Trial of motion sensitive cameras for monitoring a range of animals in Malleefowl monitoring sites

Report to VMRG and Malleefowl management committee

Joe Benshemesh
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Introduction

Monitoring Malleefowl provides data on the trends in the species populations which is essential for informed management. This information is made meaningful by relating it to other factors that influence Malleefowl populations, such as rainfall, fire history, and landscape context (Benshemesh, Barker & MacFarlane 2007). However, many important factors can't be tracked so easily. For example, foxes are the main predators of Malleefowl but are elusive and difficult to monitor; previous studies have resorted to counting fox scats on mounds as a means of estimating fox trends and their effect on Malleefowl populations (Benshemesh, Barker & MacFarlane 2007, Walsh *et al.* 2012). Obtaining useful data on the abundance of other predators and competitors that may affect Malleefowl populations is even more difficult (Benshemesh 2007), yet this information is essential to make sense of Malleefowl trends and identify the most effective management options. As Malleefowl monitoring moves from a passive activity to a dynamic interaction with management under the Adaptive Management project (Benshemesh & Bode 2011), information on trends of predators and competitors will become increasingly important.

Motion sensitive cameras provide an efficient means of gathering data on a range of medium to large sized animals simultaneously ((Silveira, Jácomo & Diniz-Filho 2003, Vine *et al.* 2009, Claridge, Paull & Barry 2010). In regard to Malleefowl monitoring, cameras could provide quantitative data on the abundance of several animals of interest, including predators such as foxes, dogs and cats, and potential competitors such kangaroos, goats, and rabbits. Cameras might also provide alternative information on Malleefowl abundance that cannot be obtained through the current monitoring practice which focusses on breeding birds. In particular, cameras may provide some information on non-breeding Malleefowl, and help identify years in which recruitment of young occurs into the adult population.

As monitoring sites are only visited annually, the ideal setup would involve cameras that require little maintenance and are able to collect photos over a 12 month period. In this ideal scenario, people doing the Malleefowl monitoring each year would simply swap the full memory cards of the cameras with empty cards.

In this study I provide an assessment of the utility of camera traps for the Malleefowl monitoring and adaptive management projects. 24 cameras with solar panels and external batteries were placed in two monitoring sites and evaluated in terms of the suitability of the technology, the ease of processing the photos, the usefulness of the ensuing data, and the practicability of developing a larger program in which camera traps might be placed in the majority of Malleefowl monitoring sites and provide information on the abundance and trends of a number of species of interest.

Funding for this study was provided by the Iluka Malleefowl Management Fund, and on-ground support was provided by the Victorian Malleefowl Recovery Group and the Mid-Murray Field Naturalists. I am especially grateful to Peter Stokie, Keith and Cynthia Willis, Rod Cavanagh, David Thompson, Neil Macfarlane and Judy Irvin. The work was carried out under permit from DEPI (#10006879) and we thank Parks Victoria and the Menzies family for their support.

Methods

Equipment

Faunatech supplied 25 cameras (KeepGuard KG-680v) and each of these was provided with an SD card (4GB), battery (6V, 12Ah lead-acid dry-cell), and solar panel. Faunatech also supplied all necessary wiring and attachment brackets for the solar panels.

Installation

24 cameras systems were installed in the Menzies (v14) and Wandown (v15) Malleefowl monitoring sites (see Appendix 1 for map): 16 of these were in Wandown (about 20km^2) and 8 in Menzies (about 3.4 km^2). Cameras were placed 50-100m off tracks to facilitate access while keeping them out of sight from passers-by. Cameras were typically strapped to the base of mallee trees (see Appendix 1 for image). Orientation was usually southerly to minimise glare from the sun, and care was taken to select a site and orientation that avoided vegetation that might move in the wind and trigger the camera. The battery was wrapped in plastic bags and covered with sticks or triodia clumps to reduce interference from animals. Solar panels were attached to a mallee stem 1.5-2m above the ground and orientated to the north.

Read process:

Cameras were revisited by VMRG members (David Thompson, Judy Irvin, Neil Macfarlane and Barry Wait) who had not previously seen the cameras or their locations. Instructions were provided to these people that detailed the reading process (Appendix 1), and these were followed to visit each camera, check its condition, exchange the SD card for an empty one, and restart the camera. In addition, Judy Irvin and David Thompson provided an excellent report on the exercise made a number of useful recommendations (Appendix 2).

Data Process:

The data on the 24 SD cards was transferred to a PC and then copied to two 300GB harddrives for security, one of which was sent to me and prepared for analysis. A separate folder was created for each camera, and photos were renamed with the camera number followed by the photo number. Subfolders were created for eight species of interest: Malleefowl, Fox, Cat, Emu, Kangaroo, Pig, Rabbit/Hare, Echidna (rabbit and hare were combined as they were relatively rare). I used Windows Explorer opened in two separate windows to scan through the photos rapidly and move them to the appropriate folders, and ExPrint (JD Design) to write the contents of the directory that included the camera folders from Windows Explorer to a spreadsheet (Microsoft Excel) and a database (Microsoft Access), including the file path, and the exif date/time (all photos were jpg format).

All cameras had been set to take photos whenever the infrared trigger was activated. Cameras were originally set to take 2 photos in rapid succession when triggered, however inspection of the photos showed that there was no advantage in this. In quantitative analyses, these second photos were ignored. To simulate photo-sets that would eventuate from setting the cameras to be insensitive for 1-60 minutes after a photo was taken, I manipulated the data in Excel and Access.

Results

Installation of cameras took 10-20 minutes and exchanging the SD cards and checking the systems took less than 5 minutes. All but one camera worked well; the single camera that did not capture photos may have been left in 'setup' mode but appeared to work well when restarted with AA batteries (Camera #23, Appendix 2). Another camera had been taking photos correctly but lost power when being read; it probably had a faulty connection between the external battery and solar panel (not yet ascertained or corrected) but worked correctly when restarted with AA batteries (Camera #9, Appendix 2).

23 cameras captured 29,237 photos over the 54 day period between 24/3 and 18/5. Of these, 13% were of target animals, and the rest were regarded as nulls. Most photos classified as nulls did not have recognisable animals in them, and were presumably triggered by moving vegetation or shadows. However, nulls also included photos of small to medium sized birds, especially choughs and magpies, but also yellow throated miner, ravens, a frogmouth, and a chestnut quail-thrush.

Target animals were photographed by every camera (except camera #23), averaging 81 target animal photos per camera (range- 7-288), or about 1.5 target animal photos/day. The proportion of photos that were of target animals averaged 34% but this varied considerably between cameras from less that 1% to nearly 80%. The discrepancy between the proportion of photos that were of target animals calculated from total numbers (13%) and the average per camera (34%) was due to five cameras at which a very high number of nulls occurred (Figure 1).

