	*295*	*24*
v35	Broken Bucket	-	60	6	*94*	*4*
v36	Boughtons WH					
v37	Wisemans					
v38	Tooan					
v39	Oldfields					
v41	Mali Dunes	-	36	6	*51*	*3*
v42	Cooack					
			4246	*246*	*5252*	*332*

Which brings us, as always, to reiterate (this time in Harrington font):

⌘ ⌘ ⌘

Please be systematic with fox scat collection.

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

⌘ ⌘ ⌘

6. Participation and in-kind contribution

We have not attempted to add up the hours contributed by individual volunteers this year, but assume that it was similar to previous years, with the exception that we added a new site, v44 Annuello New. From the number of mounds monitored, we estimate that we totalled about 1350 monitoring hours in the field, 771 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 2,520 hours contributed by VMRG in 2020.

A fair estimate of the dollar value of this contribution the malleefowl monitoring program is the replacement value: what would it cost to undertake all these activities if volunteers were not involved? To estimate this, we used the base rate for a university employed research assistant (grade 1) of $54.72 per hour, although this is still 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; accounting for the associated vehicle expenses at $0.65/km adds at least another $25,350 to the replacement value of VMRG activities.

Thus, we conservatively estimate the replacement value of the VMRG activities in 2020/21 to be about $163,240.

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. Without question, the VMRG continues to lead 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 and an inspiration to other citizen science groups.

This season, breeding numbers were a little higher than last season, but the increase was largely due to the establishment of a new site in Annuello FFR rather than increases in already established sites. Although rainfall was generally better than last season, assisted no doubt by La Nina, once again there was a dry spell at most sites during the critical winter period when malleefowl prepare their mounds. Fox numbers do not appear to be especially high compared with previous seasons, and where fox scats were most prevalent, malleefowl did not appear to be negatively affected.

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.

- *Trend graphs*

This year we tweaked the graphs reporting trends by calculating weighted means and standard errors (the weights representing long-term site averages). This approach reduces biases (see Appendix 3) while providing a comprehensive view of trends that includes virtually all the data collected in current and past years. These changes mean that the graphs have changed slightly in shape compared with last season, particularly where regions comprise a mix of sites, with some containing few and others many breeding malleefowl.

However, the approach is not perfect, and the results should be regarded as indicative rather than definitive; we may improve our approach again in future years to make best use of the data. Moreover, a more rigorous analysis of trends will be undertaken when the opportunity presents itself (the last rigorous analysis included data up to 2017 from across Australia and was published last year).

- *National and NRM reports*

Our improved method of calculating trends is also being used by the National Malleefowl Recovery Group (NMRG) to report to the Australian Government Department of Agriculture, Water and Environment (DAWE) on malleefowl breeding trends in the 17 NRM regions across Australia in which monitoring sites have been established. The NMRG is also producing reports to NRMs that, together with DAWE, have provided funds to support the NMRG (such as the Mallee and Wimmera CMAs). These reports have all been modelled on an abbreviated form of the Victorian report and represent an important milestone for malleefowl conservation both because it is the first time annual reporting has been undertaken outside Victoria, and because of the partnerships and opportunities for conservation that these developments represent.

- *Update on the motion-sensitive camera project*

Our 48 cameras traps (with solar panels, batteries and stakes) installed in 2015 at six sites in the Vic mallee (Wathe v03, Menzies v14, Wandown v15, Lowan v20, Dumosa v21, and Paradise v34) are still going, although more are failing as they age, and requiring more maintenance. We now also have cameras at v07 Annuello as part of the AMPE project, funded by the Mallee CMA.

Nonetheless, the cameras provide invaluable insights into the trends in various animals that might affect malleefowl numbers such as foxes, cats, goats, pigs, rabbits and kangaroos.

In the past year, Mick Webster and Tony Murnane swapped the memory cards at all cameras in the field in the Mallee CMA. In the past we have had people doing the monitoring swap out the SD cards, but having a dedicated team doing the task has advantages; in addition to reducing the workload on volunteers, Mick and Tony are able to inspect the condition of the cameras, and undertake repairs. Indeed, they have revived a number of cameras that were not operating, often by installing AA batteries where the old panels or gel-cell batteries have failed.

I did not send out photos for sorting last year, partly because there were not many to send out due to camera failures, but through Mick and Tony's efforts we once again have lots of photos to sort. We intend to send out the photos in July, so please help out if you can.

