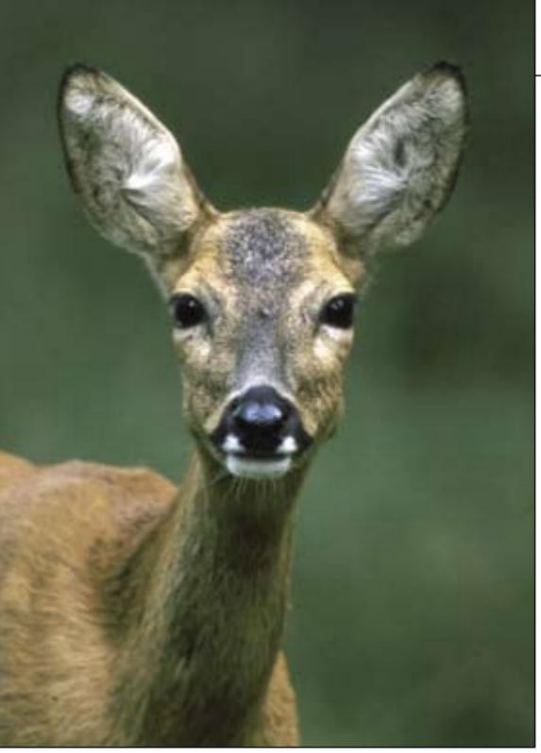


Rehgrants

Color vision in hoofed game

Distinction in Blue and “non-blue”

Autumn has brought out its colors and we wonder if our wildlife perceives this splendor in a similar way to us humans.

Prof. Dr. Peter Ahnelt from the Institute of Physiology at the Medical University of Vienna has investigated the matter and confirmed that our hoofed game is at least partially color blind.

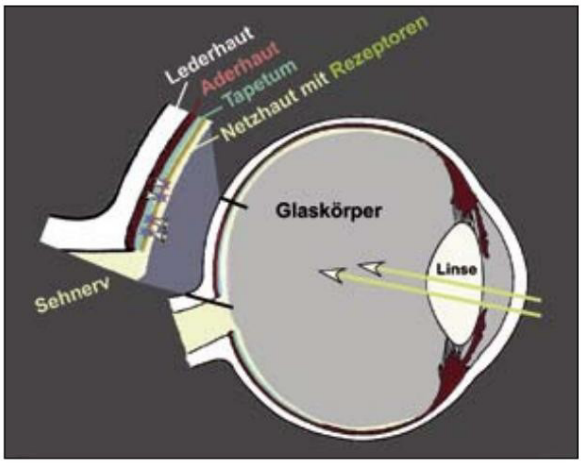
We have the scientific confirmation, that color vision must play an important role in intraspecific communication for the rainbow trout. This is less the case for deer or other ungulates, such as wild boar, even though roebucks tend to wear a red coat in the summer.

Only recent research using modern techniques such as electrophysiology and molecular genetics has been able to determine which parts of the solar spectrum are responsible for these Animals are distinguishable.

Essentially, this depends on the number of sensory cell types, the so-called photoreceptors, in the retina on the back inner wall of the eye. In mammals, there are two basic types of such receptors: rods for vision in dim light and at night, and

Cones for daylight vision.

As we know only too well from sitting in a hide at dusk, switching to the rod system results in the loss of both color vision and visual acuity. This is because rods only have one type of pigment; their maximum sensitivity is in the blue-green range at approximately 500 nanometers (see figure below).



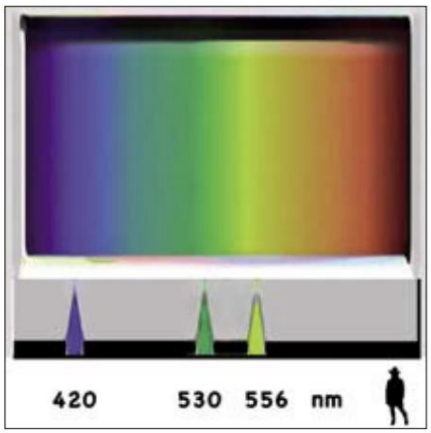
The diagram of the deer's eye shows that light can be detected by the receptors of the retina directly or after reflection by the tapetum (reflective layer).

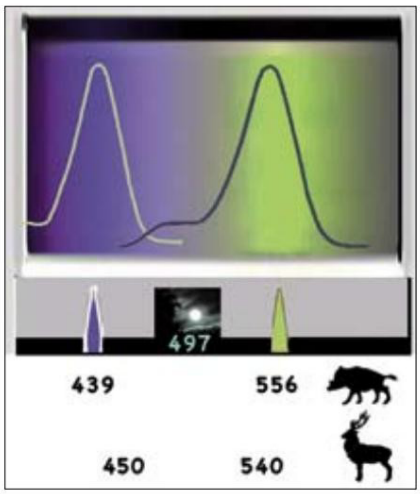
At least this allows us to perceive rough contours in grayscale even in low light. Our visual system is a compromise solution in this regard.

