



# Barnsley



## Underwater Video Workshop

Rob Mason – July 2020

## TABLE OF CONTENTS

1	Introduction .....	4
2	The Underwater Environment .....	5
2.1	Simple Workarounds.....	5
2.1.1	Filters.....	5
2.1.2	Artificial Light (Torches & Strobes) .....	6
2.1.3	DivePlus+ .....	6
3	Underwater Camera Settings.....	7
3.1	The White Balance challenge .....	7
3.2	Locking White Balance .....	7
3.3	Resolution, Frame Rate and ISO .....	8
3.4	Avoiding Black Bars on your Video .....	9
3.5	Additional Settings to Consider.....	10
3.6	Pre-Dive Checks.....	10
4	Composition .....	11
4.1	Field of View (FoV).....	11
4.2	Focus.....	11
4.3	Lighting .....	11
4.4	What makes a Good Video? .....	12
5	Post Processing .....	14
5.1	Video Editing Tools.....	14
5.2	Colour Balancing .....	14
5.3	Adding a Soundtrack.....	14
6	Publishing Your Movie.....	15
7	A Final Note.....	15

## **Change Log**

- May 2020 Updated FPS and resolution advice
- April 2020 Initial draft release for lock-down presentations
- July 2020 Updated FPS and resolution following experimentation at Eight Acre Lake
- July 2020 More tuning following UK sea dive to the Farnes (Exposure Value)

# 1 INTRODUCTION

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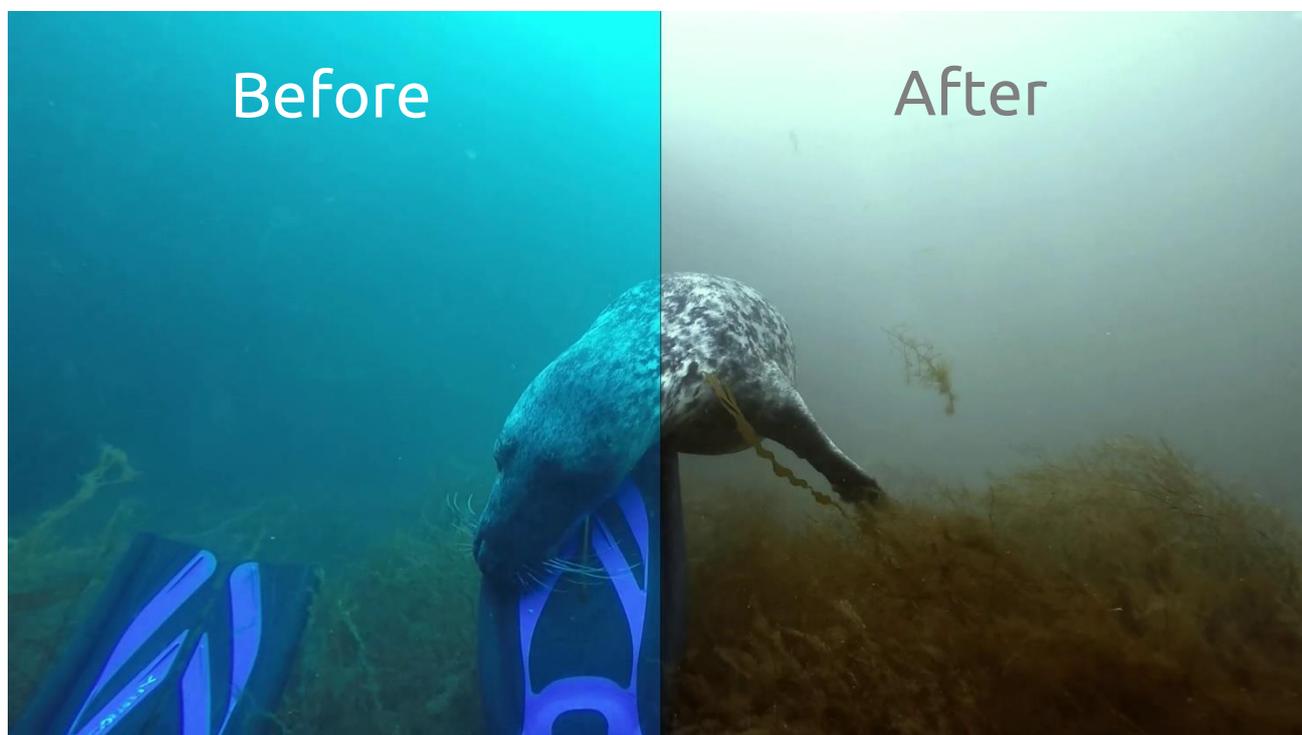
*No Atlantic grey seals were harmed during the making of this guide!*

Greetings Divers. This guide (and supporting workshop) is aimed at improving those familiar greenish coloured videos captured in UK sea waters. Whilst the focus is on UK waters, the concepts presented within this guide can be adapted for tropical climates.

