Edited by Don Silcock

On the Rise

Flourescent

Night Diving

Text and photos by Steffen Beyer

Fluorescence night dives, or fluoro, UV and glow dives, as they are also known, are becoming increasingly popular as more and more dive centres offer scuba divers and underwater photographers the chance to experience this unique underwater phenomenon.

There are also an increasing number of vendors offering diving equipment for use on these special dives, and the purpose of this article is to explain the basics, background, techniques and equipment associated with this interesting aspect of the underwater world.

The basics—what is it?

Fluorescence is the capability of certain materials to absorb light transmitted on one wavelength and then emit it again nanoseconds later on a different wavelength. The phenomenon occurs in certain living organisms, various minerals and in petrified fossils.

Fluorescence should not be confused with either phosphorescence, which is the capability to store light and then emit again over time such as on the dials of our diving gear or watches, or bioluminescence where light is produced by living organisms when they consume energy.

Underwater fluorescence is usually identified with green, and indeed it is the most common colour for reasons that will be explained, but it is also possible to see red, orange and yellow fluorescence.

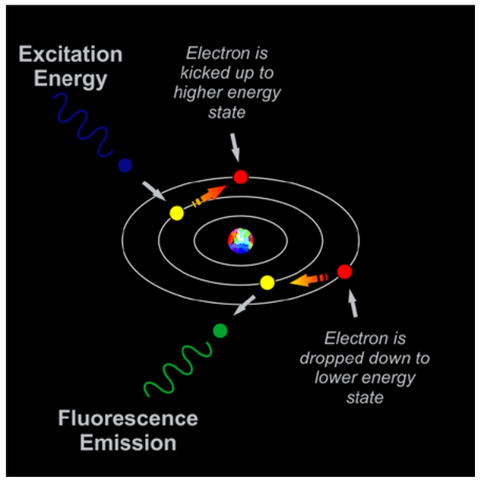
The background

—Once upon a time in Torbay…

The fluorescence phenomena is believed to have been first discovered in marine creatures back in 1927 when a certain Charles E.S. Phillips noticed some glowing anemones in a tidal pool on the beach at Torbay, in the southwest of England.

The bright green colour they were emitting caught his eye, and he took some samples back to his laboratory where he used a light source together with a filter called "Wood's Glass", which absorbs visible light but allows ultraviolet light to pass through, to establish that the anemones

photo & video



Fluorescence schematic (right); Red fluorescing anemone in daylight (far right)

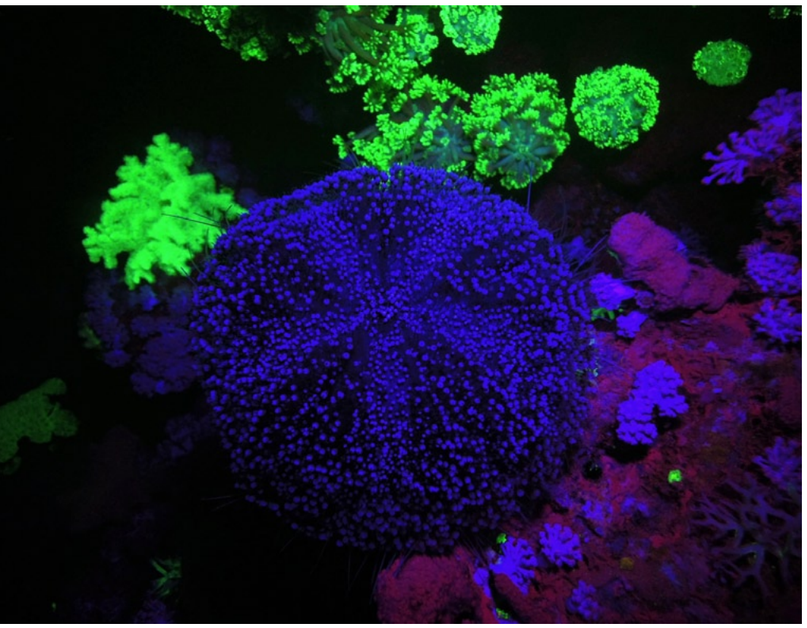
were in fact fluorescent.

