A Year in the Life of the White-tailed Deer
Through the eyes of a deer

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You've just topped over a little rise, and there he stands – less than 100 yards away. Looking straight at you! You freeze, but you know you've been spotted. You know that at any instant he's going to bolt. But amazingly, after a short while he drops his head and resumes his search for acorns! "Certainly he saw me", you think, "I see him clear as day. Why didn't he recognize me as a human? Is he just stupid?"

I imagine that any deer hunter who has spent any time in the woods can relate very similar experiences. Why does it seem that a deer can look directly at something, and still not 'see' it? The answer lies in how a deer's eyes are constructed. A deer's view of the world is very different than how we see it. Our eyes, and those of a deer, are adapted for very different purposes, and understanding these differences can not only make you a better hunter, but a safer hunter as well.

As prey animals, deer must constantly be on the lookout around them. Their eyes are set on the sides of the head, and protrude slightly from the skull. Although they cannot see directly behind themselves, this eye placement gives a deer a field of vision of about 310 degrees, which would explain how a deer can see a bowhunter draw back even with a quartering-away shot.

Every hunter certainly has noticed that a deer's eyes are larger than ours in comparison to our relative body sizes. This larger eye allows the pupil opening to be much larger than ours, particularly in low light conditions. A larger pupil opening greatly enhances the light gathering ability of the deer's eye. In fact, due to the larger pupil opening, a deer's eye may allow 10 times (or more) light to enter the eye than ours. In addition, like other animals that are adapted for nocturnal behavior such as cats, dogs, and even whippoorwills, deer have a reflective membrane located at the back of the eye. This membrane, called the tapetum lucidum, is what causes the eyeshine of deer caught in an automobile headlight (or spotlight). Light entering the eye passes over the receptive layer of rods and cones in the deer's retina, and then is reflected back over this receptive layer a second time. Therefore, if a deer's eye has 10 times the light-gathering ability as we do, and the light passes over the rods and cones twice, it is easy to understand why deer can run through the woods on the darkest nights without crashing into trees.

There are other differences between our eyes and those of a deer. In the human eye, the lens focuses the image on a small circular area of the retina called the fovea. Sharpness of vision, and sensitivity to color, depend on the number of cones in this area, whereas sensitivity to movement is more dependant on the concentration of rods. In the human fovea, the number of cones in the fovea may exceed 150,000 per square millimeter, giving us excellent visual acuity. A deer's retina contains fewer cones in proportion to

the number of rods, which likely explains why they have such excellent ability to detect movement.

In a number of ungulates such as cattle and horses, the lens focuses the image on a horizontal band across the retina instead of on a small circular area. This area has a high density of receptors and allows the animal to focus on a horizontal band, instead of a single point like humans. As you might expect, this ability to focus on a wide horizontal band also would enhance the ability to detect movement. Deer likely are similar to these other ungulates. In fact, if you take a close look at a deer's eye during daylight, you'll notice that the pupil opening is reduced to a side-ways oval, rather than a small circle like in the human eye.

The differing proportion of rods and cones, along with the different focusing mechanism of the lens also results in differences in visual acuity. But attempting to determine just how well a deer can see is a difficult undertaking – they can't read a doctor's eye chart very well! However, I have seen the reports of one experiment suggesting that humans have a visual resolution about twelve times better than that of deer.

Unlike deer, humans and other primates are unique in that they have a yellow pigment in their lenses that screens out short-wavelength light to protect our retinas from damaging ultraviolet light. Without this pigment, deer should be more sensitive to short-wavelength light, particularly under low light conditions.

So far, we've shown that humans tend to have keener eyesight than deer during the day, but deer are better at discerning movement and have better night vision. But, can deer see colors? This question has been debated among hunters for centuries. We know that deer have cones in their retinas, but possessing cones does not necessarily mean that they can see color.

A few years ago, we conducted a study at the University of Georgia, in collaboration with the University of California, Santa Barbara to conclusively determine if deer had the ability to see in color. Before I describe the study and the results, we first need to review some basic facts about how color vision is produced.

Cones contain different types of materials called photopigments, and it is these materials that produce the ability to see color. Rods only contain one photopigment, which means they can only produce black and white vision. On the cones, color vision is produced if there is more than one type of photopigment. We have three types of photopigments, each with sensitivities to different wavelengths of light. One has peak sensitivity at the wavelength we call blue, one at green, and the third at red. These are the three primary colors from which we derive all other colors. Although we know that deer have cones in their retina, what we did not know is what types of photopigments are contained on the cones.

In our study, we used a highly sensitive apparatus to record the electrical impulses from the photopigments in the deer's eye. If we found two or more photopigments, deer

certainly should have the ability to see color. Our results indicated that a deer's eye has two types of photopigments. One of the photopigments was very similar to our blue pigment, while the other peaked in sensitivity in the wavelength that we call yellow. Without going in to too much detail, our study indicated the following:

1) Deer have the ability to discern among some colors, and their color vision likely is somewhat similar to a human with red-green colorblindness. In other words they likely would have a hard time distinguishing between reds and greens, but could distinguish these colors from those in the blue range.

2) Deer appear to be more sensitive to light in the shorter wavelengths – in other words they likely can see blues better than we can, so leave the blue jeans at home! In addition, many detergents have brighteners in them that would be quite sensitive to a deer's eyes. So, be sure to wash your hunting clothes in a detergent that does not contain these brighteners.

3) Deer cannot see colors out into the red range as far as we can. Dark red would appear black to them. More importantly, deer are not able to see blaze orange with the vividness that we do – a deer's sensitivity at this wavelength is less than half of a human's sensitivity. Deer would have a much harder time distinguishing it from the colors of the forest. So there's no excuse not to wear blaze orange when deer hunting! They just don't see it the same way you do. ***Be safe, not sorry!***