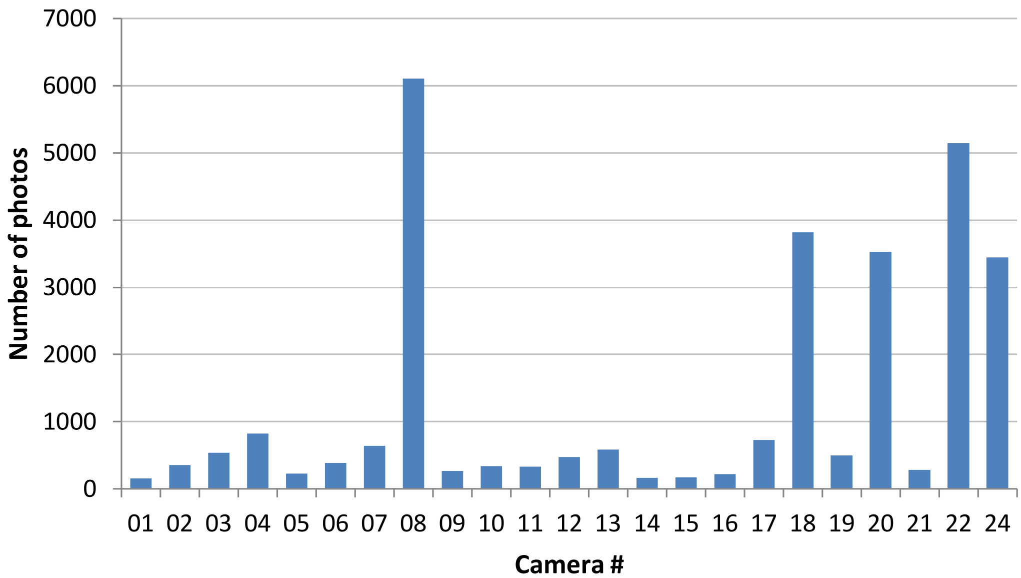

Figure 1 Number of photos per camera. Cameras 1-16 were located in Wandown (v14) and cameras 17-14 were in Menzies (v14).

The proportion of target animal species detected by cameras for different simulated intervals is shown in Figure 2. Nulls were detected at every camera, regardless of interval. Foxes were the most ubiquitous animal and were also detected at all 23 cameras regardless of interval. Kangaroos and Emus were well represented and were recorded at 21 and 17 cameras respectively, and both showed a slight decline in the numbers of cameras at which they were detected with increasing intervals. Malleefowl and rabbit/hare were detected at 11 and 10 cameras respectively, while echidnas, cats and pigs were less common, occurring 3-7 cameras. In most species with the exception of foxes and pigs, increasing intervals resulted in only slight decreases in the number of cameras at which they were detected.

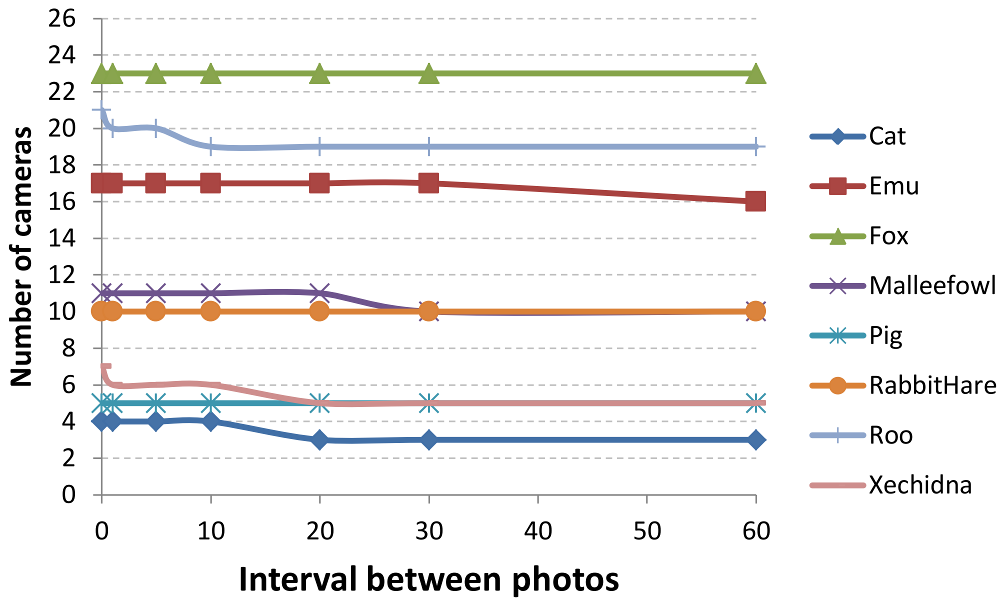

Figure 2. Number of cameras that detected target animal species for different photo intervals (23 cameras in total)

The number of photos of the target animals and nulls per camera was greatly affected by interval length. Nulls in particular were reduced enormously: a 1m interval between successive photos reduced the number of nulls by 42%, a 5-min interval by 69%, and a 60-min interval by 82% (Figure 3). Similarly, the number of animal photos was reduced by 45%, 60% and 67% for 1, 5 and 60-min intervals respectively. The reduction in the number of nulls was greater than that of target animals, and consequently the proportion of animal photos increased with increasing intervals (Figure 3).

Target species responded differently to varying the interval length between photos. Kangaroos in particular were the most commonly photographed animals, averaging 46.5 photos per camera in the original dataset, but this dropped to 18.5 photos per camera with a 1 minute interval, and to 8.8 photos per camera with a 5 minute interval. Thereafter declines were less intense (Figure 4). Emu detections also followed this pattern, but the decline was less extreme. In contrast, the number of photo detections of foxes, cats, rabbit/hare and echidna changed little with different interval length. For example, while foxes averaged 19.3 photos per camera in the original dataset, and a 1 minute interval between photos reduced this to 16.3 photos per camera, thereafter there was little change and even a 60 minute interval resulted in an average of 15 fox photos per camera. Malleefowl and pigs showed an intermediate pattern in which declines in the average number of photos per camera were slight compared with kangaroos and emus, but nonetheless greater than for foxes, cats, rabbit/hares and echidnas. In general, there was little change in the average number of photos per camera for target species with intervals greater than 5-10 minutes (Figure 4).