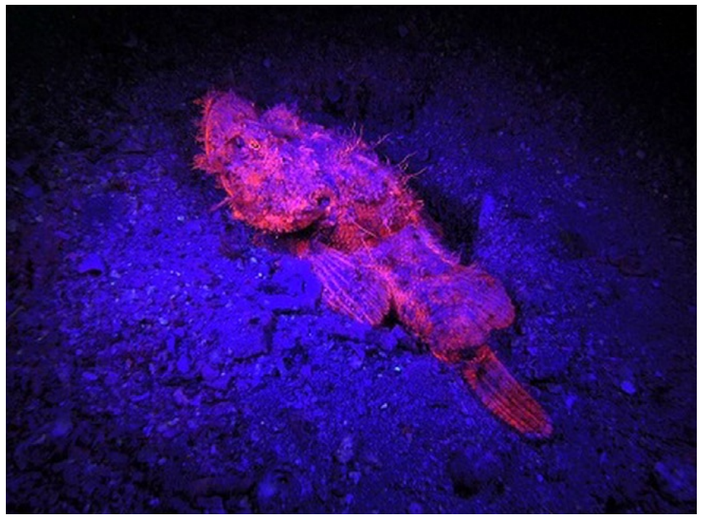
Then in the 1930s, the Japanese marine biologist Siro Kawaguti established that the most common coral pigments also in marine creatures fluoresced in green, followed in 1955 when those pigments were first described and formally recognised as a protein—coining the name "Green Fluorescent Protein" or GFP.

During the late 1950s, as more people started to scuba dive, the phenomena became more widely known, and articles started to appear in publications such as *Skindiver* and *National Geographic* showing the use of "blacklight" ultraviolet underwater torches to observe it.

In 1963, Sir Arthur C. Clarke, the renowned author and diver, further popularised the phenomenon when he described his experiences with fluorescence in his science fiction novel *Dolphin Island*.

Probably the most well-known example of fluorescence from those early days, and one which still puzzles many to this day, are bright red anemones at depths well beyond where the colour has completely disappeared from the visible spectrum. Just ask any underwater photographer about the puzzling results from their efforts to capture an image of such anemones.





Sea urchin (above) and scorpionfish (center) show fluorescent properties

Ultraviolet and blue light 101

While it is possible to see fluorescence underwater during the day, it really is at its eerie best after dark, but you will need a light source to stimulate those proteins! For many years ultraviolet (UV), or "blacklight"—light which in not visible to the human eye because of its relatively high frequency—has been synonymous with viewing fluorescence, largely as a result of the work done by Dr Rene Catala in the late 1950s at New Caledonia's Noumea Aquarium.

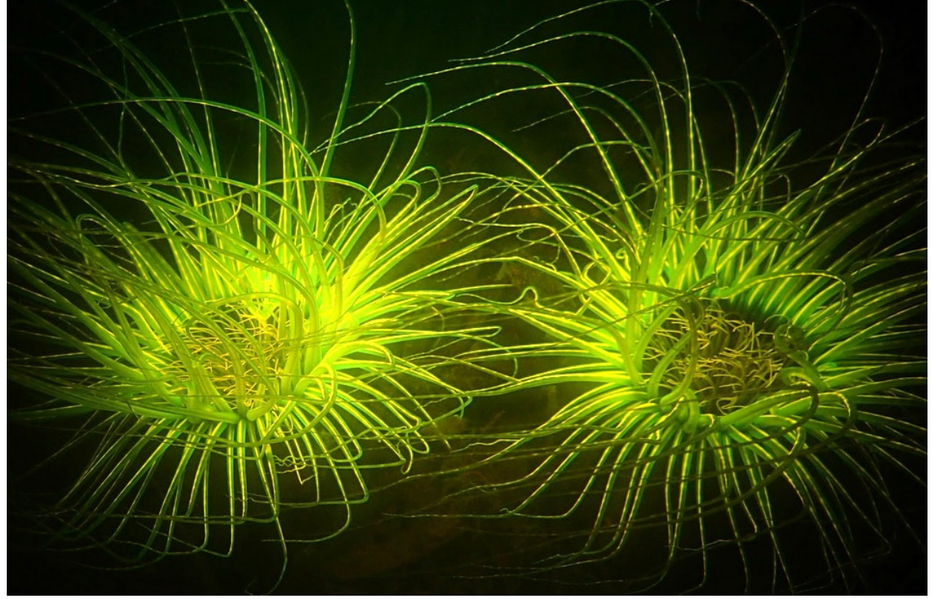
But in the early 1990s, research by Dr Charles Mazel in the cold waters of Massachusetts and the warmer climes of the Bahamas, established that blue light was much better than UV. What Mazel found was that blue light (high energy visible light with a frequency between 400 and 500nm) was much more effective at exciting those proteins to fluoresce, and he went on to start a company called NightSea in 1999, which manufactures equipment for viewing and photographing fluorescence—be it underwater or in the laboratory.

