

ZSL Trail Camera Comparison Testing

29th August 2017

Location: Regent's Park, London

Weather: 27°C, medium gusty wind, sunny with clouds.

BLUF

The results reveal that all trail cameras have strengths and weaknesses and it is up to the user to match their requirements against the performance found. Table 3 in conclusions and recommendations summarises each cameras performance in these tests.

Introduction

From a questionnaire of ZSL conservationists with years of experience using trail cameras it was determined that:

- Wildlife monitors need a detection range between 0 – 20 metres with a very high degree of accuracy, i.e. animals must not be missed.
- Trail cameras are usually set to take a burst of images for every trigger to ensure the animal is captured. Alternatively the camera is set-up to take an image with the minimum time delay between trigger events. This ensures that if a group of animals pass the camera they are all captured.
- Image quality must be good enough so that an animals distinct features can be determined for identification.

Therefore this trail camera testing was designed to compare a range of trail cameras for:

1. Detection range – 5 metres out to 20 metres.
2. Detection accuracy – to ensure every pass of the camera was captured.
3. Burst speed – to see how quickly the camera captures images and recovers.
4. Image quality – images need to have good colour and clarity to identify animals.

What this testing does not reveal:

- Accuracy of detection over time – cameras could not be left in place for an extended test so it is unknown how clouds, weather or foliage would contribute to false alerts.

Camera Set-Up

Ten trail camera were selected for the testing and are listed in Annex A. Every camera was fully loaded with charged AA Duracell Rechargeable NiMH 1.2V/2500mAh batteries and had a new empty Transcend 8GB SD HC Cat 10 SD card inserted.

Cameras were set to:

- The lowest resolution images in the settings (usually 2 - 3 MP).
- To take a burst of images per trigger (usually 3 images).
- Highest PIR sensitivity settings.
- Lowest trigger interval (usually 1 second).

Test Set-Up

The cameras were mounted in two rows of five cameras with 20 cm of lateral separation with row heights of 1.5 metres and 1.7 metres above the ground. This meant that all the cameras had extremely similar fields of view.

Bamboo sticks with pink flags acted as distance markers and were placed in parallel lines in front of the cameras at 5, 10, 15 and 20 metres. At 5 metres the bamboo markers were separated in 1 metre increments. At 10, 15 and 20 metres the bamboo markers were separated by 2 metre increments. This enabled easy analysis of captured images.

The test target conducted six walk passes and four run passes at each distance. When walking the speed was approximately 3-4mph and when running 6-7 mph. For each pass a numbered sign was carried: Numbers 1-6 for walks and 7-10 for runs.

The test target would start each pass 10 metres from the first marker in a line, well outside the cameras fields of view. The target would then pass directly behind the bamboo markers along the line and on for a further 10 metres. They then waited for 20 seconds before turning around and making the next pass in the sequence.

Pictures 1 & 2 and Figure 1 show the test set-up.



Picture 1 - Trail cameras on test. From left to right, top then bottom: Bestguarder SG009, L-Shine, Bushnell, Bestguarder 880, Ltl Acorn, Reconyx, Scoutguard 983, Scoutguard 880, Scoutguard 883, HCO Spartan



