Reindeer see a weird and wonderful world of ultraviolet light

May 26 2011

A wild reindeer with velvet covered antlers. Part of the southern herd on the island of South Georgia in the South Atlantic. Image: Wikipedia

Researchers have discovered that the ultraviolet (UV) light that causes the temporary but painful condition of snow blindness in humans is life-saving for reindeer in the arctic.

A BBSRC-funded team at UCL has published a paper today (12 May) in the Journal of Experimental Biology that shows that this remarkable visual ability is part of the reindeer's unique adaptation to the extreme arctic environment where they live. It allows them to take in live-saving information in conditions where normal mammalian vision would make

them vulnerable to starvation, predators and territorial conflict. It also raises the question of how reindeer protect their eyes from being damaged by UV, which is thought to be harmful to human vision.

Lead researcher Professor Glen Jeffery said "We discovered that reindeer can not only see ultraviolet light but they can also make sense of the image to find food and stay safe. Humans and almost all other mammals could never do this as our lenses just don't let UV through into the eye.

"In conditions where there is a lot of UV – when surrounded by snow, for example – it can be damaging to our eyes. In the process of blocking UV light from reaching the retina, our cornea and lens absorb its damaging energy and can be temporarily burned. The front of the eye becomes cloudy and so we call this snow blindness. Although this is normally reversible and plays a vital role to protect our sensitive retinas from potential damage, it is very painful."

Human beings are able to see light with wavelengths ranging from around 700nm, which corresponds to the colour red, right through all the colours of the rainbow in sequence to 400nm, which corresponds to violet. Professor Jeffery and his team tested the reindeer's vision to see what wavelengths they could see and found that they can handle wavelengths down to around 350-320nm, which is termed ultraviolet, or UV, because it exceeds the extreme of the so-called visible spectrum of colours.

The winter conditions in the arctic are very severe; the ground is covered in snow and the sun is very low on the horizon. At times the sun barely rises in the middle of the day, making it dark for most of the time. Under these conditions light is scattered such that the majority of light that reaches objects is blue or UV. In addition to this, snow can reflect up to 90% of the UV light that falls on it.

Professor Jeffery continued "When we used cameras that could pick up UV, we noticed that there are some very important things that absorb UV light and therefore appear black, contrasting strongly with the snow. This includes urine - a sign of predators or competitors; lichens - a major food source in winter; and fur, making predators such as wolves very easy to see despite being camouflaged to other animals that can't see UV."

This research raises some interesting questions about the effect of UV on eye health. It had always been assumed that human eyes don't let UV in because of the potential that it will cause damage, just as it does to our skin. In our eyes, UV could damage our sensitive photoreceptors that cannot be replaced. This would lead to irreversible damage to our vision. Arctic reindeer are able to let UV into their eyes and use the information effectively in their environment without suffering any consequences.

Professor Jeffery added "The question remains as to why the reindeer's eyes don't seem to be damaged by UV. Perhaps it's not as bad for eyes as we first thought? Or maybe they have a unique way of protecting themselves, which we could learn from and perhaps develop new strategies to prevent or treat the damage the UV can cause to humans."

Professor Douglas Kell, Chief Executive, BBSRC said "We can learn a lot from studying the fundamental biology of animals and other organisms that live in extreme environments. Understanding their cell and molecular biology, neuroscience, and other aspects of how they work can uncover the biological mechanism that meant they can cope with severe conditions. This knowledge can have an impact on animal welfare and has the potential to be taken forward to new developments that underpin human health and wellbeing."

Provided by Biotechnology and Biological Sciences Research Council