Those who know me may or may not be mildly surprised to learn that I am writing this whilst lying completely submerged in the deep end of my koi pond. I have a four foot length of garden hose to aid breathing and am watching an early spring sun rise above my statue of the Buddha which is situated just above the biological filter chamber. You might be misled into thinking that this is some new form of alternative therapy but in fact I am checking out some claims made in recent carp angling magazines.

I have read how red fishing line and red light are the first to become invisible underwater. Now while red is the first colour to be **absorbed** in **clear** water as it gets deeper it will not become invisible but will look black. Objects that look red reflect only red light and absorb all the other colours. If there is no red light available to reflect then the line will look black. At night we see little colour as there is little light to be reflected. A line that appears black in water may not be what we want. While red is the first colour to be absorbed in clear, oceanic type waters it is the last to be absorbed in most waters that carp live in. This is due to the heavy concentrations of suspended and dissolved matter in these waters which absorb the light of shorter wavelengths, leaving the longer wavelength reds.

There is another scientific principle known as scattering to consider when we discuss depths at which colours "disappear". Light which is not absorbed will be scattered. Scattering occurs when light photons hit particles in the water and are deflected, in random directions, rather than travelling straight through the water. In clear water with small particles, (molecules), scattering will depend on the wavelength of the light hitting the particles. Red light will scatter less than blue light because of its longer wavelength. As the particles increase in size, wavelength has less of an effect and as the concentration of the particles increases so the amount of scattering increases. Carp waters often contain heavy concentrations of "large" particles. In this type of water scattering will not be wavelength dependent so there will be no real difference between the scattering of red and blue light. However, overall red will be transmitted better than the other colours of the visible spectrum in the waters we fish so will not be the first to "disappear".

Still bodies of water which contain algae, decaying vegetation, fish stirring up bottom sediment and run off from the land may hold comparatively heavy concentrations of suspended particles and dissolved substances which will encourage the absorption and scattering of light. The result of absorption and scattering in this type of water is that there will be little penetration of light below the surface layer. Once again, if the light is not reaching an object then it cannot be reflected off it. I think we need to be aware of this, not just with line but also with some of the coloured baits we use. What we can see out of the water in daylight, we may not be able to see under it, especially in deep and / or murky conditions and at night.

Light penetration in water is influenced by how much light enters the water as opposed to being reflected off its surface. This in turn depends on many things including the angle of the sun; whether it is overcast or bright, windy or calm, etc. It is possible that the colour of an object underwater might alter with the time of day and weather as well as the time of year and how near to the poles we live.

Carp have colour vision and can see a greater range of wavelengths than we are able to. Their colour sensitivity is slightly different to ours. Like us, they are able to change their visual sensitivity between daytime and night time or between bright and low light conditions. In daytime, the fish uses the cones in its eyes and, over a period of time, it changes to using light-sensitive rods in the eye as it gets dark. The cones are colour-sensitive while the rods allow a monochromatic form of vision when little light is available. In other words the rods do not differentiate between colours. Perhaps the areas we need to be looking at are **contrast** and camouflage rather than colour.

I have also read that carp have infrared vision. Infrared is beyond the red end of the spectrum we can see, so is invisible to us. Objects can emit infrared and reflect it. Warm bodies emit more infrared than cold ones but "warm" is relative. Ice is warm compared to liquid nitrogen. Any object above absolute zero in temperature will emit infrared. The infrared part of the spectrum has a much greater variation in wavelength than the visible part of the spectrum. If carp did have true infrared vision then they would be able to detect some degree of thermal difference between objects. There is no evidence to show that this is the case

Specialists in the field of fish vision believe that a carp's eyesight will allow it to see **slightly** longer wavelengths than we are able to. Put another way, it can see just beyond the red we can see. This is because the red sensitive visual pigment in the cones is more sensitive in the carp's eyes than in ours. This is probably the extent of its "infrared vision". If infrared is defined as longer wavelengths than we are able to see then yes, a carp does see a little bit of near infrared but it will not have the ability to detect thermal difference by sight. It is a part of its normal vision – It doesn't suddenly switch into infrared mode. They are also able to see slightly shorter wavelengths than we can, so are able to see some UV.

Recent articles have stated that infrared vision enables carp to see underwater, at night. Furthermore, it has been suggested that it allows them to find bait at night and has been given as the reason why carp do not damage themselves by bumping into underwater objects in the dark.

Infrared in water will come mainly from the sun. At night this radiation will cease to exist so I am not sure how it can help a carp to see at night.

Even if a carp did have true infrared vision, and could detect thermal differences between objects, I would not be convinced it would allow it to see underwater in the dark. In these circumstances the bait, or any other inert object, would need to be at a different temperature to that of the water for the carp to be able to differentiate between them. I doubt if this difference will exist because water is a good transmitter of heat. Within a short time of being immersed, an object will be at the same temperature as the layer of water it is in. At night time I would have thought that smell and taste would be more useful senses than infrared sight in detecting baits.

For the same reasons I doubt that carp avoid objects in the dark because of infrared vision. The carp's ability to navigate at night, (and in murky waters), is in most part due to its lateral line although the light-sensitive rods in the eye and other senses will come into play. As a fish swims through water it will create pressure waves. The lateral line contains sensors that enable the fish to detect changes in pressure waves caused by reflection off objects in the water and thus avoid them. In a similar fashion it will allow them to pick up bank side vibrations and aid in detecting food. Perhaps it also helps detect line!

The carp's ability to see some near infrared will be an aid to vision in the daytime. The longer wavelengths of this radiation will be absorbed and scattered less than light from the visible spectrum in the waters in which they live.

Thank goodness carp don't have the facility to detect temperature differences by sight. If they did then all that lovely camouflage gear would have been a waste of money! Our body temperature is around 38C and the bank side in winter is sometimes around freezing point. We would stand out like a sore thumb to infrared inspection.

With so much being written about carp vision and colour underwater I hope this may be of interest. I am no expert and stand to be corrected by any of the many with a greater understanding than me. Hopefully they will be able to shed more *light*, (ha ha!), on this subject!

A positively colourful, if not glowingly fluorescent,

Gert