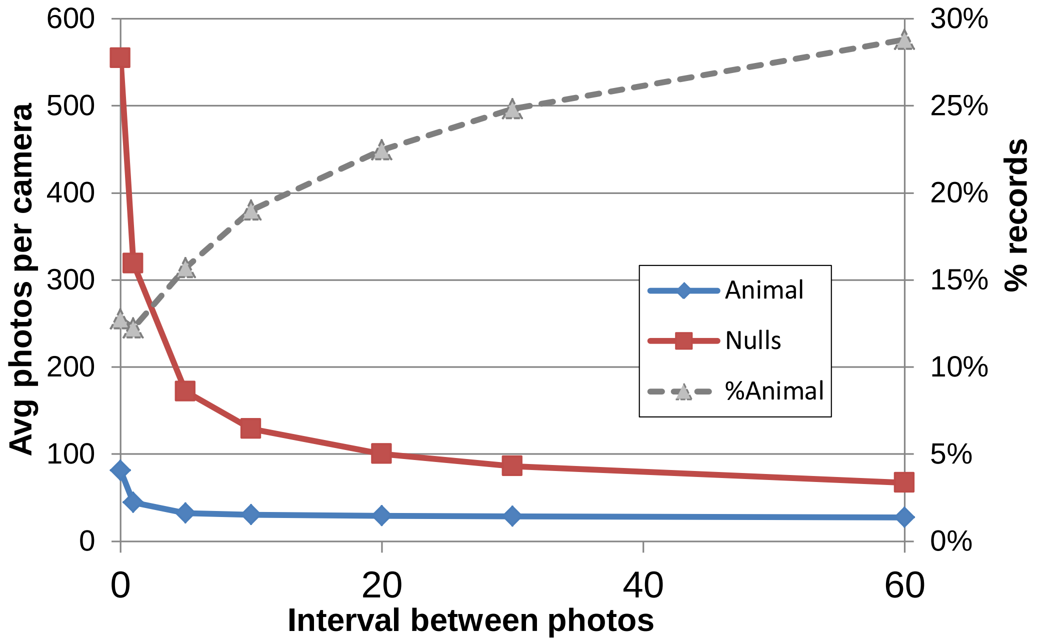

Figure 3. Average number of null and target animal photos per camera, and proportion of photos that were of target animals, for different photo intervals.

The effects the length of the intervals between photos on different species had ramifications for estimating the relative abundance of species (Figure 5). While kangaroos were by far the most commonly photographed species in the original data set (no interval between photos), representing 57% of photos, with a 60 minute interval this had dropped to only 20%. Conversely, foxes represented 24% of photos in the original data set, but 55% of photos with a 60 minute interval; foxes were the most commonly photographed species for intervals longer than 1 minute. While most target species except kangaroos and emus showed an increase in their representation with increasing intervals between photos, the relative abundance of species was reasonably stable for intervals of 5 minutes and longer (Figure 5).

Simulated numbers of photos with a 10 minute interval were used to examine differences in the abundance of target animals at Menzies and Wandown (Figure 6). Kangaroos were recorded more than eight times as often at Wandown than in Menzies; pigs emus, and Malleefowl were also more commonly detected at Wandown by factors of 3.5, 2.8 and 2.2 respectively. Rabbit/Hare was the only target animal that was clearly more commonly detected at Menzies (by a factor of 5.6). Foxes and echidnas were slightly more commonly detected in Wandown, and cats in Menzies, but the differences were relatively small (factors 1.3-1.5).

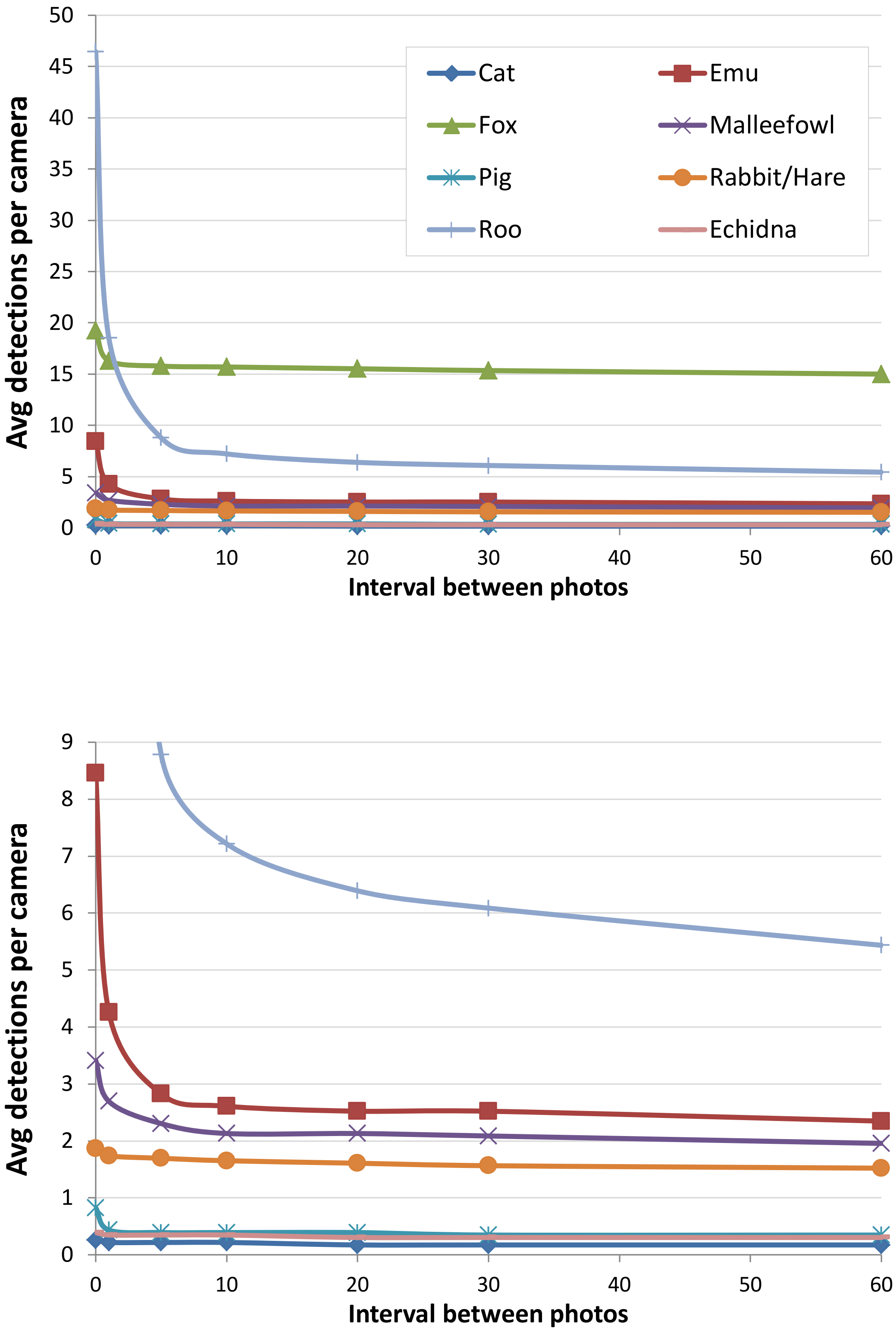

Figure 4 Average number of detections of target species per camera for different intervals between photos: a) all species; b) expanded Y axis showing the less common species (less than 9 detections/camera).

