

A Journey into Fluorescence

by James Lynott

The phenomenon of fluorescence in marine life has been known of for some time, with some of the first observations as early as 1927 which were anemones in rockpools in Torbay England.

There are more reports from the 1950s and 1960s, with the possible first use underwater recorded as being between 1959-1961, Jacques-Yves Cousteau even mentions underwater fluorescence in *The Silent World*.

In the 1970s Charles Mazel began experimenting with underwater fluorescence and would later go on to develop the Nightsea light range with Light & Motion.

My journey into fluorescence started much later than this, it was in 2011 during an episode of 'Britain's Secret Seas' that I was first introduced to the phenomenon of fluorescence diving. In one of the episodes there was a small segment filmed during a night dive at St. Abbs where the presenters used blue lights to observe fluorescence in lightbulb tunicates.

At that time I had only been diving for a couple of years and I was already amazed by the underwater world and marine life but the fact that

we had marine life in our seas that could fluoresce in this way was just fascinating to me and I immediately wondered what other species had this ability.

As I work in science, I was already familiar with Green Fluorescent Protein (GFP) and the origins from jellyfish, but I was not aware of fluorescence in other marine species.

I started to research the subject and found that "fluo-diving" was becoming increasingly popular in tropical waters with many dive centres offering these types of dives, as coral reefs and a lot of the associated species display incredible fluorescence when exposed to UV or blue light. It was difficult however to find any reports or information about fluo-diving in UK waters, or in fact, other temperate seas.

I was keen to start trying this for

Phosphorescent sea pen fluorescing in Loch Leven. Canon G7XII, Fantasea FG7XII, 1 x Light & Motion GoBe+ Nightsea, 1 x Riff/FDG TL Azur, FDG Barrier filter. ISO 500, f2, 1/100





Fluorescing greater spider crab in Loch Leven. Canon G7XII, Fantasea FG7XII, 1 x Light & Motion GoBe+ Nightsea, 1 x Riff/FDG TL Azur, FDG Barrier filter. ISO 400, f2, 1/80

myself and as I was also getting into underwater photography, capturing images and video of underwater fluorescence in the UK, perhaps with species not previously known to fluoresce, was my ultimate goal. It wasn't until a couple of years after first seeing the 'Britain's Secret Seas' episode that I was able to get started.

Sourcing the required equipment back then was a little difficult; it was thanks to a limited number of specialised suppliers based in America and Germany who really promoted

fluorescence diving and could provide the necessary lights and filters that I needed to get started. As this type of diving has become more popular a greater range of equipment became more widely available to buy more recently.

To view biofluorescence you need blue light which has wavelengths of roughly 420-470nm. UV light can also be used (<400nm), but it has been shown that blue light can produce much better visual results. These short, high energy wavelengths



Snakelocks anemone in a rock pool near Oban. Canon G7XII, Fantasea FG7XII, 2 x Riff/FDG TL Azur, FDG Barrier filter, Inon UCL-165m67 close up lens. ISO 160, f5.6, 1/100

of light are absorbed by fluorescent proteins (such as GFP) and other compounds, they are then re-emitted at a longer wavelength, low energy light (green, yellow, red). Along with the blue light, a barrier filter is also needed. This is a yellow filter for your mask or camera which blocks some of the blue light reflecting from the subject allowing the fluorescence to be viewed more effectively.

My first attempts at viewing fluorescence underwater were with dichroic filters placed over

video lights, these did work but I soon realised that in order to view fluorescence effectively, dedicated powerful lights are needed.

As I was interested in capturing video as well as still shots, I decided to go down the constant light route rather than strobes with a filter, although this method also works very well when the correct filter is used.

Over the years I gradually improved my camera and lights setup to what I use now which is a Canon G7xMkII, Fantasea FG7XII, 2 x

Light & Motion GoBe+ with Nightsea wide angle heads, 1 x Light & Motion GoBe+ with Nightsea narrow beam, 2 x Riff/FireDiveGear TL Azur lights, a 67mm heliopan Y12 barrier filter, a 67mm FireDiveGear barrier filter. Inon UCL-165 m67 close up lens.