Picture 2 - Overview of test set-up showing bamboo markers

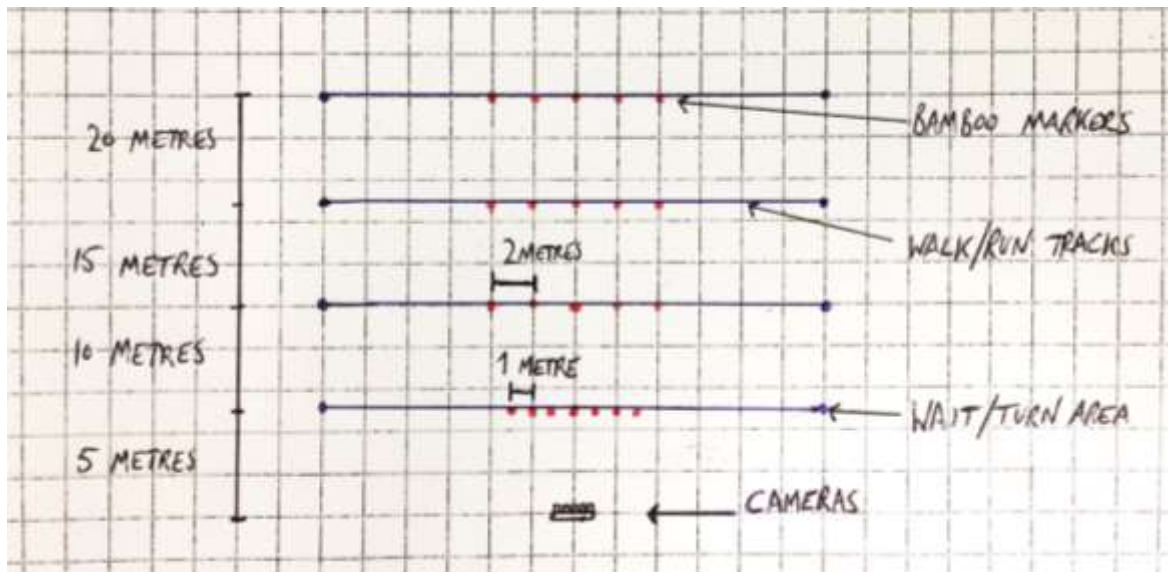


Figure 1 - Diagram of test set-up showing distances

Image analysis

Images were analysed and rated for each camera for every pass. A score of 2 was given to images where the target is captured and easily identifiable. A score of 1 was given where the target is only glimpsed or hard to identify. A score of 0 was given where an image is empty. Passes where no image was captured was recorded and marked with #. These results can be seen in Appendix 1.

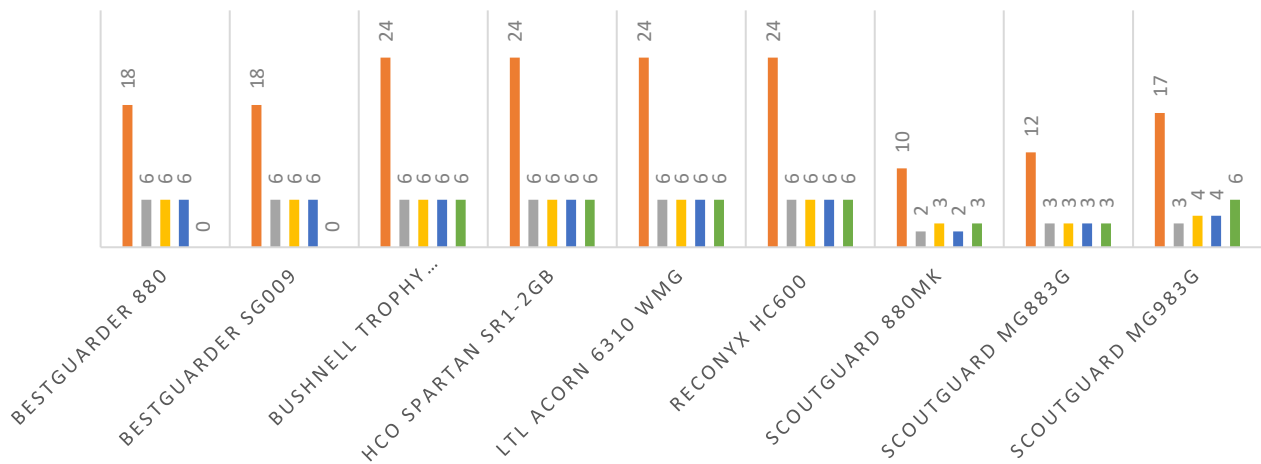
Results

1. Detection Range

Detection range simply shows how far away a target can pass from the camera and still be detected. To understand how the cameras compare it is useful to show how frequently they detected passes at these ranges and also how the speed of the passing target affected detection. To show this the results have been split between the walk passes and the run passes.

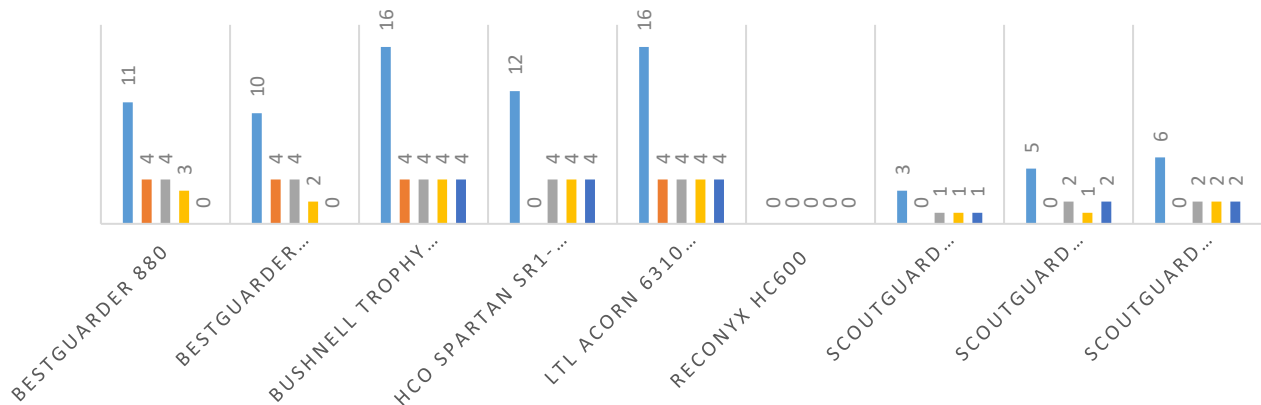
GRAPH 1 - NUMBER OF WALK PASSES CAPTURED BY DIFFERENT TRAIL CAMERAS AT VARIOUS DISTANCES