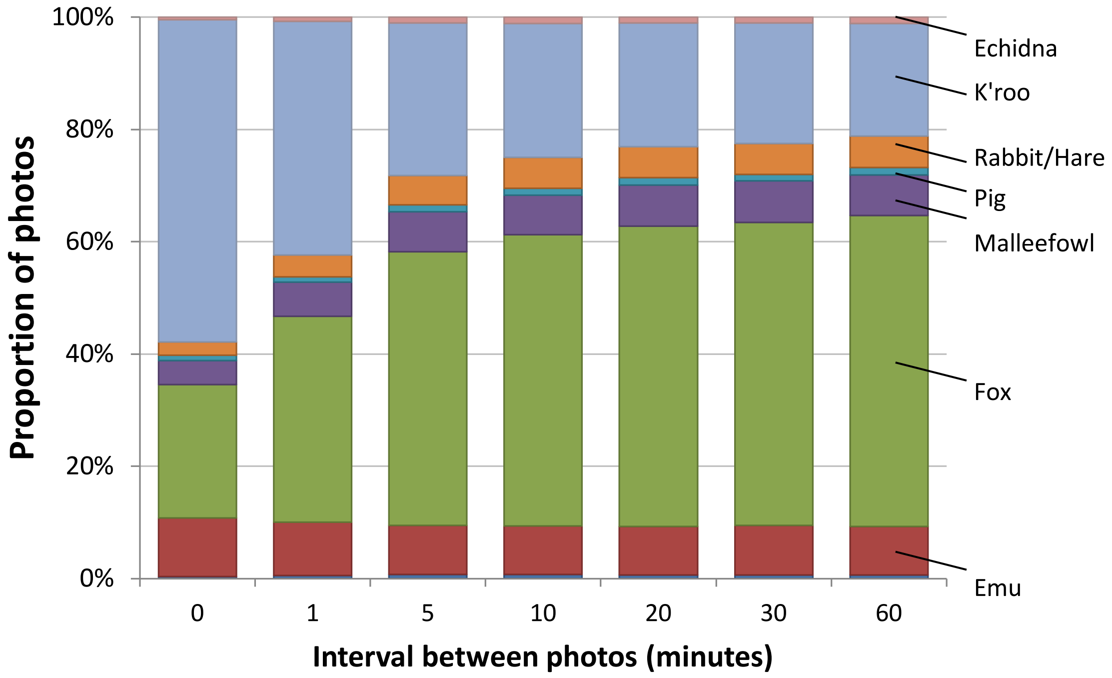

Figure 5 Proportion of photos of target species for different intervals between photos.

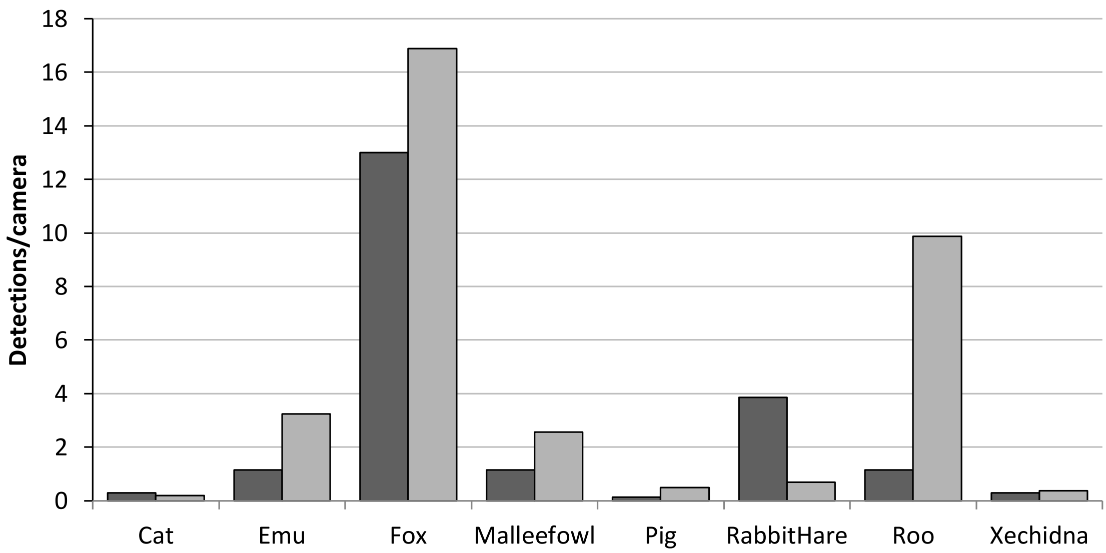

Figure 6 Number of detections of target species per camera at Menzies (dark grey) and Wandown (light grey) as apparent with a 10 minute interval between photos.

The time taken to sort through photos averaged 62 photos per minute (n=13, se= 19 photos/minute; 7557 photos sorted) and varied from 20 to 217 photos per minute. The variation in sorting rate probably reflected the nature of the photos being sorted: where there were many successive nulls or repeated photos of particular animals (especially kangaroos), sorting was faster because many photos could be dragged to the appropriate folder in a single action.

The data collected over the 54-day trial period was used to estimate the total number of photos per camera expected over a 12 month period for different interval lengths between photos (Figure 7). If a 4GB SD card were used (as was the case in this study), the total number of photos would limited by the capacity of the card to about 6100 photos (red line Figure 7) and cards at several cameras would fill up before the 12 month period had elapsed. Indeed, 5 of the 23 cards (22%) would fill up within 12 months at intervals between of 0 and 1 minute, one card would fill up at intervals of 5 and 10 minutes between photos. and none were expected to fill up with intervals longer than 10 minutes.