The first purpose made lights I used were Light & Motion GoBe+ with Nightsea heads, these are fantastic small lights with a nice wide beam great for video and photography, and the same light with a narrow 15° beam is very useful for macro. After using these lights for some time, I decided I needed something more powerful still.

There are many options available now but I opted to go for the Riff TL Azur light which was co-developed with FireDiveGear. Both the Light & Motion and FireDiveGear lights have blue LEDs in combination with a dichroic filter, this produces the optimum light wavelengths which excite fluorescence.

I have also discovered that the choice of barrier filter is important. Some, such as the heliopan Y12 filter, completely removes all the reflected blue light so only the fluorescence is viewed. I find this works well for some subjects, but it will reduce exposure by at least 1-stop as it is removing much of the light.

The FireDiveGear barrier filter allows more of the blue light through to the camera which can produce more dynamic images as they are not just green and black, but if the fluorescence of the subject is weaker it can be washed out by the blue. Each has it's own pros and cons.

One of my first experiences of fluorescence diving in Scotland was in Loch Fyne; this was actually during day but it was dark enough to try



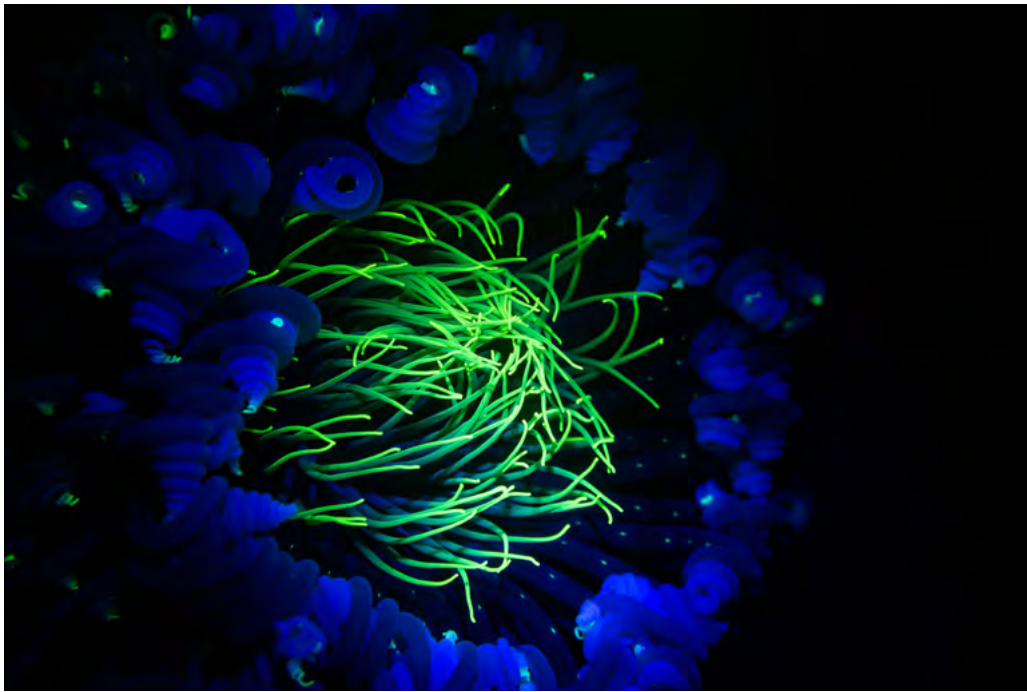
Fluorescing greater spider crab in Loch Leven. Canon G7XII, Fantasea FG7XII, 1 x Light & Motion GoBe+ Nightsea, 1 x Riff/FDG TL Azur, FDG Barrier filter. ISO 400, f2, 1/80

thanks to the murky freshwater layer at the surface cutting out all ambient light (a common feature of winter sea loch diving).

There was something quite eerie about going along in complete darkness only being able to see what is fluorescing! What really surprised me on this first dive were the mouthparts and claws of squat lobsters fluorescing brightly, just poking out of the crevices and burrows.

