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## **Taking Videos or Still Photographs Underwater**

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(this workshop was presented in conjunction with a dive at Jervis Bay, NSW)

Students and their teachers gain an understanding of how photographic and electronic imaging is used by marine specialists and enthusiasts to record what is encountered under the water. The following factors have to be taken into account when photographing underwater:

### **General issues**

#### **Comfort**

The most important aspect to shooting pictures underwater is to be comfortable in the water. That usually means being an experienced and competent diver. Just by being a good photographer does not in itself qualify a person to don SCUBA equipment and begin recording underwater images. Diving courses are offered by most Dive stores throughout Australia, so look around for the best buy and do it!

It takes considerable patience and time to shoot underwater, so dress appropriately in a quality wetsuit to protect yourself from the cold and possible abrasions from rocks and corals, as well as encounters with the occasional stinging organism.

#### **Ecology**

It is important to know something about the animals that inhabit the place where you are diving, so you'll know what to look for and what to look at. Ask the local Dive shop or other divers who have been to those particular areas.

Whilst surveying a possible photographic site, it is very important to stay clear of the bottom. A great deal of damage to the ecology can be inflicted by a diver's fins as well as copious amounts of sediment being stirred up making photography difficult and frustrating.

#### **Depth**

The shallower the water, the longer you can spend diving and taking pictures. Therefore the longer you spend in the water, the more opportunities you will have to obtain that great shot.

#### **Safety**

A fundamental rule in diving is never dive alone. Apart from safety reasons, it is always worthwhile to have someone else to help find subject matter for you to photograph.

#### **Lighting**

In very shallow water, say up to 1.5 m, a flash or artificial illumination is not usually required. Excellent images can be obtained of seascapes and fish, providing some basic principles of underwater photography are followed.

#### **Camera lens**

Underwater scenic shots are best taken with wide angle lenses. As a rule, a 28 mm lens would be considered a minimum requirement for such work. The wider the lens, the

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closer you can get to the scene, thereby eliminating much of the suspended material in the water and enabling you to obtain clearer and sharper pictures.

For portraits of small to medium sized fish, lenses which range from 50 mm to 100 mm are the best, while lenses with a focal length of 35 mm are useful for large fish and divers.

	focal length of lens		angle of view	
	above water	underwater	above water	underwater
<b>35 mm cameras</b>	21mm	28mm	92°	75°
	28mm	37mm	75°	60°
	35mm	47mm	63°	50°
	50mm	67mm	47°	36°
<b>2 / x 2 / cameras</b>	38mm	51mm	93°	77°
	50mm	67mm	78°	62°
	60mm	80mm	68°	53°
	80mm	106mm	53°	41°

Because light is refracted as it passes from water into the air in the camera housing, both the focal length and angle of view of lenses are affected, as shown in this chart. Thus the focal length of a 50mm lens, normal for a 35mm camera above water, is increased by one third to 67mm underwater, and the angle of view is narrowed from 47° to 36°. Note that the slightly wide-angle 35mm lens performs underwater much as the normal 50mm performs out of the water.

**Figure 1.** How focal length changes underwater

## Basic techniques

### Optics

The underwater photographer is faced with two distances, real and apparent. While an object may in fact be measured to be one metre away (real distance), to the eye and camera it appears only 75 cm away (apparent distance). Since water is about 800 times as dense as air, light moving through the denser medium is slowed by about one quarter of its speed through air.

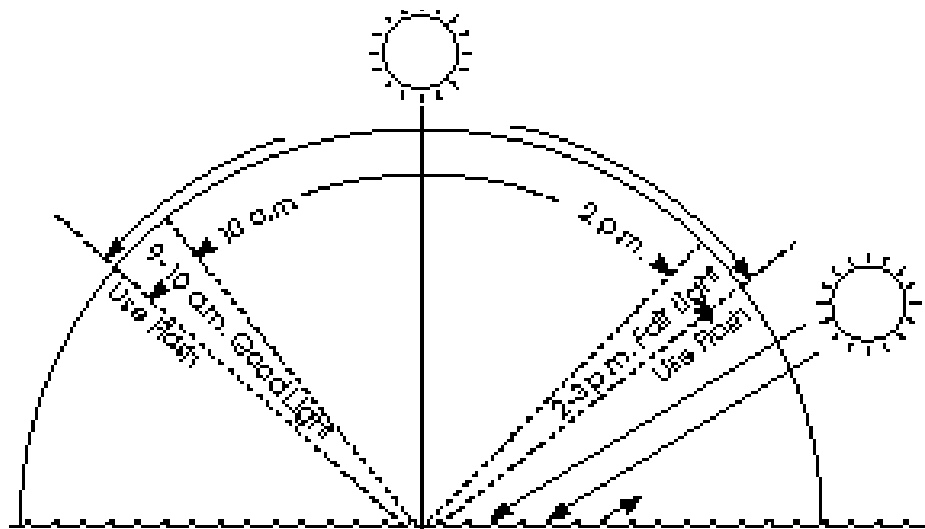
When light is reflected from a subject underwater, it first travels through water at one speed, then abruptly alters both its speed and direction as it passes through the glass and air space of the diver's mask and underwater camera housing.