- Total Number of walk passes captured (out of 24)
- Number of walk passes captured at 5 metres (out of 6)
- Number of walk passes captured at 10 metres (out of 6)
- Number of walk passes captured at 15 metres (out of 6)
- Number of walk passes captured at 20 metres (out of 6)



GRAPH 2 - NUMBER OF RUN PASSES CAPTURED BY DIFFERENT TRAIL CAMERAS AT VARIOUS DISTANCES

- Total Number of run passes captured (out of 16)
- Number of run passes captured at 5 metres (out of 4)
- Number of run passes captured at 10 metres (out of 4)
- Number of run passes captured at 15 metres (out of 4)
- Number of run passes captured at 20 metres (out of 4)



- Only Bushnell and the Ltl Acorn detected all target passes at all ranges. However these cameras also took significantly more pictures than the other cameras.
- Bestguarder cameras performed well but were unable to detect the target at the 20 metre point. This indicates that the Bestguarder cameras have a short detection distance of 15 metres.
- Scoutguard cameras could detect out to 20 metres. However, detection for all models was sporadic with many passes missed. This wasn't affected by which direction the pass was being made from. Mostly the missed passes were immediately following a detected pass. This may indicate that the recovery time is longer than the 20 seconds waited and time out of the PIR detection zone between passes.
- Reconyx could not detect running passes at any distance.

2. Detection Accuracy

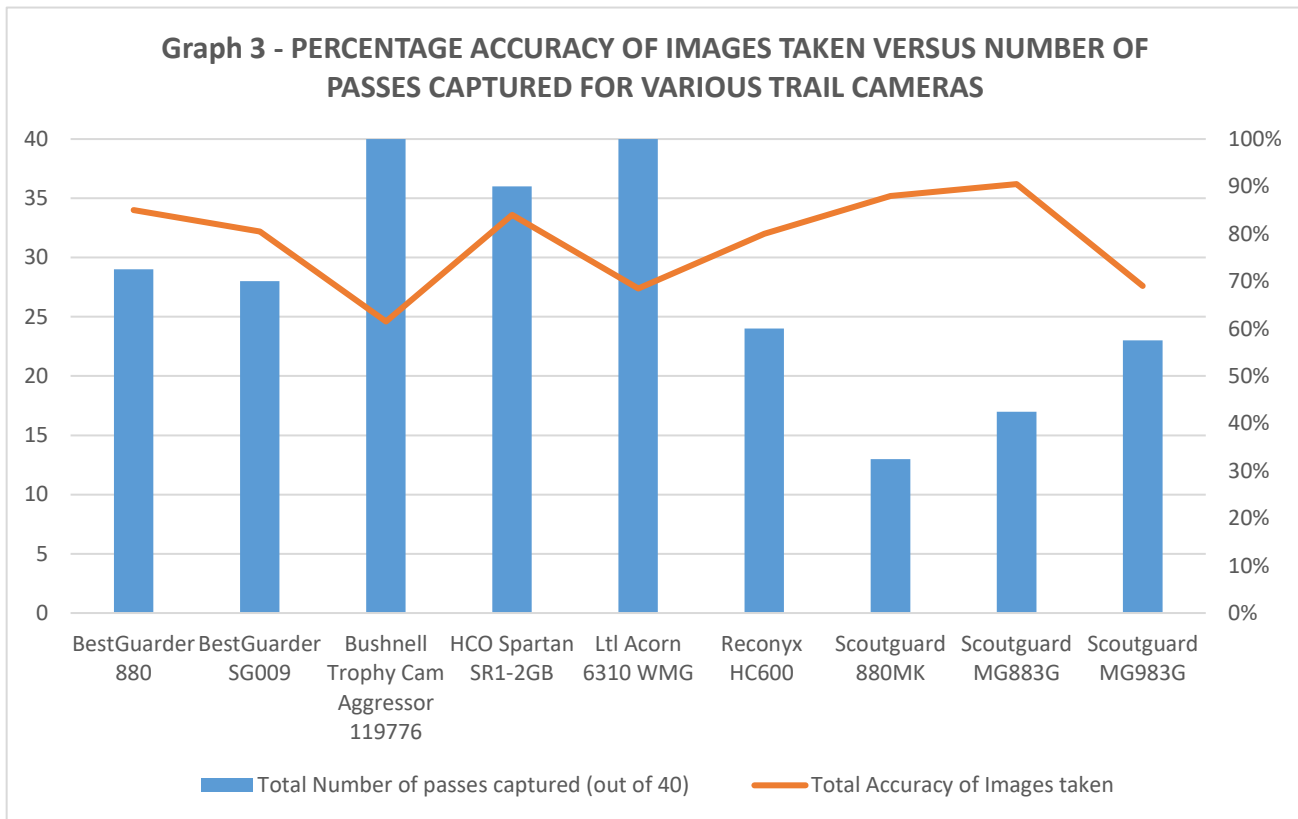
Detection accuracy is more useful than detection range when establishing the effectiveness of a trail camera. The detection range results have already shown how frequently passes were detected at different distances but they do not show how many images were captured for each pass or how many images were taken that missed the target. This is useful to know which cameras will take a lot of false alert images and will therefore waste battery power or data if transmitting the image on.