Graeme Tonkin, through the NMRG, has also been busy working on the camera-trap project. Graeme has designed a D cell battery pack for the cameras that should be much easier to maintain than the solar system that we have been using for the past 6 years, and which is now the cause of numerous failures. Graeme has also enlisted the help of Google and Microsoft to assist in the sorting process! While not yet available to the general public, Graeme has got us into these programs that use AI to identify animals in photos. We are most interested in using these programs to reduce the number of nulls that can make the photo sorting so tedious. Initial tests have been very promising – sometimes astonishingly good – and we area in the process of comparing the results of past sorting by the VMRG with the AI results. We envisage that we will continue to use VMRG volunteers to do the identifications but use AI to reduce the number of nulls to a manageable amount.

- *LiDAR and the Annuello New site*

As reported last year, the Mallee CMA undertook Lidar surveys of our sites at v07 Annuello and v15 Wandown in preparation for these sites becoming part of the AM Predator Experiment (Mallee CMA will undertake fox baiting and possibly cat management at Annuello but Wandown remains unbaited). Few new mounds were discovered at v07 Annuello and v15 Wandown even though it's been many years since we last searched these sites. However, a potential new site about 15km to the east of v07 was also surveyed with lidar, and in 2020 Jessica Keem and Eliza Thompson ground-truthed the lidar results for this new site with assistance from the VMRG Geoff Armstrong Trust. Of the 67 lidar detections that they confirmed were mounds, 15 were active! Jess and Eliza also monitored all the mounds they visited, so the site is now fully established. The Mallee CMA has also funded the purchase of 10 camera-traps for this site which we will install in late May. The new site, v44, does not have a name yet so we simply call it Annuello New. It is unbaited and will become part of the AMPE cluster that includes v07 Annuello and v15 Wandown.

- *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, but there are other clusters in WA, SA and NSW. In each cluster, there are one or more sites that are baited for foxes, and control sites that are no baited. The project is overseen by the National Malleefowl Recovery Group (NMRG) and depended on the statistical expertise of scientists at University of Melbourne and funding from the National Environmental Science Program, a federal initiative.

Unfortunately, our University of Melbourne colleagues lost their NESP funding a few months ago which is certainly a blow to the national AMPE project. 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 2 years to run before results are obtained (at least 4 years is required to see malleefowl chicks recruited to the breeding population) by which time we hope to secure funds to undertake an appropriate analysis.

- *Other monitoring news*
    - Jessica Keem, one of Darren Southwell's students, has competed her Masters! Jessica's research looked at fox density, and the effectiveness of baiting methods on foxes, using genetic and modelling techniques at both Victorian AMPE sites (Annuello/Wandown in the Mallee, and Cooack/Nurcoung/Tooan in the Wimmera). Her field work focussed on obtaining DNA samples from resident foxes by systematically collecting fresh fox scats and she also used VMRG camera trap data Jessica's work has important practical implications for malleefowl management and is being prepared for publication.

      Eliza Thompson, who worked with Jessica ground truthing and monitoring the Annuello New site, also completed her Masters last year and has started a PhD at Deakin University looking at avifauna in plantations.

    - Vale Neil Macfarlane! Neil was a staunch and loyal malleefowler and past president of the VMRG. He was instrumental to the formation of the VMRG, a font of information on mallee ecology and history, and a source of great inspiration and warmth. He will be greatly missed. Ross Macfarlane has written a wonderful obituary to his father in the May 2021 national malleefowl newsletter.

Appendix 1. 2020/21 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	1183	48	46	70	87	15	54	17	16		15	26	39	17	94	45	27	25	19	49	34	10	66	10	7	28	17	27	10	6	10	11	6	68	10	15	46	25	10		14	28	16	
New	76			1	2		3								1					1						1																		67
Sought, NOT found	2																								1									1										
NOT sought or found	18		1	2	1		3							2	4											1													4				
Total	1279	48	47	73	90	15	60	17	16		15	26	39	19	99	45	27	25	19	50	34	10	66	10	8	30	17	27	10	6	10	11	6	69	10	15	46	25	10	4	14	28	16	67

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	257	32	10	30	19	1	8	2		4	2	3		3	14	1	5	3	4	13	8	8	5	8	1	2	3	6	2	4	9	8	3	17	2	1	6	7	1			1	1	
New	0																																											
Sought, NOT found	2			1																																	1							
NOT sought or found	20			1			1							8	6								1															1		1		1		
Total	279	32	10	32	19	1	9	2		4	2	3		11	20	1	5	3	4	13	8	8	6	8	1	2	3	6	2	4	9	8	3	17	2	1	6	9	1	1		2	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				1		1				1				2			1															1				3				1		
New	0																																											
Sought, NOT found	0																																											
NOT sought or found	1														1																														
Total	12				1		1				1				3			1															1				3				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	1570	80	57	105	110	16	70	19	16	4	18	29	39	30	122	46	32	29	23	63	42	18	72	18	9	32	20	33	12	10	19	19	10	86	12	16	55	34	11	5	14	31	17	67