Although much more efficient than ultraviolet, there is a downside to using blue light, as the fluorescence has to be viewed through a yellow barrier filter to block out the blue light reflected back to you, which tends to overwhelm the actual fluorescence. Plus high energy visible light has been linked to age-related macular degeneration.

The yellow filter is mounted on the face mask and basically makes it safe to view the blue light induced fluorescence, while greatly enhancing the overall experience—you can see much more fluorescence with the filter than without it.

photo & video

Anemones fluorescing (right); Brain coral fluorescing (lower left)

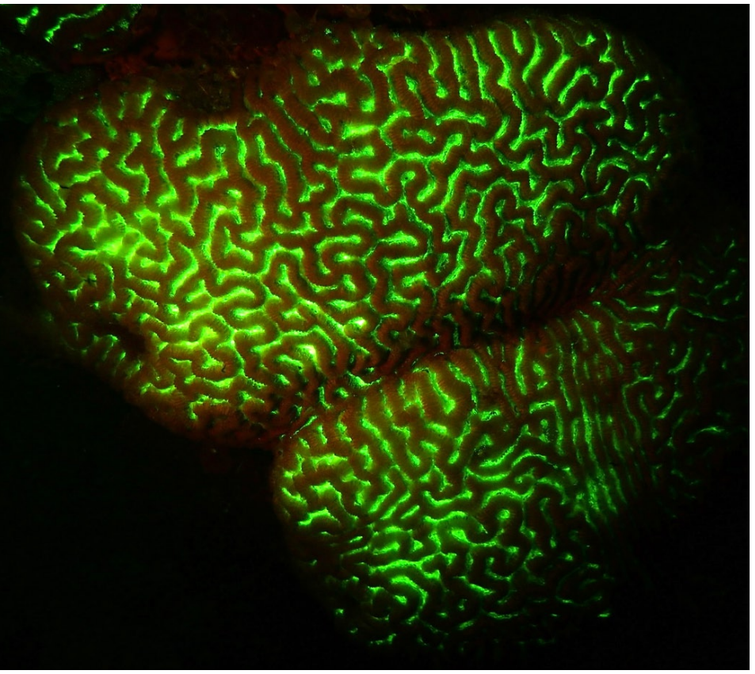


Why is the fluorescence there?

Fluorescence occurs in many marine organisms such as coral, tunicates, barnacles, sponges, anemones, jellyfish, clams, nudibranchs, cephalopods, shrimp, crabs, worms and fish—to name but a few. It also is found in some fresh water organisms, and it seems obvious that the phenomenon must provide some form of benefit to all those creatures, but unfortunately research into what benefit this might be is still in its infancy.

However, there are some preliminary hypotheses and findings, one of which is that some studies suggest that fluorescence in corals may act as a form of sunscreen by protecting the corals and their symbiotic algae against harmful UV radiation.

Another hypothesis states that fluorescence allows corals to transform the only light available to them, namely blue light, into such wavelengths as can be used by their symbiotic algae for photosynthesis, allowing the corals to dwell successfully at greater depths than their competitors without such a capability can, giving them an evolutionary advantage to survival.



Yet another is that fluorescence in reef fish may help them to visually merge with their coral backgrounds so as to make less conspicuous to predators.

And a recently published study shows that the health of corals correlates with their fluorescence, which means that the latter can be used as a measure of the former.