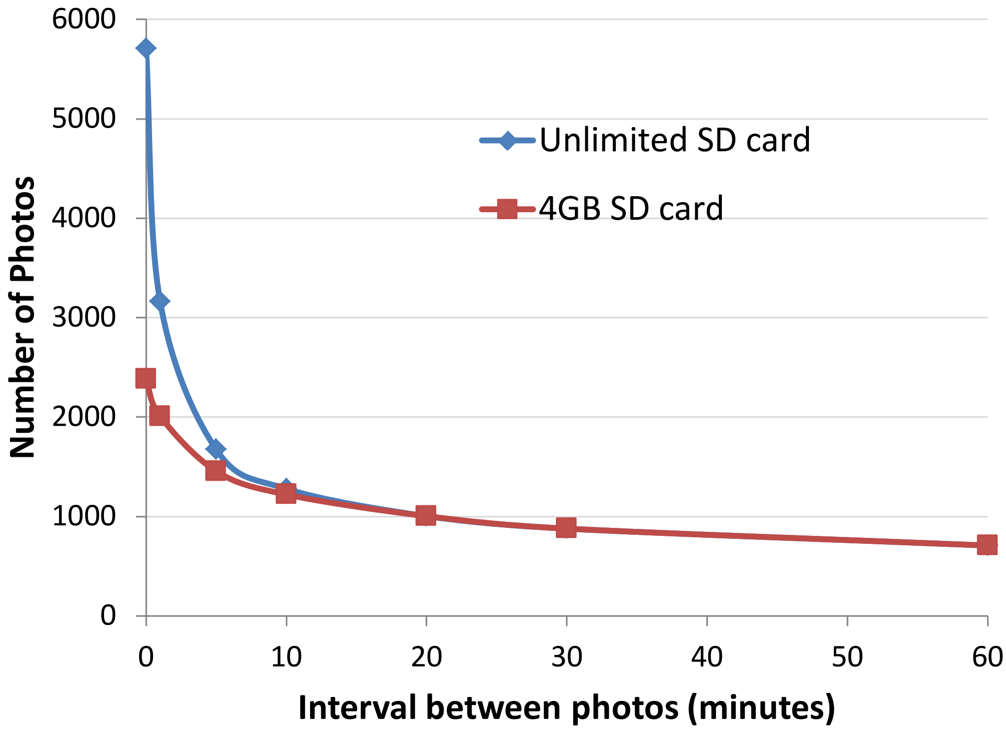

Figure 7 Estimated number of photos per year for different interval lengths

Discussion

This study focussed on three issues that are critical to determining the feasibility of using motion sensitive camera to obtaining information of relevance to the Malleefowl monitoring program. The first of these concerned the **technology**. All of the cameras appeared to perform correctly and the battery and solar panel arrangement also worked well. Although we did have some power failures, this may have been due to incorrect setup. I am not aware of any reason to doubt that the camera systems would continue to operate and collect photographic information on the occurrence of animals for several years.

The second issue concerns the **practicability** of running a program involving several cameras at several, and perhaps all monitoring sites. As with the current monitoring program, maintaining a rigorous program over many years requires a commitment by volunteers. The involvement of volunteers is necessary where appropriate resources to do the monitoring can't be obtained, but volunteers also provide the longevity that is necessary for an effective program. A program run by volunteers is relatively immune from interference and the vagaries of funding decisions, and can thus be maintained in the long-term with a degree of certainty. The VMRG members have been very enthusiastic about the camera project and many have offered their assistance. However, volunteers already make an enormous effort undertaking the monitoring which in Victoria already involves 40 sites and 1200 mound visits per year. A wide scale camera trapping project would require another large commitment by volunteers and may not be sustainable long term if it was labour intensive.

In this study, volunteers installed half of the cameras without any technical assistance, and another team of volunteers revisited the cameras and retrieved the photos with only written instructions and a GPS. Both operations were simple and straightforward and were accomplished without any problems. A bigger concern regards the initial identification of photos, counting the animal detections and processing of information onto a database. Each camera is capable of taking tens of thousands of photos and processing these from many cameras could become a huge undertaking. However, in this study the processing of photos was found to be surprisingly fast and easy and the most time consuming part, the sorting of photos, was well within the capabilities of volunteers. Set to trigger a photo capture at least 5 minutes after the last trigger, an average of about 1500 photo captures would be expected per year, and sorting these photos is likely to take only about 24 minutes (average sorting speed in this study) or at most 75 minutes (slowest sorting speed in this study). Increasing the interval between photos to minutes is likely to reduce the number of photos and sorting time to 19 minutes (average speed) and 60 minutes (slow speed). Assuming 6-10 cameras would be needed at each site to provide information on trends in various animals, sorting the photos for a site could feasibly be done by one person in a day.

In short, the labour requirement for processing a full year of photos does not seem excessive and there is no reason why the effort could not be spread out over many days or weeks. Whether volunteers would be interested in sorting the photos is another question, but the indications are that they would be, and I have been approached by a number of people offering their services. Moreover, viewing and sorting the photos is an inherently interesting task that is both informative and addictive. There is a high degree of site fidelity amongst volunteers involved in the Malleefowl monitoring, and people who monitor sites are likely to be very interested to see what other animals are recorded at the site. There has also been a great deal of interest in the motion camera project from volunteers who are unable to meet the physical demands of monitoring, which involves many hours of walking in remote regions, but who are nonetheless keen to help with less arduous activities.

The third issue concerns the **usefulness** of the data. In this study, a wide range of species that may impact on Malleefowl were detected, including foxes, cats, pigs, kangaroos, rabbits/hares and Malleefowl. Goats, sheep and deer are unlikely to occur at Wandown and Menzies, but are animals of great concern at other monitoring sites and would be easy targets for camera traps. Information on the abundance and trends in these animals is of great relevance to Malleefowl management and conservation, especially given the current emphasis on the development of a formal adaptive management program to guide management.

Although I have not examined the data statistically, it seems clear that the camera trap results have the capacity to describe differences between sites and monitor species trends over time. In the current study, there were apparent differences between Wandown and Menzies: rabbits/hares were more common at Menzies whereas kangaroos, emus and some other animals were more common at Wandown. This result conforms to expectations, given that Menzies is a much smaller and disturbed isolate than Wandown. One of the attractions of this pair of sites was that I thought Menzies was baited for fox control, however it later became clear that baiting had ceased at Menzies a few years ago. In any case, there was little difference between the detection rates of foxes at the two sites during this study.

The camera trap trialled in this study have clear advantages over alternative methods for monitoring the diverse set of animals of interest to Malleefowl conservation. The camera traps provide the ability to count the number of times a species of interest passes the camera every day and night for an entire year. Maintenance and data management requirements appear to be very low, especially considering the number of species that are monitored, and the quantity and quality of ensuing data. In brief, the camera traps provide a relatively cheap, logistically simple and highly efficient means of collecting data on species of interest to Malleefowl conservation.

In this study I examined the effect of different intervals between photos from the practical rather than statistical point of view. Short intervals between photos had the effect of increasing the proportional representation of kangaroos, but more importantly short intervals resulted in a large numbers of redundant photos that would inflate the time needed for processing the photos and quickly fill up the SD cards. The proportional abundance of different animals appeared to stabilise with intervals greater than five minutes, and intervals of five minutes also resulted in a manageable expected number of photos per year. Accordingly, setting the cameras to become insensitive to triggers for an interval of 5 minutes after each photo would seem advisable. Increasing the interval more than this would further reduce the number of photos that need to be processed, but would also increase the likelihood of missing rarer animals (such as juvenile Malleefowl). While these practical issues are of great importance, they should not be confused with the statistical issue of autocorrelation (i.e. the similarity or non-independence between observations as a function of the time separation between them) which will need to be dealt with in any statistical analysis of the data. A related and more urgent statistical issue concerns the number of camera traps needed to adequately determine the abundance and trends of species at each monitoring site, and it is recommended that a statistician to be consulted on this matter.