Crepuscular and nocturnal species, on the other hand, have optimized the sensitivity of the rod system much further. This was likely a characteristic feature of the earliest prehistoric mammals, giving them advantages over diurnal dinosaurs.

Actual color discrimination requires the existence of subclasses of cones optimized for daylight. Different photopigments make them particularly sensitive to certain wavelengths of light. In humans, three pigment types cover the range from violet to red. However, we now know that we can recognize the existence of our medium-wavelength (green) and long-wavelength (red) cones.

Pigment and cone types are due to a relatively recent mutation. This qualitative leap only arose in the ancestors of the diurnal monkey groups.





In contrast to humans (above), in wild animals (right), differentiation of the spectrum occurs via only two photopigments. Switching to the rod system at night makes them particularly sensitive to blue-green and virtually blind to red.

Hoofed game is partially colorblind

Most mammals, including wild animals, can only perceive the spectrum through two receptor systems. From our perspective, these animals are therefore partially colorblind.

Comparing the color simulation with the original makes it clear: The game perceives the orange of our high-visibility vests as green-yellow (right image). However, the blue of the parka is also recognized as such by the game and stands out clearly.

They are best able to distinguish between the blue-violet range on the one hand, and a counter-range in which we humans can also distinguish green to yellow and red. The color world of hoofed game is thus reduced to a blue versus a "non-blue," whose position usually lies within our yellow-green to green range. This creates a middle range in the blue-green that cannot be distinguished from a gray of the same brightness. Accordingly, landscape images filtered à la deh appear somewhat monotonous to us (see illustration above right).

This partial color blindness is also relatively common in humans: one in twelve men has more or less severe color vision deficiency. One-third of this group completely lacks a functional red- or green-sensitive pigment. Such limited color vision thus resembles the standard type of mammals—an involuntary step backward in evolution.

30,000 cones per square millimeter in deer

Deer have up to 30,000 cones per square millimeter of retina, while wild boars have about 20,000 to 25,000. This seems like a lot, but in our retina, the cone density can reach over 250,000. It's certainly sufficient for daring escapes and for detecting movements in the field of vision.

In the receptor mosaic along the outer edge of the retina of a deer's eye, the green- and blue-sensitive cones – recognizable by their larger diameter – lie in a sea of small rods. The more crepuscular and nocturnal Hoofed game species reserve a large portion of their retinal surface for these rods and optimize vision in low-light conditions. Blue cones are less common, at about ten percent. This means that visual acuity is primarily dependent on green cones.

In wild boar, the situation is markedly different. Here, the cones are much thicker, and the yellow-green sensitive variant occupies a large portion of the surface, supplemented by a minority of blue cones. The rods function more as stopgaps here. In the peripheral retina of the pig, there are more rods, but the cone cells are still prominent. The light is absorbed by the photopigments in the receptors. Remaining photons are intercepted by the pigment granules behind them to minimize scattered light. Shining a light into the eyes of pigs produces, as in humans, a reddish-brown reflection. This constellation—dominance of cones and a shielding pigment behind them—is typical of diurnal animals. However, it appears that pigs with this concentrated cone population can also cope quite well with moonlight and can therefore shift their feeding to the safer night.

"Low-light amplifier" for red deer

Red deer, on the other hand, have a kind of residual light amplifier built in. This "cold light" reflectance is distinguishable from the glow detectable with an infrared camera. Bluish-green reflective elements in the choroid ensure that photons that have passed the photopigments in the first pass are reflected back to the sensory cells. This increases the light output and thus the minimum usable luminance, albeit at the expense of contrast. Nature had not foreseen that this mirror system would naturally lead to debilitating glare when illuminated by car headlights.

Low sensitivity to red

Hoofed game shows low sensitivity to red. This means that the orange of high-visibility vests, which is so obvious to us, is hardly noticeable to them – yellow, on the other hand, is more so.
However, there is a potential problem at the other end of the spectrum: the lens of deer and roe deer is also more permeable to (ultra)violet light. This means that these animals can also use wavelengths that are inconspicuous to us. This wouldn't be a problem in itself if many modern detergents didn't contain so-called brighteners. These substances collect light in the UV and reflect it in a lower blue range, where it is invisible to us – but very noticeable to the deer's eyes. This can make apparent camouflage clothing appear like a ghost to the animals through the forest and fields. The same applies, of course, to high-visibility vests washed in this way. It is therefore highly advisable to care for hunting clothing with simple detergents. This example shows how important it can be in practice to understand the differences between the sensory worlds and to adhere to species-appropriate "etiquette."