WARNING

What You Don't Know About Dark Adaptation And Natural Night Vision Could Turn You Into An Asphalt Snow Angel

There is more to dark adaptation than just understanding that most healthy people will be dark adapted in approximately 30 minutes. Especially if you intend to use your natural night vision to the fullest extent and gain a tactical advantage. With some basic knowledge of human eye physiology and the use of a few techniques, you can improve the time it takes to become dark adapted and better use your natural night vision.
To understand the “whys and wherefores” of the techniques and tactical action tips that will be offered here, it is important to acquire some basic knowledge of human eye physiology. Most of you are familiar with the common parts of the eye such as the retina, cornea, iris, and optic nerve, so I won’t get into a lengthy detailed discussion about those eye components, and move on to the elements of the eye more specific to dark adaptation and natural night vision.

Human Eye Physiology Dictates Tactical Considerations For The Use Of Natural Night Vision :

Our eyes are wonderful organs. The human eye can provide us high resolution, binocular color vision(with enough illumination) with nearly a 180 degree horizontal visual coverage and about 130 degree vertical coverage. In breaking down our visual acuity a bit further, the human eye additionally provides us with two types of vision, central or focused vision, and off center or peripheral vision. The latter being extremely important to natural night vision. For the most part the human eye is primarily a daylight color system and does not work as well at very low illumination levels.

Besides the eyes somewhat weak night vision performance, there is another human eye biological characteristic that must be considered when addressing day and night tactics. Human eyes have a blind spot. Those of us with two good eyes and thus overlapping vision, don’t often notice this anatomical situation. But it is there and can rear it’s ugly head especially when we use one eye to focus through a magnified scope including night scopes. To understand what causes the blind spot a short explanation of human eye imaging is necessary. Light in the form of wave energy, enters our eye and stimulates light sensitive receptors called rods and cones in nerve tissue at the back of the eye called the retina. The optic nerve carries the neural messages from the receptors to the brain and in doing so, the bundle of nerve fibers pass through the retina of the eye. This circular passage is referred to as the optic disc. This spot near the center of the retina, is void of rod and cone receptors and therefore can not provide any information to the brain— thus a blind spot. You can experience this yourself by visiting the following websites and setting up you own short experiments. http://faculty.washington.edu/chudler/chvision.html
http://serendip.brynmawr.edu/bb/blindspot1.html

The technique to overcome this issue is very similar to the technique used to increase your natural night vision acuity and will be discussed in great length later. In addition to the missing receptors causing the blind spot, the volume and arrangement of the rods and cones directly influence dark adaptation and natural night vision, so it is important to understand how these receptors affect our ability to see at night.

Rods are much more sensitive to the detection of movement than cones.
Many more rods than cones are located in the areas of the eye that provide us with peripheral vision.

Rods are extremely more sensitive to light than cones and also appear to register the intensity of light better than cones.
Our imaging is primarily accomplished by the rods when illumination is low.

Rod receptors do not have the ability to create color images, but do respond to various colors giving us the sensation of seeing shades of blacks, grays or whites. Thus the sensation of seeing everything in gray or black and white at night unless illumination is introduced.

Rods are sensitive to red light. That's why red filters are used on flashlights, tactical vehicle interior lights etc.

Due to the rods physiology and neural structure, they provide a much lower image resolution than cones. However, rods seem to decipher patterns, textures, and silhouettes extremely well.

TACTICAL ACTION TIP: *Do not use bright red filtered light as this will destroy your dark adaptation. Use lowest readable level. Do not mark your maps or field directives with red, brown, orange, or yellow pens or hi-lighters if you intend to use red filtered light at night. You may not see your markings. Be aware that the brown delineation lines found on some maps may not be seen. Prolonged viewing of maps or objects with a red filtered light can cause eye fatigue.*

Studies have revealed that rods also are sensitive to blue and or blue/green light. The blue/green light causes less eye fatigue in dark adapted individuals. It easier to focus on maps etc. when using blue or blue/green filtered light. Blue or blue/green lights require less intensity to see the same objects than red filtered lights.

TACTICAL ACTION TIP: *Do not use bright blue filtered light. Use the lowest readable intensity. Use blue filtered light to track blood trails. It is effective and will preserve your night adaptation. However if using blue filtered light, do not use a blue or green pen or hi-lighter to mark maps. Blue or green map delineation lines will tend to disappear. Blue or blue/green light also has less of an infrared signature than red light.*

Cone receptors are much more color sensitive than rods, identifying three different portions of the color spectrum-red, green, and blue.