Feather star fluorescing

Photographing fluorescence

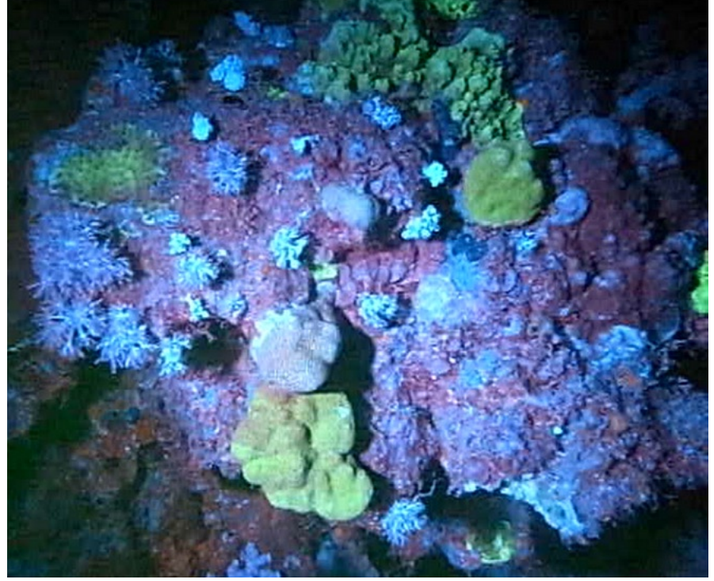
To photograph fluorescence underwater a normal camera and strobe is used, but two additional special filters are required—one on the strobe and the other on the camera. The strobe filter converts the normal white light output in to one of intense blue light, which stimulates the fluorescence and allows it to be photographed.

While the one on the camera is a yellow filter, which allows the sensor to record the image in the same way the barrier filter allows the human eye to view the blue light induced fluorescence.

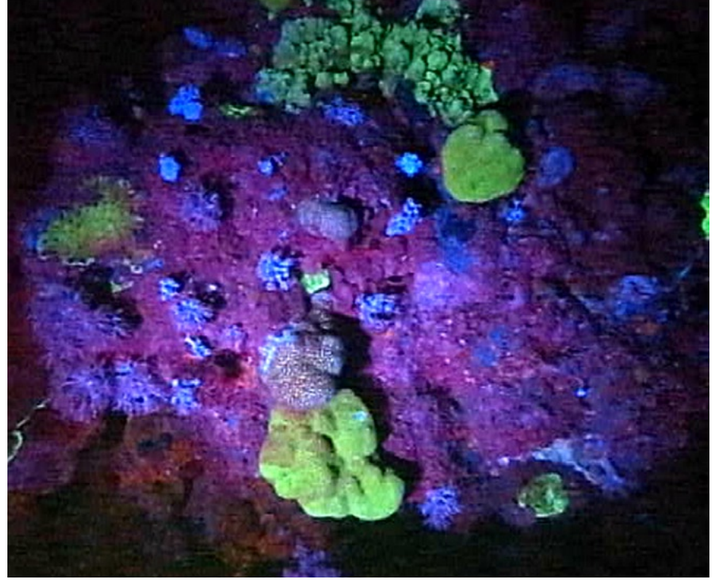
Once suitably equipped, the physical logistics of night time fluoro-photography need to be given some thought. Specifically, you will need a traditional white light source to find your way around the actual site and a blue light one to initially stimulate the fluorescence so it is visible.

Prior to switching light sources the yellow barrier filter on your mask needs to be in place so that you can see the fluorescence properly, but once the filter is in place that is all you can see and everything else is pitch black.

There are various solutions to this, with some divers opting for the more expensive option of two separate torches, while others have a blue dichroic filter on a traditional torch so that blue light can be switched to white as required. Alternatively a phosphor filter can be used on a blue light torch to



Fluorescent coral without blue filter

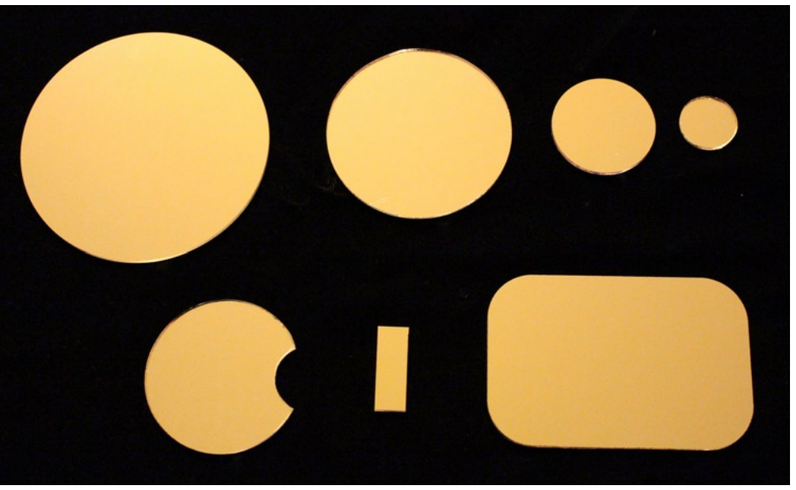


Fluorescent coral with blue filter

convert it to white light.