Finally, while this report has examined the data collected by the cameras over a 54-day period, the 24 cameras were downloaded again on 4-5/11/2013, about six months after the last download, with the help of David Thompson, Judy Irwin, Neil Macfarlane, and Barry Wait. About 85,000 photos were obtained, a total which is in line with expectations detailed in this report. The camera set-up was modified so that cameras would be insensitive for a 5 minute interval after each trigger, and for only one photo to be capture for each trigger event. Several cameras were re-positioned onto stakes to avoid being triggered by movement of trees, one solar panel was found to be faulty, and water had collected in the plastic bags protecting 2 of the external batteries. Apart from these minor issues, the camera traps continued to perform well 8 months after their installation and will probably continue to do so for several years.

Conclusions

Over the 8 month period of this study the motion sensitive cameras proved to be reliable and successful at detecting a range of animals of interest to Malleefowl conservation, including Malleefowl themselves. The technology (cameras, battery and panels) appears to be adequate for the task and is simple to install, the cameras need only be visited once per year during the monitoring, and an efficient way of processing the large number of photos and entering the data onto a database has been developed. Sorting the photos, which is the most labour intensive part of the process, is within volunteer capabilities and is estimated to take only a day or two per monitoring site per year (assuming 6-10 cameras per site). There is a high level of interest by the Victorian Malleefowl monitoring community in the project and I expect this will increase once people begin sorting photos because it is inherently fascinating to see what animals pass the cameras, day and night, at sites where Malleefowl are monitored.

Given these results, expanding the project to include more Malleefowl monitoring sites would seem to be a very worthwhile investment in Malleefowl conservation. This would greatly enhance the existing monitoring program and provide much needed information on the abundance and trends of a range of animals that may impact on Malleefowl. In addition, Malleefowl are often detected by the cameras and these data are likely to prove very useful in determining trends in adults and young that are independent to the monitoring of mound activity. The information provided by the motion sensitive cameras is expected to be of great value to the AM project and it would be prudent to develop the system in parallel with the AM project and begin installing cameras at a range of monitoring sites.

Recommendations

1. VMRG should investigate funding options for cameras at the majority of Malleefowl monitoring sites in Victoria. Given the success of the project, the high level of interest it has generated amongst volunteers, and its importance to the AM project, it is recommended that this be considered a high priority by the VMRG and National Malleefowl Recovery Team over the next 2 years while the AM project is being developed. A target of installing cameras at 12 sites in 2014 is suggested as reasonable and achievable and is likely to cost about $40k.
2. A statistician should be consulted regarding the number of cameras to be placed at each site. All data should be made available, particularly the database.
3. The AM team should be consulted regarding the end use of the data in the AM project and data made available to them. The ensuing data on trends of various animals will be of great interest to land managers (such as Parks Victoria), locals and those involved in monitoring Malleefowl. However, its greatest utility will be within the AM project where it will provide insights into the factors affecting Malleefowl populations, and on the effects of interventions (such as animal control measures) on the target species and on Malleefowl.
4. A number of minor modifications to the camera setup are recommended:
    - To reduce the number of redundant photo, cameras should be set up for a 5 minute minimum interval between photos, and 1 photo per trigger.
    - Although most cameras performed quite well strapped to the base of tress, attaching cameras to stakes is nonetheless advisable to minimise movement of cameras, and to better avoid moving shadows and bark all of which may trigger the cameras.
    - Longer leads between solar panel and battery would be helpful (e.g. 3m rather than 2m).
    - A more permanent housing for the external batteries should be investigated.
    - While the KeepGuard cameras performed well, other makes and models should be investigated: it would be advantageous to be able to set up the cameras from the outside and to not have to unplug the power to access the SD cards.
5. Over the next 6 months it would be beneficial if VMRG volunteers helped sort the photos obtained between May and November 2013. Over 85,000 photos were obtained during this time (not represented in this report) that have yet to be sorted. Providing interested volunteers with batches of 5,000 photos (the approximate number expected to be generated by 6 cameras at a site over 1 year) would provide them with a clear idea of the time and effort involved in sorting photos, and a means of gauging their support and commitment to an ongoing program.

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Appendix 1: VMRG Malleefowl Motion Sensitive Cameras routine maintenance and SD Card retrieval

Joe Benshemesh April 2013

- 24 motion sensitive cameras have been set up at Wandown (16) and Menzies (8) (figure 1)
- These cameras are part of a trial to examine the usefulness of the technology for monitoring pest species and young Malleefowl abundance
- A typical camera setup (shown in Figure 2) comprises the camera, solar panel and battery (hidden in photo)
- The setup is designed to only require visits every year during the Malleefowl monitoring, but we will be checking them more often to see how they are going
- When we visit, our primary task will be swapping the SD cards which hold the photos. However, we will also be recording the state of the cameras when we arrive and leave as part of maintenance

Routine maintenance and SD Card retrieval

In general:

- We need to remove the power cable to open the camera (Figure 3). The cameras will hold all setting for about 30sec without power, so be quick to replace cable as soon as camera is opened. Likewise when closing camera be quick to replace power cable to avoid having to reset the camera.
- Always switch camera OFF before switching to SETUP or ON (ie. do not switch from SETUP straight to ON or vice versa)

To replace SD card and record info:

1. Arrive at site
   - Record if cable in, disturbance etc
2. To open camera:
   - Remove cable
   - Open camera (2 clips)
   - Reinsert cable
3. To record info
   - Switch to OFF, then SETUP
   - Record: battery, number photo taken/remaining, megapixels
4. To swap card
   - Switch OFF
   - Push and release SD card to remove
   - Insert replacement SD card (push to click)

5. To leave…
    - Switch to SETUP (off first)
    - Record number photo taken/remaining
    - Switch OFF, then ON
    - Remove plug, Close case, Reinsert plug
    - Check for flashing

Changing settings

Assuming camera open, plugged into power

1. Press menu
2. Using the up/down buttons to change setting, OK button to save setting, and forward (right) arrow to move to next option
3. Please let us know if you have had to change any settings and record battery, number photo taken/remaining, megapixels and time when you have finished

Option	*Setting*
Mode	camera
resolution	3M
Capture number	1 photo
Video size	na
Video length	na
Interval	10sec
Sensor level	normal
Format	WILL DELETE PHOTOS; only use to format SD card that is problematic
TV out	na
Time stamp	on
Set clock	Used to set time (24hr clock); don't forget to OK to save)
Default set	na