Along with the brightly glowing tentacles of burrowing anemones on the sea floor and even a yarrell's blenny with glowing head fringes. I had suspected some anemones would fluoresce but had no idea squat lobsters or yarrell's blenny would. I was completely hooked after that dive and desperate to get out and try it as much as possible.

Anyone who has dived in Scotland will be familiar with the amazing fireworks anemone,



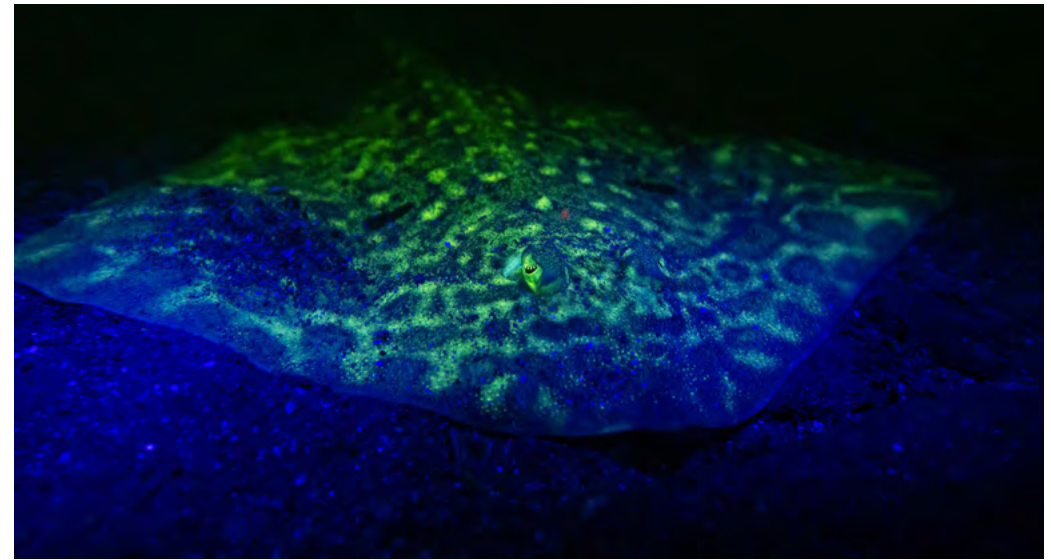
Close up shot of fluorescing inner tentacles of the fireworks anemone, Loch Fyne. Canon G7XII, Fantasea FG7XII, 1 x Light & Motion GoBe+ Nightsea, 2 x Riff/FDG TL Azur, FDG Barrier filter, Inon UCL-165m67 close up lens. ISO 250, f4.5, 1/100

and this was one of the species I was really keen to see if they would fluoresce. I was finally able to try this out in November/December 2016 over a couple of dives near the head of Loch Fyne and I was not disappointed.

These large anemones are impressive under normal circumstances but viewed under blue light they really do look like fireworks in the darkness. Over the last few years, I have collected many images and video clips of these anemones

fluorescing and it is fascinating to see all the different patterns of fluorescence on individuals.

In 2016 David Gruber et al published their fascinating work on fluorescence in two Catshark species, Swell sharks in the Eastern Pacific, and Chain sharks in the western Atlantic. After reading this I was curious to see if our own catshark species, the small-spotted catshark (*Scyliorhinus canicula*), and other elasmobranch species would also fluoresce. I was able to confirm this



