

White Papers on Trail Cameras

With many new cameras entering the market with different configurations and functions at different prices, the ordinary users are often confused about what to buy, and even what the specifications mean.

This white paper is meant to provide some guidance to the ordinary users who desire to know a little more about the trail cameras before they make a buying decision.

1. Websites dedicated to Trail Camera Reviews

There are quite a few websites dedicated to trail camera reviews. They offer detailed reviews for many models released each year. The following is just a short list of these sites:

A. <http://www.chasingame.com>

B. <http://www.whitetaildeer-management-and-hunting.com/digital-trail-camera-reviews.html>

C. <http://www.trailcampro.com/reviews.aspx>

D. http://trailcam.com/blogs/trail_camera_reviews/default.aspx

E. <http://trailcamerareviews.com/>

F. <http://www.sportsmansreview.com/reviewgrid.asp?n=Digital+Trail+Cameras>

While these websites contain info. and reviewer's opinions on the camera models, they may not help solving your needs of buying the right camera you need, because they are mostly operated by game camera manufacturers providing **misleading** info.

So the bottom line, don't trust what a manufacturer say, but do more side-by-side comparison tests, and let the facts speak.

2. Important Things for a Trail Camera

The following table summarizes the technical features in terms of importance ranking on a trail camera:

Rank	Feature	The Effect	Good Numbers
#1	Detection Distance (DD)	Distance detecting an animal	85ft-100ft
#2	Detection Angle (DA)	The angle	50-80 degrees
#3	Detection Range = DD x DA	Area where animal can be detected	350-2400 square ft.
#4	Flash Range	How far LED can illuminate	> 80-100 ft
#5	100° vs 50° angle	How big is the View angle?	>70° is called wide angle
#6	Motion Blur?	Picture will be blurred when object is moving	Motion Sharp is desired

#7	Trigger Speed	Time from waking up to capture	< 1 second
#8	Shutter Speed	Affects Motion Blur and Image brightness	< 1/15 second
#9	False Alarming rate	Percent of Picture/video taken has no animal	< 5%
#10	Missing Rate	Percent of animal visits but camera does not capture	< 10%
#11	Image Quality	Whether it pleases to the eye	Too many things to look
#12	Reliability	How many years a camera lasts?	>5 years
#13	Battery Efficiency	How many pictures are taken with the same set of batteries?	8K pics with 8 AA batteries

3. Things to Look on Image Quality

While image quality is fairly subjective, there are many objective things you can check to determine the image qualities. The following is a table of the image quality items to look at.

Aspect	What to look	Notes
Brightness	Is picture too bright or too dark	Neutral is good
Contrast	Is picture foggy or both too dark and too bright	Clear is good
Color Fidelity	Is color natural	Natural is good
Color Saturation	Is Color rich and pleasing your eyes	Natural is good
Noise	Does picture contain random, unpleasing dots	Less is good
Detail	Zooming a picture to 100%, do you see details?	Many is good
Sharpness	Are the edges sharp and the objects clear? Are the edges blurred?	Sharp is good
Uniformity	Does the center and the peripheral of a picture have the same brightness?	Uniform is good
Motion Blur	Is a moving animal clear in the picture?	Sharp is good
Skin Tone	Does the human skin look healthy & beautiful?	To your taste
Color Alias	Do the colors (especially near edges) look pure and clean?	Smooth is good
Dynamic range	Is sky or light bulb over exposed? Can you see things on the dark areas?	Seeing both dark and bright areas is good

4. Detection Range vs. Trigger Speed

Some camera manufacturers emphasizing on Trigger Speed, while others emphasizing on Detection Range. What is more important and how they fare in real actions?

First of this is an Apple to Orange comparison. So we have to look at the objectives of Motion-triggered cameras. The purpose of Motion-triggered cameras includes:

1. When the animal/person comes, camera must detect; =>low missing rate
2. When nobody is there, camera must not take pictures; =>low false alarming rate.

As such, larger Detection Range directly leads to low missing rate, and low false alarming rate, and hence is much more important than fast trigger. Fast trigger is not the purpose of a trail camera, it is only one way to assure that when the animal comes, its picture/video will be taken (to assure low missing rate).