NB : Although cameras were set to take three image bursts per trigger with the minimum interval between PIR triggering (mostly 1 second), when the Bushnell camera is set at 1 second PIR interval it will not take a burst but only 1 image a second for as long as a trigger event is detected.

Graph 3 broadly shows the detection accuracy percentage (images with target captured divided by images taken multiplied by 100) against the total number of target detections. This data shows that the Bushnell has low detection accuracy but good target detection whereas the Scoutguards have high detection accuracy but poor target detection.

In other words the Bushnell detects target passes every time, takes a lot of images and although some capture the target many others miss, whereas the Scoutguards entirely miss many target passes but when they do trigger they capture the target accurately.

This indicates that the Bushnell PIR detection zone is very wide so that often the target is detected but has already left the field of view. Conversely the Scoutguards may have a narrow PIR detection zone.



A better representation of detection accuracy is provided by comparing the number of images taken versus the number of images in which the target was captured at each distance. This is shown in the Graphs 4,5,6,7 and 8.

For most cameras they are most accurate at target detection and target capture at 20 metres (except the Bestguarders). At 20 metres the field of view and PIR detection zone is largest and the target has the most distance to move across the cameras' field of view. Therefore every image in a burst would capture the target moving across the field of view.

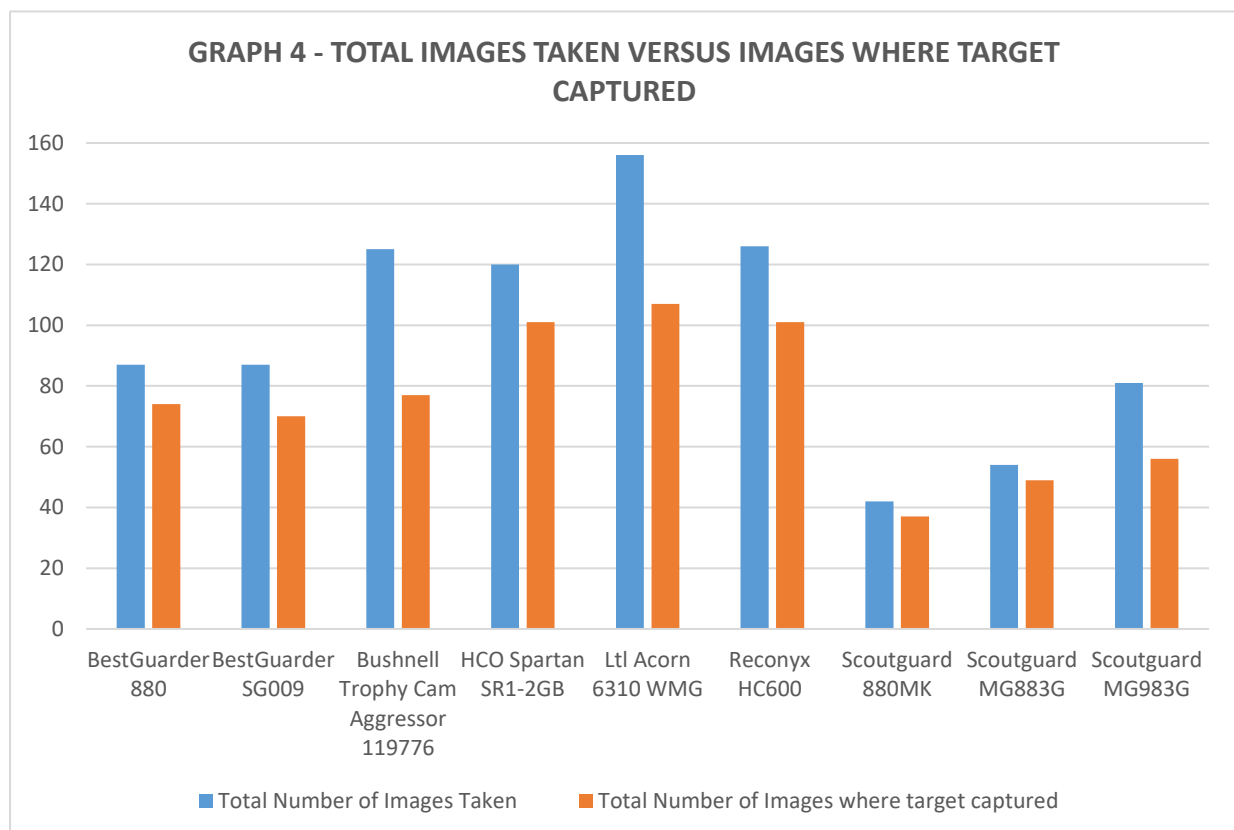
The Ltl Acorn is unique in that it uses three PIR sensors. This explains why the Ltl Acorn has taken so many images. The camera has two PIR sensors that face sideways. When triggered these wake up the camera before the target moves into the central PIR's detection zone. The results show that the Ltl Acorn would frequently take a second burst of three images per pass that would all miss the target, likely triggered by the side PIR sensor.