Contrary to what one intuitively thinks is the correct white balance setting, "Fluorescent Light" should not be used and Auto should be selected instead. Because the overall levels of illumination are not high with fluoro-photography, it is best to increase the camera's ISO setting to make its sensor more sensitive to the available light and smaller apertures are preferred.

Interestingly, as any reflected blue light is absorbed by the yellow camera filter, fluoro-photography is not as susceptible to backscatter as white light photography. Therefore, blue light strobes do not need to be positioned as far away from the optical axis of the camera as they are in white light photography.



Dichroic or interference filters of different shapes and sizes

Let there be (blue) light!

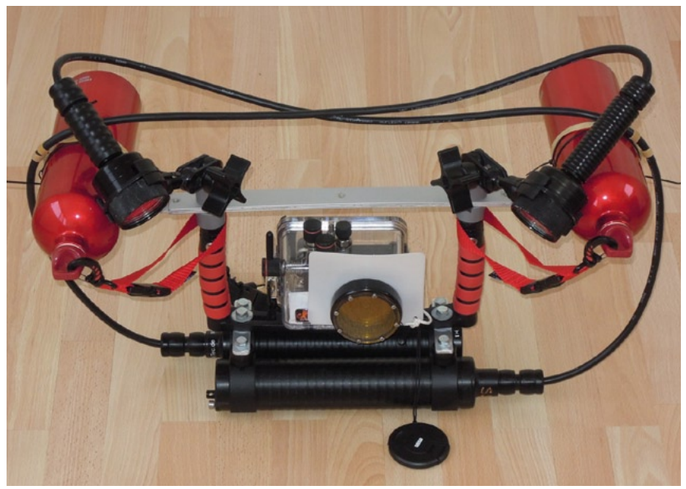
Night time fluorescence diving and fluoro-photography is indeed an interesting and exciting new aspect of the underwater world, which will continue to attract interest because of its uniqueness. Our eyes and senses are attuned to seeing things as they are illuminated and reflect light back to us, but with fluorescence the light is being emitted from the object itself and all else is blackness—a truly strange and enthralling experience! ■

Steffen Beyer has been a keen scuba diver since 1988. He graduated from Aachen University in Germany where he studied computer science and biology. In 2004, he worked as a patent examiner in the field of "computer-implemented inventions" at the European Patent Office in The Hague, Netherlands.

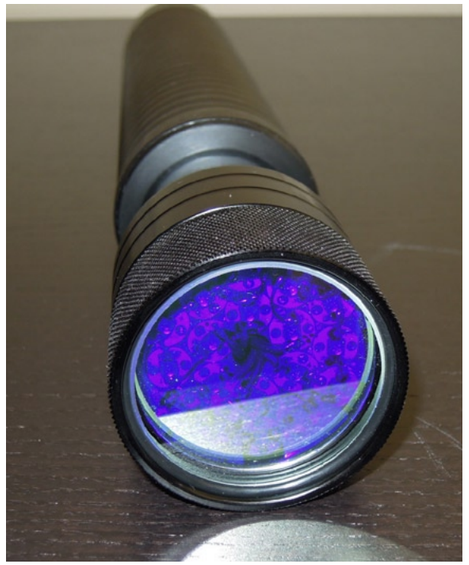
Inspired by Sir Arthur C. Clarke's book, Dolphin Island, in autumn of 2010 the Beyer began building his own fluorescence torches, because he could not find any commercially available UV dive lights.

In order to get as close to the experience described in the book as possible, Beyer initially exclusively used UV LEDs and built torches of increasing power, first with a single LED of about 395-410 nm and 1 Watt, then a torch with two LEDs with 365 nm and about 6 Watt, and finally one with 4 quadruple LEDs (equivalent to 16 single LEDs) at 365nm and 46 Watt.