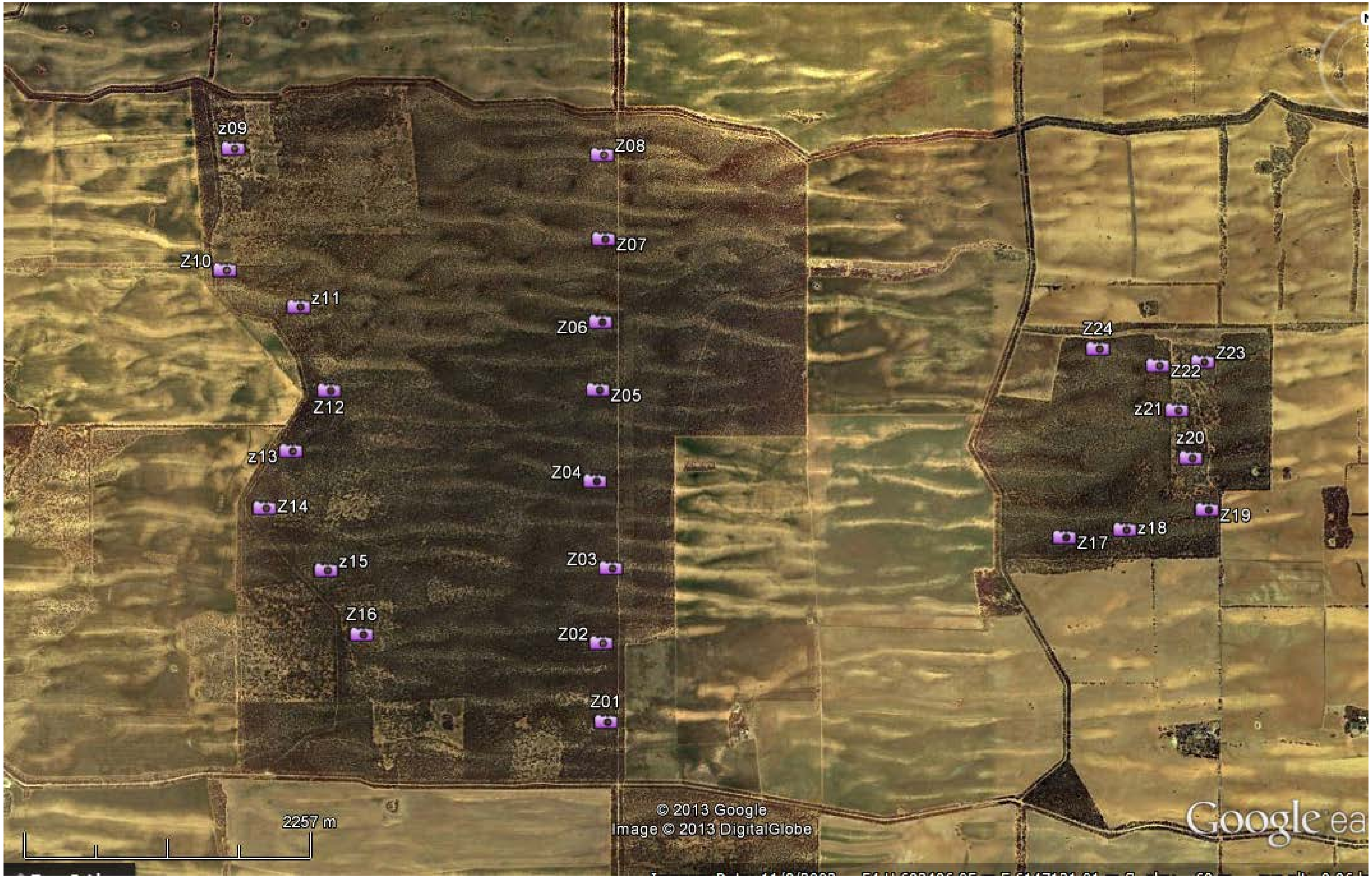
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Figure 1

Figure 2


Screen (see Figure 4)
3M
0000/6781
OFF-SETUP-ON
OK button
OK
MENU button
Power
SD Card (under)

Figure 3

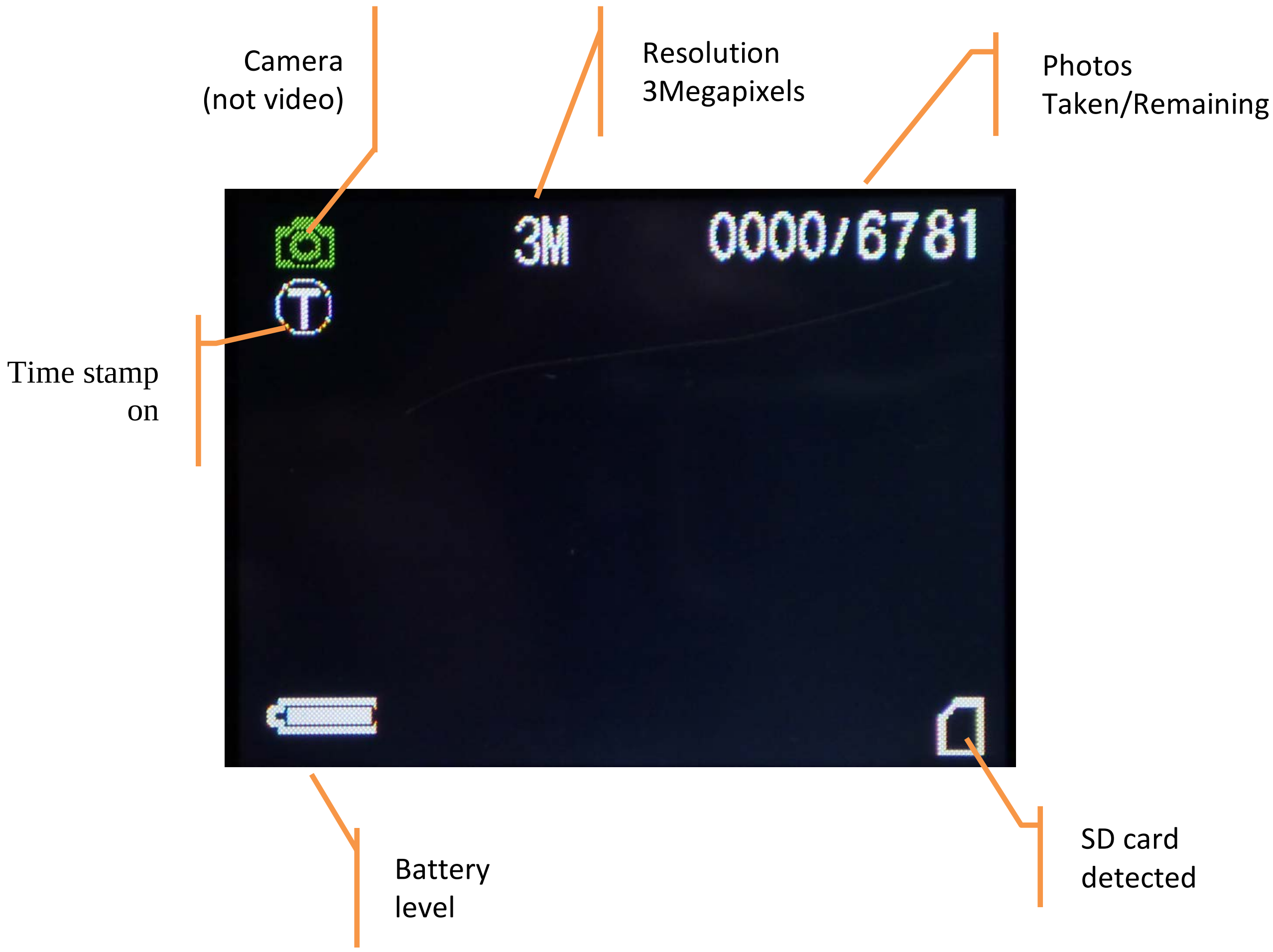
Camera
(not video)
Resolution
3Megapixels
Photos
Taken/Remaining
3M
0000/6781
Time stamp
on
Battery
level
SD card
detected

