INCREASING THE VISIBILITY OF DIVERS ON THE SURFACE AND AT DEPTH

Quentin M Bennett

Clear water absorbs warmer colours such as red, yellow and orange, and by a depth of 100 feet they are not visible. The human eye does possess remarkable adaption processes to ambient light, and this disappearance of the warmer end of the spectrum is not quite as obvious to the eye as when recorded on film.

Natural light photographs taken at a depth of 10 metres are usually almost devoid of the colours, red, orange or yellow, although the experienced diver can usually see them. An experienced diver will be more certain of what he is seeing than will be someone less experienced.

Other factors come into play in the poor visibility of colours underwater. Much of the light travelling underwater is scattered by suspended particles. This causes the brightness of the water background: and a “veiling brightness” between the object being observed and the eye: thus reducing greatly any contrast.

If the contrast is low to start with because of the warmer brighter colours having been already absorbed, the final contrast is very low indeed.

Briefly, an object is seen if it appears of a slightly different brightness or colour to its background. Speaking very generally, the human eye can detect brightness differences of between 1% and 2% if the light level is fairly high.

If the water did not scatter light, but only absorbed it, the water background would appear black and all the light would come from above. As, however, the water both absorbs and scatters, light will come from all directions, with upwelling light being about 2%.

Water does not absorb light of all wavelengths equally, and it is those wavelengths which are least absorbed which give the water its characteristic colour. As the depth increases, the ambient light is restricted to a narrow band of wavelengths and, according to Tyler, the water behaves as a very efficient monochromator.

Clear ocean water is shown to be brightest in the blue green around 470 nanometer (blue) was found to penetrate farthest. Chlorophyll containing phytoplanktons and partly decayed vegetable substances give yellow and green shades to coastal and fresh waters.

So, whilst the phenomenon that red light is absorbed in blue water is well known and understood, it is often and easily forgotten that this is but an isolated example.

The absorption characteristics of different bodies of water vary considerably. Some inland lakes can be quite black, others are quite brown or yellow, or green and springs blue. Combinations can run from black, grey, brown, yellow, green to blue. Fairly obviously absorption characteristics, and hence visibility, are totally different for these different coloured bodies of water.

The visibility of divers is very important. The foremost rule of diving is ‘never dive alone’, and to carry out this it is essential to be able to see one’s buddy diver.

With the advent of modern self adhesive materials, a new approach can be made in an endeavour to make the diver more visible. These materials are available in several fluorescent colours. The Dictionary of Visual Science defines fluorescence as ‘the property of emitting radiation from some other source, the emitted radiation being of longer wavelength’.

Especially in blue water, the blue end of the spectrum is passed readily. Because it is the blue end of the spectrum that provides the excitation for fluorescence, it can be deduced that fluorescence is most effective underwater. This is very true, and interestingly enough, it appears to be very effective even in greenish water. Of course it probably appears all the more brilliant because the warm colours originating at the surface have been absorbed, and the eye has adapted to at least a certain degree; and the fluorescence will stand out to a stunning degree.

Fluorescent materials, such as used on aeroplanes, are very durable and most suitable for adhering to a diver’s air bottle. Little else of his equipment is probably really suitable for attachment of the material, although his buoyancy compensator or life vest could be manufactured from fluorescent material. The front of his wetsuit hood could have a piece of fluorescent retro-reflective material sewn to it. Attaching the self-adhesive material to the outside of the diver’s air bottle has the added bonus arising from the considerable protection that the material gives the paint on the exterior, thus prolonging the life and retaining the value of these expensive pressure vessels.

The 3M Company manufacture three fluorescent colours in the “Scotchcal” brand of film. They are red-orange, yellow-orange, and Saturn-yellow. There is not a great difference in colour between the red-orange and yellow-orange. Red-orange is quoted by 3M Company as having a much greater durability expectancy when under heavy ultraviolet degradation.

One important point is that too red a fluorescent material used in very clear water could mean that the red colour emanating from the fluorescence could have been absorbed before it reaches the observer. In other words, the clearer the water, the cooler the fluorescent colour should be.

On the other hand in such very clear waters, the visibility of the diver is less of a worry compared to that in more turbid water. Fay (1976) found that sensitivity of the eye underwater to red was considerably increased even in an adaptation period of only 30 seconds. This would probably indicate that in the 3M Company “Scotchcal” range of colours the warmer red-orange and yellow-orange would be mere suitable than the Saturn-yellow.

We are in the process of further study of all three colours in varying bodies of water and, it is hoped, under ice.

FURTHER READING

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BLIND THEM WITH SCIENCE DEPARTMENT

We join with the editor of the Aviation Medical Society of Australia and New Zealand Newsletter in humble admiration of the Victorian Branch of the Ergonomics Society of Australia, which claim to print its address labels as follows:

"The mailing labels now appearing on the wrapping of your copy of the Newsletter are printed on a microcomputer system, involving a Cromemco system 3, a Teleray 1061 VDT and a Citoh line printer. For those interested, the Cromamco uses a Z80A microprocessor running at 4MHz, has 64K of fast (150 nanosecond access time), random access memory and a pair of Per Sci 277 8" disc drives."

It seems no time since your editor wrote the labels personally. Such is progress, the above may soon also seem old fashioned.

THE GREAT WHITE LIKES YELLOW

Valerie Taylor has a piece of information to impart which is not all good. In a recent article (Oceans, 1979, No 3) entitled "The Predator which doesn't eat people" she reports on experiments made by herself and her husband Ron during their years of work in the marine environment. The Great White has been found to seek our warm, light colours such as yellow, apricot and orange. Apparently it will attack such coloured floats even when bait is in the water nearby. Evidently taste and edibility came second to the colour attraction of the object in certain circumstances.

They found that a dummy wearing a black wet suit was ignored but one with an orange safety vest attracted attack with a few minutes. The dummies were not stuffed with food, though there was chum in the water. There are obviously occasions when the shark risk would make the orange-for-visibility vest a potential danger to the wearer. No cases of this having a practical importance are known, but if you like to "do your thing" with Great Whites, it seems only commonsense to dress in formal black.

A PUBLICATION OF SIGNIFICANCE
SOUTH AUSTRALIAN DIVING FATALITIES

Peter Horne

This provides a thorough and well researched review of all the known South Australian diving-related fatalities 1951-1979, with a discussion of sites and critical factors. There is a regular report available at a cost of Aus$3.00 (incl p&p) and a special issue available to those with a professional interest in Diving Safety, which contains confidential information not included in the regular publication, for Aus$5.00 (incl p&p).

The cases discussed include some from the early days of civil diving, while the more recent cases are those reported in the "Provisional" Stickybeak reports but not there given a locality identification. This report is highly recommended and the Author commended for both the information provided and its presentation. Copies are obtainable from:

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