Cones provide high image resolution.

More cones are located in the central areas of the eye than rods and come into play with more with focused vision. Thus our ability to perceive a sharper image during high illumination by focusing straight at an object and why our peripheral vision, location of more rods, does not appear as sharp.

In short, rods are basically movement detector low light receptors while the cones provide high resolution color enhancement. Natural night vision relies almost completely on the rod receptors of the peripheral regions of the retina. That is why in low illumination, the eye is most sensitive to images focused off center, non-focused viewing. **The number one**

technique to increase your natural night vision acuity is to focus 5 to 30 degrees off center. By doing this, you will direct the available light more to the rod region of your eyes than the cone regions, and thereby detect light and see objects more readily. Corrective lenses do not affect peripheral vision, so these techniques work just as well for those of us wearing glasses as those that don't. The off center viewing technique is not only for stationary night observation. Traversing using this technique is very doable with a little practice. Because we tend to use our focused vision so much, it is a little uncomfortable at first to begin to rely on off center viewing while observing or walking. However, as you gain experience in using this technique and literally "see" the results, the apprehension will dissipate. It is important to note however that visual acuity diminishes to 20/200 or less even when fully dark adapted.

Overcoming The Blind Spot, Day Or Night:

As discussed earlier, our eyes have a blind spot where the optic nerve passes through the retina-the optic disc. Most of us never notice the blind spot because with two eyes we have overlapping vision. This is a good thing because the optic nerve of the right eye passes through the retina slightly left of center, and the optic nerve of the left eye passes through the retina slightly to the right of center. That means the blind spot is in a different place in each eye. Because our eyes are not located on the exact centerline of our body, when we look at an object the light waves reflected from the object are projected onto the retina of each eye in a slightly different position. This is referred to as retinal disparity. This is another good thing, because the left eye captures what the right eye misses due to the optic disc and the right eye catches what the left eye misses due to the optic disc. Here is the tactical consideration; what happens when we close one eye and sight with the other through a magnified scope on a rifle or a spotting scope. No retinal disparity or overlapping vision. This is not a good thing. You could miss head size targets at short distances in the daylight. This is definitely not a good thing. It gets worse. The area around the optic disc, our blind spot, is immediately surrounded by cones. Rod receptors surround the cones. Remember, cones stop functioning at low light levels. That means the blind spot is larger in the dark (the area of the no light receptor optic disc, plus the area of non-functioning cones). That's a very bad thing if we intend to use only one eye for observation through a scope. Field tests have shown that our night blind spot when using focused vision is large enough to conceal a man at a distance of 65-80 feet, hide a large vehicle at 300 yards and conceal an aircraft at 3,000 feet. A very bad thing indeed. However, armed with the knowledge about why the blind spot occurs, will now make it easier to understand the value of the following technique.

TACTICAL ACTION TIP: *Just as off center or peripheral viewing enhances natural night vision, off center viewing directs the light and thereby the image, to receptors away from the area of the retina that is void of the rod and cone receptors. Viewing only about 10 degrees off center will overcome the blind spot, day or night. However a better technique is to keep the eyes slowly moving up and down, right and left when conducting day or night surveillance. Slow scanning is key. Rapid head or eye movements decrease the integrating capability of your dark adapted eyes. Avoid focusing on any one spot for over 2 seconds because it will appear to fade away. An additional technique found to work extremely well*

for both day an night observation, is to cause your eyes to slowly follow a figure eight pattern while conducting surveillance. Remember this technique becomes critical if you are using a standard magnified scope or spotting scope for low light or night observation because you are using only one eye and no longer have the benefit of overlapping vision.

Dark Adaptation:

Simply put, dark adaptation is the sensitizing of the photo receptor cells for darkness. Most of us have been taught that full night adaptation occurs in 30 minutes. The thirty minute time frame always referenced by trainers only applies if you are in good health, a non smoker, non drinker, eat non-fatty foods, have avoided exposure to carbon monoxide, avoided exposure to bright sunlight and bright artificial light, haven't taken drugs, legal or not, that affect oxygen processing, and are at elevations below 4,000 feet. Add any of these items into the equation and the time it takes to become fully dark adapted increases significantly.