A 3x-4x wider detection area leads to 3x-10x more pictures taken and hence much lower Missing Rate. As a matter of fact, a larger detection range is 2-3 seconds faster than a fast trigger camera, because cameras with larger range detection finishes picture/video taking before cameras with smaller detection ranges even wake up.

The attached animation explains why.

5. **Wide Angle vs. Regular Angle**

Most cameras on the market today has only 50-52 degree viewing angles. A few of them have more than 90 degree. A wide-angle camera covers 3x-4x more area than a regular angle camera. However, a wide-angle camera has the following weaknesses:

- i. The pictures/videos on a wide-angle camera is typically less clear than those on a regular angle camera, if both using the same image sensor and lens.
- ii. The night picture/video on a wide-angle camera is much darker than a regular angle camera, if the same LEDs are used (assume same image sensor and DSP).

That means, the picture/video quality of a wide-angle camera is typically poorer than a regular lens camera.

In fact, it is very difficult to deliver even a 850nm IR (Red IR) wide angle camera at acceptable quality.

Boly is the only game camera maker that produces wide-angle camera with Black IR at at high quality and deliver Long Range lighting and sensing at the same time.

6. **Wide Angle vs. Long Range**

Increase the distance of detection and lighting is difficult, as such, some manufacturers try to use wide angle to increase the detection and capture area, to compensate the shortcomings of their detection and lighting ranges.

Theoretically, a 2x Wide Angle Detection can cover the same area of a 2x Long Range Detection, but practically, Long Range is still better than Wide Angle detection for the following reasons:

1. In most trail application scenarios, the ROI (region of interest) has a narrow angle of 50 degrees or less. In such cases, Wide Angle has no uses;

2. Detection range falls dramatically when angle increase. As such, those who use 3-nose design typically has only a detection range of 20ft at the peripheral of the detection area, thus leading to a detection area increase of only 1.5x, while a 2x Long Range Detection can lead to a 4x detection area increase.
3. Wide Angle Detection requires a wide angle camera lens and a wide angle Lighting to match the angle of Wide Angle Detection. Wide Angle Lens brings forth a image distortion issue and dark peripheral area for night picture/videos .
4. Wide Angle Lens has a much lower image resolution than a Long Range Camera. First of all, Wide Angle lens has a much lower optical resolution than a regular angle (50 degree) lens. Secondly, since a wide angle lens covers a much wider fields of view, it requires a 4x more pixels image sensor to provide the same image detail and sharpness. Most wide angle cameras on the market today have a highest image resolution of 5MP, which is insufficient for 80+ degree wide angle cameras.

As such, the wide angle cameras on the market today, all fail to compete with 2x Long Range cameras.

Boly is the only game camera maker that produces camera with both Wide Angle and Long Range in the same camera.

7. Matching of Detection Range and Lighting Ranging

Whether a camera tries to extend the detection range by lengthening the detection distance or widening the detection angle, the Range of Lighting needs to be increased so match the Range of Detection.

For example,

1. If the detection range is 100ft x 50 degree, then the lighting needs also cover 100ft x 50 degree;
2. If the detection range is 50ft x 100 degree, then the lighting needs also cover 50ft x 100 degree.

Otherwise, at night time,

1. a camera may have detected an animal, but the camera cannot see it because it is too dark;
2. a camera may be able to see it, but the detection sensor cannot detect, and then the Lighting module just wastes the lighting capability and battery energy.

8. Image Resolution (pixel count, or MPs)

Image resolution is a very important factor, but not the only one, for picture sharpness and clarity. There are also other factors, for example, lens quality, image processing hardware or software quality, that also affect picture sharpness and clarity.

Many cheap cameras all use Interpolation to stretch Raw image sensor resolution to a higher resolution. There are the following facts that need to know about interpolation:

1. An interpolated picture does not bring in any new information about the scene. All information is already contained in the Raw, un-interpolated picture;
2. There are major differences between good or bad interpolation hardware or software. A bad interpolator really sucks.
3. Only high quality images can be interpolated, and the maximum interpolation factor is typically 3x. Anything more than 3x is really useless.
4. A PC or Phone software does better job than most game camera on interpolation. Typically, you can take a native sized picture and let the computer or mobile phone to do the interpolation when you need it.