Together with the dive instructor and physicist, Lynn Miner, Beyer founded ***www.FireDiveGear.com*** *in May 2012, in order to develop high quality yet affordable equipment for fluorescence diving and fluoro-photography.*



The author's current camera set-up



The author's torch with 18 blue Cree LEDs and a dichroic blue filter

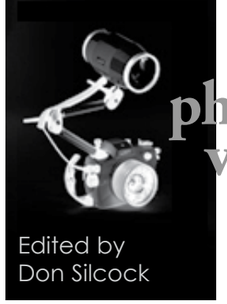


photo & video

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PRODUCT SHOTS
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Sea & Sea EOS 70D Housing

Sea & Sea has released their new housing for the Canon EOS 70D. The MDX-70D housing is made from aluminium and features the company's new internal optical YS converter, which converts the camera's TTL electronic signal into a fiber output. The housing features a quick control multi-function button, leak sensor and an externally accessible port lock. ■

Nauticam S120 Housing

Nauticam has announced the release of their new housing for the very popular Canon PowerShot S120 compact camera. The NA-S120 housing features access to the camera's front command dial, a 67mm thread on its lens port to allow the attachment of accessory lenses and fiber optic bulkheads for strobe triggering. ■

Nauticam OM-D E-M1 Housing

The march of the mirrorless cameras continues, and following Sony's recent announcement of the first full-frame versions comes the new Olympus OM-D E-M1 camera. Olympus has built on the tremendous success of the first OM-D, the E-M5, a camera that impressed virtually everybody that used it with its excellent functionality and images. But the E-M5 was aimed at the "enthusiast" market—keen photographers who were looking for most of what a DSLR offers, but in a small package. This time Olympus is looking for the E-M1 to tempt the high-end enthusiasts and professionals looking for that smaller package, and so far the signs are very positive they will achieve that. Nauticam has responded to the new Olympus in the usual record time and has announced the release of the new NA-EM1 housing. The housing is designed to make the most of the E-M1's capabilities and looks more like a fully-fledged DSLR housing with its attached set of handles. ■

Nauticam Blackmagic Pocket Cinema Camera Housing

Nauticam has released their new housing for the Blackmagic Pocket Cinema camera. The very highly regarded Pocket Cinema camera cab record 1920x1080 30P video in the high quality lossless CinemaDNG RAW and editing friendly Apple ProRes(TM) formats. It is also capable of an incredible 13 stops of dynamic range. The Nauticam NA-BMPCC housing provides access to the main camera controls such as record, focus, and lens control—all of which are placed within finger reach from the grips. Nauticam has also angled the housing's handles forward by 15 degrees for comfortable use in a level, swimming position. ■

Sea & Sea RX100 Housing

Sea & Sea has released their new housing for the very highly regarded Sony RX100 compact camera. The MDX-RX100 is made from aluminium and can accommodate versions 1 or 2 of the Sony camera using a bumper pad kit that is supplied with the housing. The housing also features a flash deactivation lever, a multi pad controller and a control ring for the camera's front command dial. ■

Ikelite D610 Housing

Ikelite has announced that it has updated its housing for the Nikon D600 to accommodate the revised D610 model. Although externally identical to the D600 housing, the new D610 has updated circuitry to enable the use of Live View underwater. The D610 housing has 200-foot depth rating and is very competitively priced at US$1,600. ■

Gates Sony Z100 housing

Gates Underwater Products has announced their new housing for the Sony Z100 4K professional camera. The new housing features complete access to all the Z100's controls, including manual focus, iris and white balance. The buoyancy and trim of the housing can be adjusted via the use of trim weights, and the housing can be outfitted with an HD-SDI surface feed. ■

Fantasea G16 Housing

Fantasea has released their new FG16 housing for the Canon Powershot G16 compact camera. Unlike the Canon housing for the G16, Fantasea's approach is to provide full access to all camera controls underwater, plus the housing is also supplied with a double fiber optic port and a moisture detector as standard. The FG16 is priced at US$499.95 and in some regions of the world, Fantasea is offering housing and camera bundles. ■

Nauticam G16 Housing

Nauticam has released their housing for the Canon PowerShot G16 compact camera. The NA-G16 housing offers access to both front and rear control dials on the camera, a 67mm thread on its port for wet lens mounting plus fiber optic bulkheads for strobe triggering. The housing also features a single 16mm threaded port for attaching an accessory vacuum system or electronic strobe triggering bulkhead. ■

Aditech MVHS-FS700 Camcorder Housing

Aditech has announced their new housing for the Sony NEX-F700 and FS100 camcorders. The Mangrove MVHS-FS700 housing is made from marine grade aluminum, which has been machined and anodized, while the rear cover is machined from solid Delrin. The housing features a control system that uses the camera's LANC control and all the controls are accessed via 12 external push buttons, which provides good user feedback via the camera's touch screen. Review and framing are achieved via a 3.5 inch (9cm) TFT rear mounted monitor. The Mangrove MVHS-FS700 housing is available now at a retail price of EU€3,119. ■