The change between the two mediums is called the relative index of refraction and causes an optical phenomenon whereby objects seem much closer and larger than they really are (see Figure 1.)

Uncorrected lenses become more telephoto in their effect, because of the increased focal length of about a third and the angle of view by about one fifth. An example would be a 28 mm lens producing a focal length of a 37 mm lens and so on.

Consequently, objects appear to be one quarter larger than they really are.

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The greater the sun's angle to the horizon, the more light is lost. Choppy water increases light loss.

**Figure 2.** Effect of angle of sun

## Light underwater

The most obvious illumination in the ocean comes from the sun. Its intensity and subject contrast are greatest when the sun is high in the sky, from 10.00 am to about 2.00 pm (see Figure 2). During these times more light penetrates the surface, as opposed to other times of the day when light is significantly reflected away due to the angle of the sun to the water.

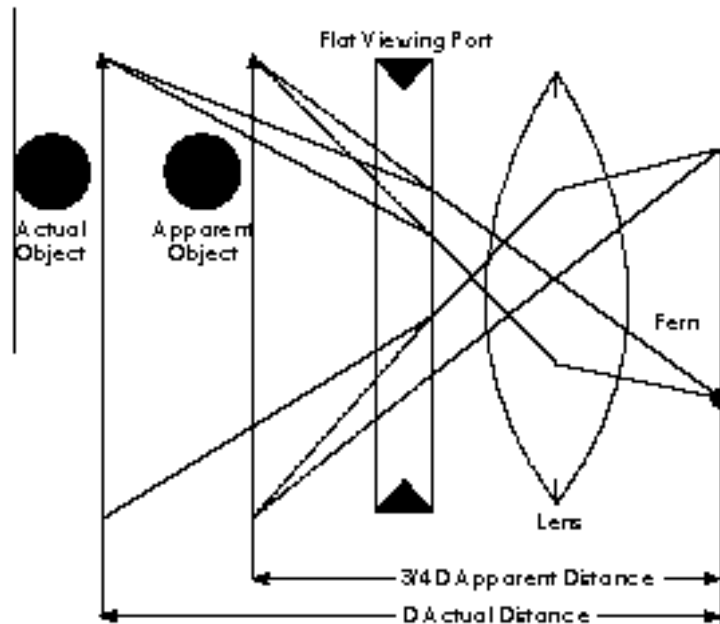
Surface conditions also affect the intensity of light underwater. Choppy sea conditions reflect a considerable amount of light, while an overcast sky will reduce the amount of light penetrating the water, which effectively reduces contrast. The scene becomes inherently flat and more monochromatic in its appearance.

Most water contains micro- and macro-organisms such as plankton, together with silt and minerals which also have considerable influence in scattering light underwater. The more the suspended particles and the larger their size, the more concentrated the scattering.

Image deterioration increases with the distance that light travels underwater, being scattered by particulate matter. This is why focal length lenses are of little use underwater.

Probably the most predominate aspect of underwater photography is to capture the extraordinary range of colours. Colours as seen and photographed underwater are severely affected by the massive blue-green filter factor of the ocean. The red end of the colour spectrum disappears rapidly as it passes through water. As depth increases, the light becomes predominantly bluer, creating a spectral imbalance. Divers must view everything through a heavy cyan water filter which disguises the true colours that are in the sea.

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**Figure 3.** Illustration of distorting effect of water on visual perception

The masks worn by divers enable them to see clearly, but not in clear full colour. Human vision makes an adjustment, psychological in part, which allows divers to perceive some of the colours that exist. Film and video however, have no ability to compensate for the cyan filter factor of the sea. This is where artificial light sources have been adopted to solve some of the many problems associated with underwater imaging.

Artificial lights such as strobes for still cameras and tungsten lights for motion picture and video are the most commonly used illuminators. However they all fall short of providing sufficient illumination of subjects which are more than a couple of m from the cameras. Like sunlight, artificial light suffers from scatter and absorption.

With 100% of the light emitted from the source, only about 50% of the light reaches the subject, with less than half that amount reflecting back to the cameras. The greater the distance, the more the absorption will filter the light toward the blue-green end of the colour spectrum. Therefore artificial light is really only effective to distances of about 2 m.

The obvious artificial look can be minimized by balancing out artificial light with natural sunlight, so that the foreground colour gradually melts into the background blue. In many instances this is not possible, or the desired effect may be one of immediate illumination with a black background. Strobes or tungsten lights provide these effects.

## Conclusion

Clearly, underwater photography, be it stills or motion, is a very specialised field. It requires good diving skills, photographic ability and a broad understanding of physics as it applies to water, optics and light. Some knowledge and understanding of marine science and biodiversity can be particularly beneficial in helping you better understand the interrelationship between species and their environment.