Figure 4

Datasheet (mobilemapper version also exists)

Observer ___________________

Date ___________________

Time ___________________

Camera number ___________________

Camera connected on arrival **Yes** **No**

Any signs disturbance? **Yes** **No**

Battery: **Full** **¾** **½** **¼** **Empty**

Photos taken/remaining ___________________

SD card swapped **Yes** **No**

After replacing SD card, please check that photos now back to 0/6781 and that resolution= 3M

Flashing on departure? **Yes** **No**

Appendix 2: Camera SD card change Wandown and Menzies 18th of May 2013.

Judy Irvin and David Thompson, VMRG and Mid-Murray Field Naturalists, 22 May 2013

Met at Neil's place at Vinifera at 8:00 am. 4 people, 2 cars and 2 GPSs.

- Barry Wait. Swan Hill.
- Judy Irvin. Swan Hill.
- David Thompson. Vinifera.
- Neil Macfarlane. Vinifera.

Report

We all changed the cards in camera number 1 and 2 together to ensure we all understood the procedure correctly, then Neil and Barry finished the cameras on the Meridian Road (1-8) and Judy and David followed the West Road in Wandown (9-16). We then took alternating turns doing the Menzies cameras (17-24).

Two batteries were found to be flat.

- #Number 9 in Wandown. It had a small amount of charge when we arrived and then ran right out during the process. We added 8 AAs and reconnected the cable. There was no flashing LED on completion, so the camera was opened again and 10 photos had been taken of us looking for the flashing LED! We left the camera connected to the battery though still no flashing LED.
- #Camera number 23 in Menzies was flashing blue and had not taken any photos.
  The camera was pointing up a bit. We added 8 AAs and repositioned it, and the camera was flashing when we left.

Several of the cards had 3000+ photos (often on a roo path): At least two of Neil and Barry's and one of Judy and David's. One had taken 6000 photos.

We had to get through a fence to get to number 17 (over the barb wire fence) and number 18 (under it). That may be a problem for some who would like to help.

We arrived at Wandown at 9:00, completed the whole changeover and had left the area by 4:00 pm.

Suggestions

Light direction on the subject

- Perhaps most cameras should face away from the sun light.
  Some cameras face NNE and may only get photos in silhouette and not good colour. You could compare photos to location to see if this was an issue or not- as I wrote what direction the camera faced at times.

Plastic bags

Many plastic battery bags were holed: Some by Mallee stumps laid over top, but most obviously were chewed with several largish holes or many small holes. Some plastic bags had ant's eggs inside, with the many small holes (approximately 50 to 100 mm) on the underside - termites? Some bags had significant condensation. It seems likely that water is running down the cable and into bag. We tried to seal the bags well and place the sealed opening under the battery, so rain water would run to the ground first before entering the bag. The bags we swapped to were thicker- may be less likely to hole. The holed bags let water in, but also let moisture evaporate. Refer to the report sheets re state of moisture and bags.

- Could it be investigated as to whether there is a way for the battery bag to breathe, but not let water in, to stop condensation?
- A longer battery cord to the camera may be advisable so we could create a ‘loop/bend’ to allow water tracking down the cord to run off, before the cord then bends up and enters the bag.
- Perhaps don’t fix the camera too low, to make it simpler to remove and replace the power cord in a shorter time: As it was harder to see to get the cord in. I imagine the lower mounted cameras might have less of a problem with sway however?

Disguising the battery:

- Maybe don’t use Triodia to cover battery (painful to move) However Neil said it did cover the battery the best though).
- Maybe not use grass or finest light sticks (blows away).
- Consider a branch of leaves, bark and large sticks to weigh them down over the battery.
- The stumps worked – probably insulated the battery from heat also.

Instructions:

We needed all the instructions, step by step. These were clear. It ensured we didn’t miss a step, as we otherwise would have several times.

- Put all instructions on one page, so no need to flip pages. Add ‘changing the camera bag’ to the list. After changing card and before resetting camera – if you need to do that again.

Report forms

- Add to the recording sheet to complete: To tick the following are displayed - 3M, Battery Full, Card in indicator on- so we DID all check all.
- Add the height above ground, direction of the camera or other comment on camera position. We wrote if it was loose and that we tightened it.

Managing the cards:

The 2 business card folders worked well. Might be good to have these set up like a ‘cartridge’, loaded with new cards with the used ones going into a second folder.

- I used the large plastic bag as a clean surface to work on, while removing, labelling and replacing the cards in the folders. Otherwise sand could get onto the cards quite readily. If not changing bags, bring a cloth then.
- Consider labelling the two sets of cards differently: 1 and 1A, 2 and 2A - so we know which has been used so there are no mix ups. *Eg ‘We are replacing all the Numbered cards with the Number+A cards this time”.* However this time there wasn’t much likelihood we’d mix it up, with 2 of us changing the cards this time. One dispensed the card, the other inserted or removed it from the camera

Possible extras in ‘SD Card changing kit’ for the day:

- Electrical tape for cable repairs, Spare AA batteries or extra batteries.
- Volt meter if someone knew how to use it
- Spare plastic bags and dot stickers.
- Pens and extra record sheets.
- Glove or tongs for moving the Tiodia
- Clean surface to put on the ground to protect the SD cards in changeover.

We had a calico bag a shoulder strap, with several ‘patch pockets’ sown on. This helped carry and organise everything and ensure the cards were secure.

- The SD cards folder only went in one pocket on its own. So can’t lose any cards.
- Map, instructions, plastic bags, pens and note book went in another pocket.