Appendix 2. Map showing monitoring sites in Victoria

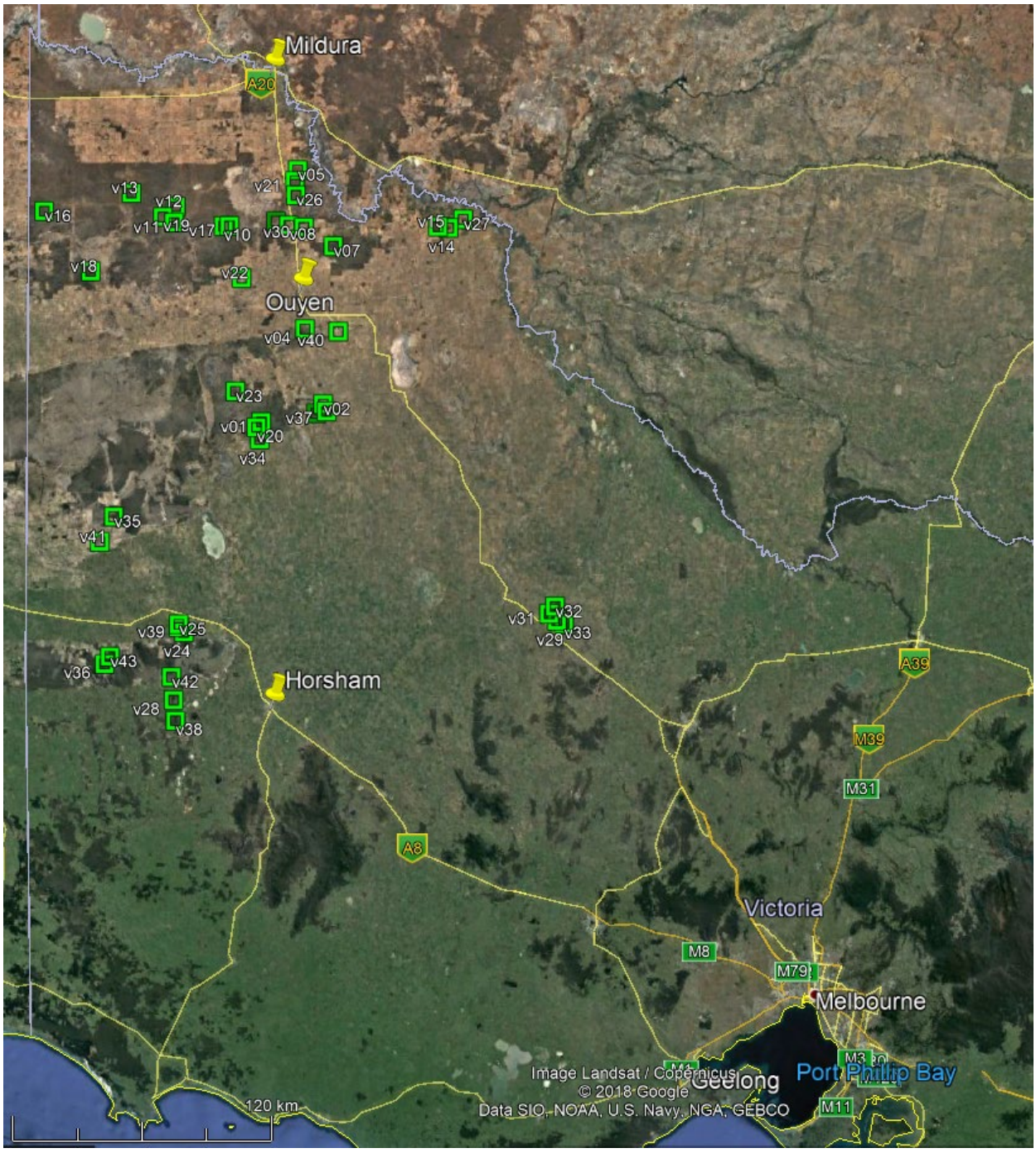


Figure 9. Location of the 43 malleefowl monitoring sites in Victoria managed by the VMRG (green squares). Over 1300 mounds are monitored each year over a total area of about 170 km2. Image from Google Earth.

Appendix 3. Why we weighted the trend statistics

Last season, 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.

This season, I have modified things by weighting the statistics, so the trend graphs are a little different, but they actually 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, we have reduced the influence of small sites and increased the influence of larger sites when we calculate the overall trend in multiple 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.