For example, tests have shown that a heavy smoker will attain only about 80% of his potential dark adaptation in 30 minutes at sea level. It will take approximately another 20 minutes for him to become fully dark adapted.
Our age affects the time it takes to become fully dark adapted and our night vision acuity. The lenses of our eyes harden and may result in clouding which affects light transmission and could cause light scattering as the light enters the eye. So if you are in your 40s or 50s understand the limitations.

During the dark adaptation process a chemical in the eye known as Rhodopsin also referred to as visual purple, accumulates in the rods aiding in the processing of the light signals from the retina to the brain. The degree of dark adaptation increases as the amount of Rhodopsin in the rods increases. Unfortunately Rhodopsin can be depleted faster than it is manufactured by our body, especially if a person spends a lot of time in bright sunlight, or bright artificial light. Sunlight or artificial light bleaches out the Rhodopsin from our eyes causing our night adaptation to not occur as quickly and our natural night vision to not be as acute as it could be. Exposure to bright sunlight for two to five hours decreases visual sensitivity for up to five hours. Rhodopsin can be bleached from our eyes within seconds, so stay away from light sources when dark adapted.

TACTICAL ACTION TIP: *If bright light is unexpectedly introduced after you are dark adapted, such as lightning, quickly close one eye, preferably your dominant eye, to protect your dark adaptation. If you know you will be observing in an area where bright light is likely to be introduced, wearing an eye patch over your dominant eye, or wearing it in a ready position, is a good way to insure dark adaptation if tactical action must be taken in the dark. Don't forget that depth perception is dramatically reduced when covering one eye.*

When fully dark adapted the rods can become 10,000 times more sensitive to light than at the start of the dark adaptation process. Large dosages of Vitamin A seem to help in the production of Rhodopsin. Competent astronomers have advised me that bilberry jam is their "elixir of the dark" to aid in Rhodopsin production, but I have no personal experience with this product. Try at your own risk.

TACTICAL ACTION TIP: *If you know you will be involved in night operations, it is beneficial to avoid bright sunlight or other bright lights for at least 24 hours prior. Wearing sunglasses during the day will aid in the preservation of Rhodopsin and thereby enhance night adaptation. Attempt to use "wrap arounds" that keep the bright sun light from entering your eyes peripherally.*

The process of dark adaptation usually occurs in two stages. The first stage takes place in the first 5 minutes of darkness and is due primarily to the changes in the sensitivity to the cones. That's why you feel you can see in the dark during the first few minutes, but if you stop and carefully observe your environment for a few more minutes, you will begin to notice more features than previously seen.

TACTICAL ACTION TIP: *Exposure to carbon monoxide lengthens the time to become fully dark adapted and degrades your natural night vision. If you know you are going to be involved in night operations, and want every edge, avoid smoke filled rooms including sources of carbon monoxide, such as a poorly vented staging area that may have engines running. Carbon monoxide is absorbed into our blood stream and can stay there for up to 24 hours.*

Legal as well as illegal drugs degrade dark adaptation. Alcohol and marijuana both alter the way oxygen is absorbed in the body and negatively affect dark adaptation. Viagra has been found to negatively affect all vision including natural night vision.

As alluded to earlier, your diet can affect the ability to become dark adapted. A diet heavy in fatty foods can lengthen the adaptation time. A diet with sufficient proteins though is necessary. You do not want the muscles associated with your eyes to become fatigued when you need to maintain long periods of night surveillance.

Altitudes above 4,000 feet affect the amount of oxygen available to you and thus to the rod receptors, and will increase the time it takes to dark adapt and the visual acuity. At 6,000 feet for example you will loose about 5% of your night vision acuity, and at 10,000 feet approximately 20%.

Dark Adaptation And Night Vision Optics:

The green glow from a night vision device will degrade your dark adaptation. Test have shown that after the human eye is subjected to the glow of a night vision device it takes a healthy individual between 3-5 minutes to become dark adapted again. Certainly a lot less than if submitted to white light, but important enough to take into consideration when coming off a night vision device. That is why we suggest that any observation or traversing being done with night vision, be done with the non dominant eye. That way you remain dark adapted in your "shooting eye" if the night vision device fails or is knocked off and immediate tactical action is required.

TACTICAL ACTION TIP: *If you are using a PVS-7 night vision goggles or some other binocular or binocular night vision device, we suggest you cover one of the eye pieces, preferably the one used by you dominant eye, with cotton balls or black tape so as to not affect the dark adaptation in your dominant eye.*

Practice the techniques.....it is only way to become comfortable using them.

We hope that the information provided will not only aid in your understanding of dark adaptation, but assist you in the real world use natural night vision.