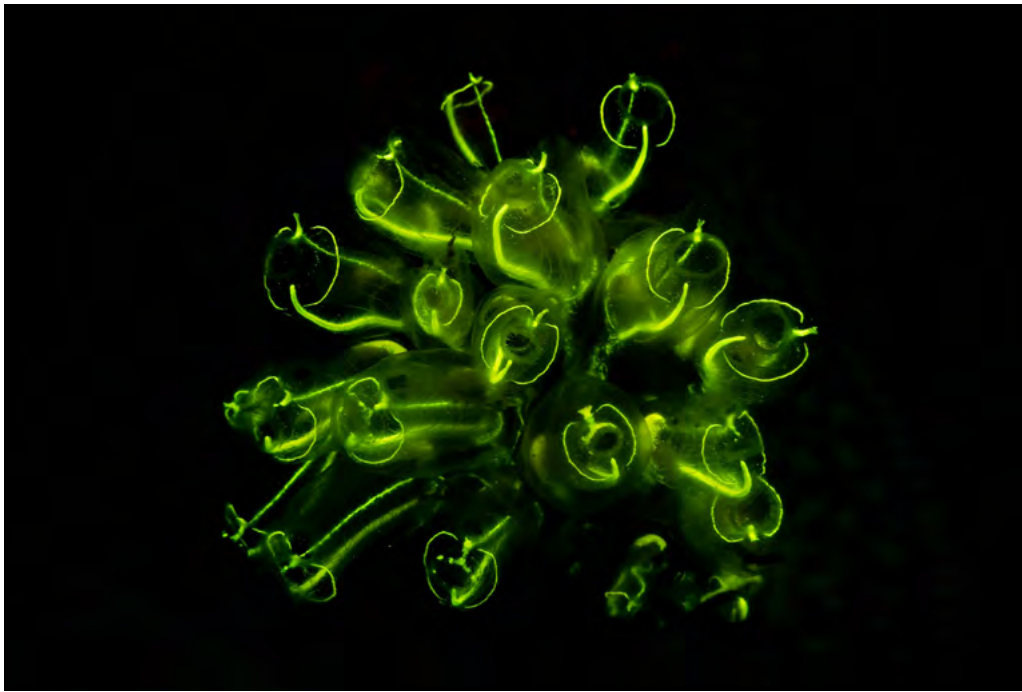
Fluorescing juvenile thornback ray in Loch Creran. Canon G7XII, Fantasea FG7XII, 2 x Riff/FDG TL Azur, FDG Barrier filter, Inon UCL-165m67 close up lens. ISO 500, f3.2, 1/80

to be true in 2018 when I got my first images of small-spotted catsharks and thornback rays fluorescing in Loch Fyne and Loch Leven respectively. This was particularly exciting as I think this was the first time fluorescence had been observed in these species in the UK.

Learning to photograph underwater fluorescence has been quite challenging and it has certainly taught me a lot about photography and videography in general. As with more conventional photography the settings used varies greatly depending on the subject being photographed.

My standard settings at the beginning of a dive tend to be

ISO500, f3.5, 1/100. I always try to reduce the ISO as much as possible first to reduce noise, and with subjects like Devonshire cup corals or lightbulb tunicates that fluoresce very brightly it is possible go as low as 125. With the shutter speed I try to avoid going slower than 1/80 as I am using constant light rather than a strobe. Sometimes I do need to widen the aperture although I try to avoid this, particularly if using the Inon UCL-165 wet lens. As with conventional photography I leave the white balance set to auto and adjust in Lightroom, I find that I rarely need to make major adjustments to the white



Close up shot of fluorescing lightbulb tunicates at the Garvellachs. Canon G7XII, Fantasea FG7XII, 2 x Riff/FDG TL Azur, FDG Barrier filter. Inon UCL-165m67 close up lens. ISO 125, f7.1, 1/100

balance to show the fluorescence as it was viewed.

I have only tried fluorescence photography in dark or low ambient light conditions so far, but it is possible to use this technique during the day in ambient light. Susannah H. Snowden Smith recently published a fantastic article about fluorescence during the day, it is certainly something I am looking forward to trying out.

It is fantastic to see underwater fluorescence photography gaining

popularity in the UK and there are now many fantastic photographers producing incredible images, and adding to the growing list of UK species that fluoresce, such as Alasdair O'dell, Dan Bolt, Colin Garrett, Steve Trewhella, and Shannon Moran to name just a few.

I wasn't really sure what to expect trying fluorescing diving in our seas but it has been an incredible journey and learning experience, it seems that every dive with the fluo gear I find something that I hadn't



Juvenile small-spotted catshark in Loch Long. Canon G7XII, Fantasea FG7XII, 1 x Light & Motion GoBe+ Nightsea, 1 x Riff/FDG TL Azur, Heliopan Y12 Barrier filter. ISO 400, f2, 1/80

seen before so I'm sure there is still plenty of natural fluorescence to discover.

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