Scoutguard 880MK and Scoutguard SG883G never managed to take consecutive passes, indicating a slow PIR recovery time between camera triggering or a temperamental PIR sensor. They missed a lot of passes because of this. The Scoutguard MG983G did take consecutive images occasionally but also missed a lot of images. This indicates a temperamental PIR sensor rather than a long recovery between camera triggering.

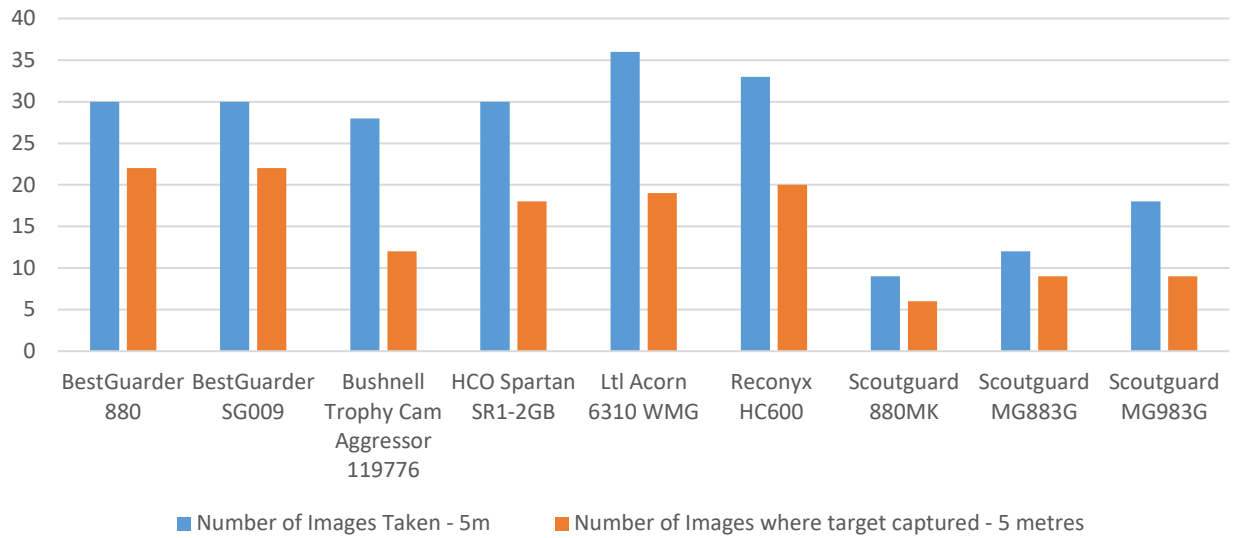
Detection accuracy should also include the position of the target in the cameras field of view. This tells us how wide or narrow the PIR detection zone is likely to be and also how fast the camera wakes up from sleep when a target is detected to take the first image. The more central the target is captured the better.

From the images it is possible to determine that the cameras fall into these categories:

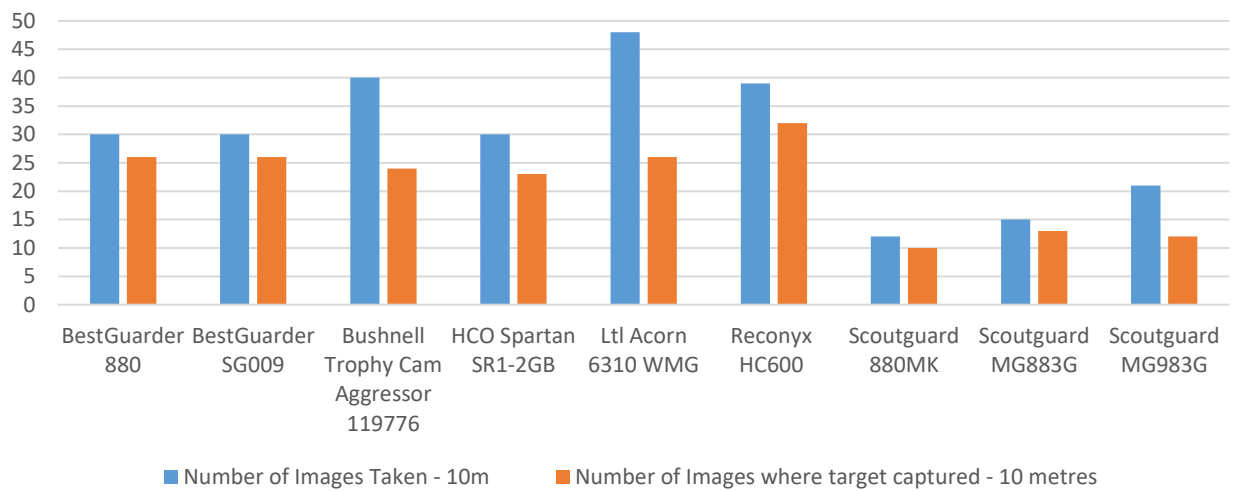
Table 1 - Target Location	
Central target = Narrow PIR detection zone	Side and centre target = Wide PIR detection zone
BestGuarder 880	Bushnell Trophy Cam Aggressor 119776
BestGuarder SG009	Ltl Acorn 6310 WMG
HCO Spartan SR1-2GB	Reconyx HC600
Scoutguard 880MK	
Scoutguard MG883G	
Scoutguard MG983G	

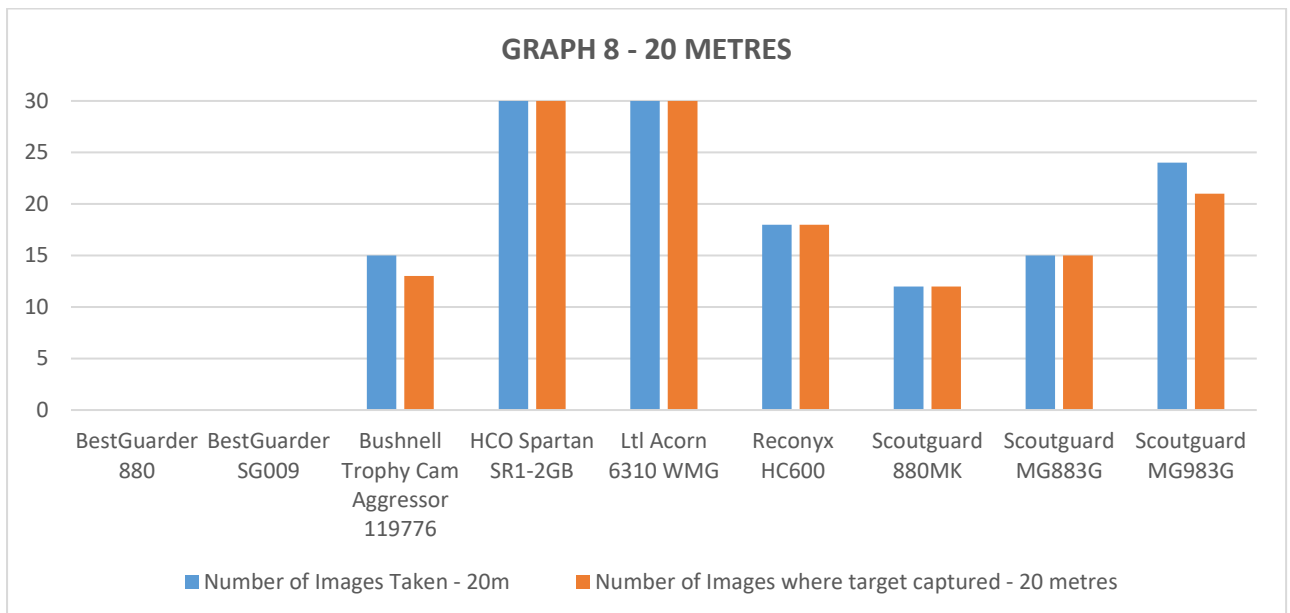
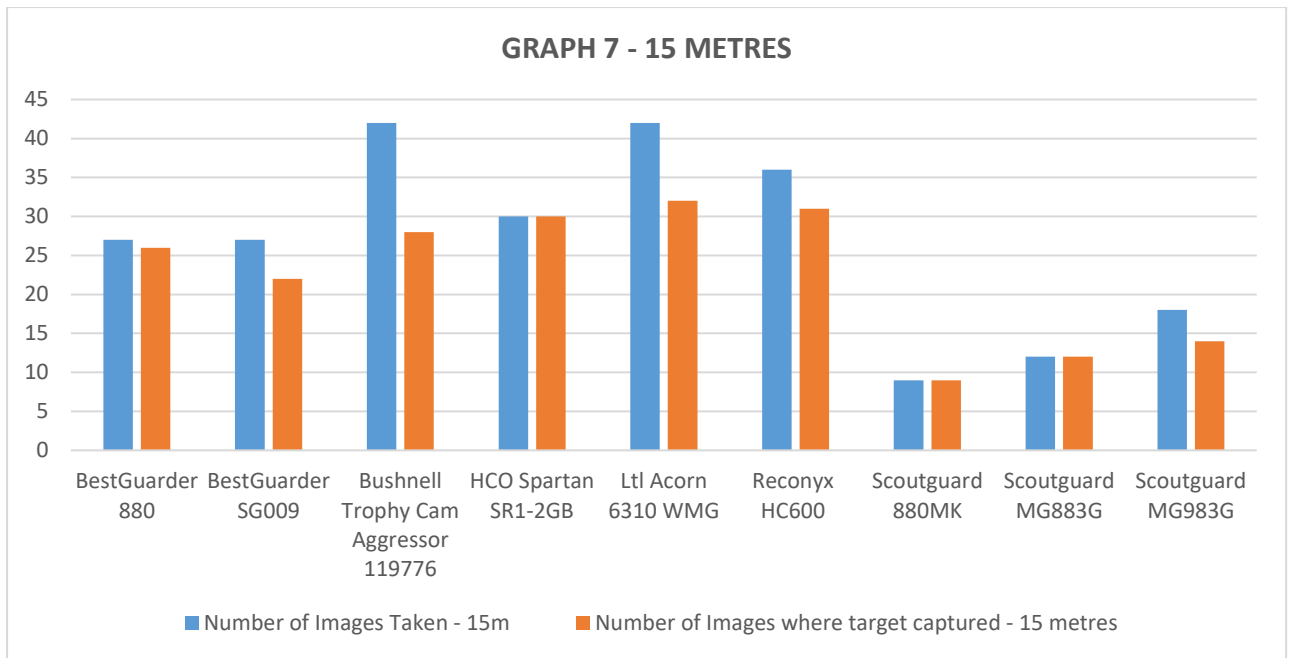