To summarize, unless the camera does a better interpolation than the PC or phone, any interpolation in the camera is a marketing hype and useless.

Boly is the only game camera maker that has a better Interpolation method than most PC software, including Windows and Macintosh.

9. Motion Sharp vs. Motion Blur

Night time pictures are typically much less clearer than day time pictures. Low MP cameras are also less clearer than high MP pictures. Another factor that affects picture clarity is Motion Blur. Pictures of moving objects will all suffer the Motion Blur problem.

Not only Boly leads High Pixel camera and night time pic/video quality, Boly is also the only game camera maker that produces Motion Sharp™ cameras.

Motion Sharp™ is a much desired feature for high-end and security customers.

10. Not all hardware is born equal

Two manufacturers may not produce the same level of camera even if they use the same major components. Now, if they use different components, or patented technologies, then the quality and performance differences may be pulled further.

11. The Key Differentiating factors of Boly Cameras

Boly Cameras stand out among existing trail camera manufacturers in the following aspects:

- i) Patented Long Range and wide-angle motion sensing technology; while the whole industry is in the range of 50ft x 50 degree detection, Boly has 100ft x80 degree detection in mass production, covering 6.4x more detection area than competitors.
- ii) In-house design of high quality lens: Boly's large aperture lens is tailored for trail

cameras and has 10-40% larger aperture and at the same time provides 20-30% more resolution.

- iii) High quality components and strict QC checking: Boly uses only high quality suppliers and do strict in-house checking before product shipping.
- iv) World-leading BolyRaw™ image processing technology:
 - i) BolyRaw allows 2x longer lighting range with the same set of batteries and LED lights.
 - ii) BolyRaw allows 2x image resolution with the same image sensor;
 - iii) BolyRaw produces the most natural and stable color;
- v) World-leading SuperScale™ image scaling technology:
 - i) Allows interpolating a 5MP image to 10MP and make it the same quality as any other genuine 10M image.
 - ii) Fast and takes minimum memory.
- vi) Patented Motion Sharp™ technology: take clear pictures of running animals.

12. What is Interpolation:

Say, a picture of 4x3 has the following pixels:

A	B	C	D
E	F	G	H
I	J	K	L

Now, we wish to make it to a larger picture of 7x5 pixels. Then, the software method to do it is using interpolation: to add more pixels in between original pixels so to have a larger image. The most commonly used interpolation method is bi-linear, which looks like as the following:

A	$(A+B)/2$	B	$(B+C)/2$	C	$(C+D)/2$	D
$(A+E)/2$	$(A+B+E+F)/4$	$(B+F)/2$	$(B+C+F+G)/4$	$(C+G)/2$	$(C+D+G+H)/4$	$(D+H)/2$
E	$(E+F)/2$	F	$(F+G)/2$	G	$(G+H)/2$	H
$(E+I)/2$	$(E+F+I+J)/4$	$(F+J)/2$	$(F+G+J+K)/4$	$(A+E)/2$	$(G+H+K+L)/4$	$(A+E)/2$
I	$(I+J)/2$	J	$(J+K)/2$	K	$(K+L)/2$	L

As you can see above, **Blue** pixels are added based on neighboring horizontal pixels, **Green** pixels are added based on neighboring vertical pixels, and **Red** pixels are added based on both vertical and horizontal neighboring pixels.

Interpolation is a way to add artificial pixels into the original picture, and hence:

1. It does not bring in any New Information; it only makes it looks larger.
2. Different interpolation method produces different visual effects.
3. If you zoom an interpolated image to 100% display resolution, you will generally

see blurred, fuzzy pictures compared to non-interpolated pictures.

4. Only the best interpolation method provides value, and anything worse than PC software or mobile phone software provides only negative value: it is a waste of time, battery, and storage spaces. You can enlarge it on the PC or phone.

As such, Interpolation on the large is a marketing hype and provides only negative value to the user. Only camera companies that have better interpolation technologies can provide positive value to the consumer when performing interpolation in the camera.

As a thumb of rule, the physical resolution (MPs) of an image sensor determines the resolution of a camera, not its interpolated pixels. However many pixels a camera interpolates is irrelevant, the only relevant thing is its image sensor resolution (MPs).