GRAPH 5 - 5 METRES



GRAPH 6 - 10 METRES





3. Burst Speed

Burst speed is hard to compare accurately but from taking measurements of how far the target has moved across the field of view in the captured images, shown in Table 2, it is possible to see which cameras take fast and slow bursts of images. It is not known the exact speed of the target so a time calculation has not been attempted.

NB: Bushnell was not taking bursts of images and so this reveals how quickly the camera resets itself after triggering. For Bushnell there is a larger gap between the first and second image taken than the second and all further images taken.

Table 2 - Distance target has moved from first image to third in a 3 image burst (metres)		
	Walk	Run
BestGuarder 880	3	9
BestGuarder SG009	3	9
Bushnell Trophy Cam Aggressor 119776	Total = 3 (first - second image = 2., second - third image = 1)	9
HCO Spartan SR1-2GB	3	9
Ltl Acorn 6310 WMG	4.5	12
Reconyx HC600	2.25	N/A
Scoutguard 880MK	1	3
Scoutguard MG883G	1	3
Scoutguard MG983G	1	3

- Bestguarders, Bushnell and HCO Spartan all have similar burst speeds, allowing the target to move 1.5 metres across the field of view between images. *NB: this is the Bushnell's recovery time, not burst speed.*
- The Scoutguards have the fastest burst speed, target only moves 0.5 metres between images, followed by the Reconyx, 1.125 metres.
- The Ltl Acorn has very slow burst speeds, allowing the target to move 2.25 metres between images.
- The Ltl Acorn would often take two bursts of 3 images per target pass. There would be a 3 second gap (from the cameras timestamp) between these bursts.
- The Reconyx takes bursts of 3 images with 1 second intervals and can continue shooting after 1 second recovery giving a good series of images.

4. Image Quality

Assessing image quality is subjective. Each camera's images have been assessed for image colour, contrast and clarity and a summary noting any other peculiarities for that camera. An image from the same pass for each camera is included below (except for Scoutguard MG880K which is from the preceding pass).

Bestguarder 880 and SG009: Good colour and contrast and good clarity.

Bestguarder 880



Bestguarder SG009



Bushnell: Quite dark images but good clarity. Target often caught on very periphery of image.



HCO Spartan: Colour washed out and purplish with bad clarity/contrast.



Ltl Acorn: Colour slightly washed out but ok clarity.



Reconyx: Quite dark images with dark contrast. Good clarity. Wide angle fish eye style field of view so can see more than other cameras. Images get distorted at edge of field of view.



Scoutguard 880MK: Slightly dark images and washed out. Good clarity. Vignetting at the corners of images.



Scoutguard SG883G: Very vivid bright colour images, almost oversaturated. Good clarity. Vignetting at the corners.



Scoutguard MG983G: Good colour and contrast. Good clarity.



Conclusions and Recommendations

This testing was quite basic and did not go in to depth on each of the cameras functionality. Nothing was tested in regards to cameras cellular functionality.

Cellular enabled cameras gave an interesting result with narrow PIR detection zones compared to field of views. This means that targets are usually in the middle of the frame when captured and that the number of false images captured where the target is missed is reduced.

However although the accuracy of pictures taken containing targets is high the actual camera accuracy of passes captured is low. This might be a deliberate design to ensure that users are only receiving images containing targets, so the camera appears accurate by only sending through captured targets. It is unlikely the user would ever know how many targets were missed anyway!

A quick test of the Ltl Acorn to try and establish the difference between having the side PIRs on and off showed little difference except that the camera would trigger slightly more when the target was outside the field of view with them off. I assume from this that it has a slow wake up time.

In Appendix 1 you will see that the Ltl Acorn took a lot more images compared to other cameras and it is assumed that this would burn through batteries – probably why it can hold so many. If used as a cellular camera it would be sending lots of empty images.

It is recommended to use cameras with wide PIR detection areas where the camera is not pointed at a defined track and animals can pass the camera from all angles.

For great image quality the Reconyx is recommended.

For best chance of target capture (regardless of accuracy) Bushnell are recommended.

Table 3 – Summary of Results									
	BestGuarder 880	BestGuarder SG009	Bushnell Trophy Cam Aggressor 119776	HCO Spartan SR1-2GB	Ltl Acorn 6310 WMG	Reconyx HC600	Scoutguard 880MK	Scoutguard MG883G	Scoutguard MG983G
Cost	£85	£85	£194	£155	£150	£440	£215	£255	£250
Detection Range (walking)	5 - 15 metres	5 - 15 metres	5 - 20 metres	5 - 20 metres	5 - 20 metres	5 - 20 metres	5 - 20 metres	5 - 20 metres	5 - 20 metres
Detection Range (running)	5 - 15 metres	5 - 15 metres	5 - 20 metres	5 - 20 metres	5 - 20 metres	N/A	5 - 20 metres	5 - 20 metres	5 - 20 metres
Total Number of passes captured (out of 40)	29	28	40	36	40	24	13	17	23
Number of passes captured at 5 metres (out of 10)	10	10	10	6	10	6	2	3	3
Number of passes captured at 10 metres (out of 10)	10	10	10	10	10	6	4	5	6
Number of passes captured at 15 metres (out of 10)	9	8	10	10	10	6	3	4	6
Number of passes captured at 20 metres (out of 10)	0	0	10	10	10	6	4	5	8
Percentage success - Total (%)	72.5	70	100	90	100	60	32.5	42.5	57.5
Percentage success - 5m (%)	100	100	100	60	100	60	20	30	30
Percentage success - 10m (%)	100	100	100	100	100	60	40	50	60
Percentage success - 15m (%)	90	80	100	100	100	60	30	40	60
Percentage success - 20m (%)	0	0	100	100	100	60	40	50	80

Total Number of Images Taken	87	87	125	120	156	126	42	54	81
Number of Images Taken - 5m	30	30	28	30	36	33	9	12	18
Number of Images Taken - 10m	30	30	40	30	48	39	12	15	21
Number of Images Taken - 15m	27	27	42	30	42	36	9	12	18
Number of Images Taken - 20m	0	0	15	30	30	18	12	15	24
Total Number of Images where target captured	74	70	77	101	107	101	37	49	56
Number of Images where target captured - 5 metres	22	22	12	18	19	20	6	9	9
Number of Images where target captured - 10 metres	26	26	24	23	26	32	10	13	12
Number of Images where target captured - 15 metres	26	22	28	30	32	31	9	12	14
Number of Images where target captured - 20 metres	0	0	13	30	30	18	12	15	21
Total Accuracy of Images taken	85%	80.50%	61.50%	84%	68.50%	80%	88%	90.50%	69%
Target Location in Images	Central Only	Central Only	Side and Central	Central Only	Side and Central	Side and Central	Central Only	Central Only	Central Only
Assessed PIR Detection Zone	Narrow	Narrow	Wide	Narrow	Wide	Wide	Narrow	Narrow	Narrow
Burst Speed	Fast	Fast	Fast	Fast	Slow	Fast	Very Fast	Very Fast	Very Fast