Most of us own an underwater camera capable of video capture. GoPro's are quite common amongst the diving community, as are other brands such as Fuji, Canon, Olympus etc. Generally, all of these devices are each capable of shooting decent underwater video – but we often end up with disappointing results!

The first problem we encounter is the huge amount of conflicting advice on the best settings and usage of video cameras underwater. What I'll attempt to do in this guide is try to demystify underwater video capture by explaining some of the problems we face with underwater video capture, and offer simple solutions and fixes to help overcome those problems.

To serve as an example, the frame below is from a video of a seal encounter at the Farne Islands. The original captured video carries a predominantly greenish-blue hue. This will be all so familiar to many of you. With some very simple steps, we can colour correct the video to better represent the underwater environment.



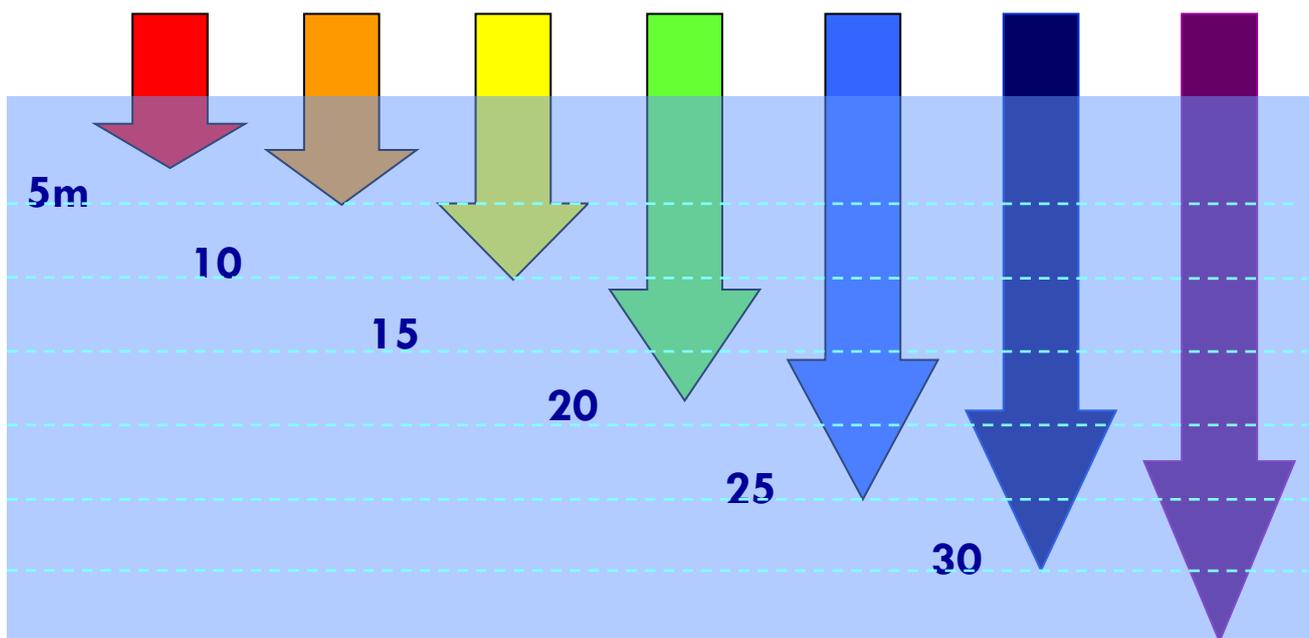
**Note** – this guide will not make bad videos look good! Your starting point has to be a reasonably clear, sharp and well composed video. Don't worry - we'll also look at a few techniques for achieving good composition too!

## 2 THE UNDERWATER ENVIRONMENT

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So, why do we end up with greeny-blue underwater videos? If we go back to our Ocean Diver training, we have to remind ourselves of the properties of water.

Water is dense – much denser than air. When visible light penetrates water, it is absorbed. The amount of absorption is relative to depth - starting with Reds within the first 5m. When we get to 15m, only the green, blue, indigo and violet wavelengths of light penetrate that far. Hence everything looks bluey-green! And dark too.



### 2.1 SIMPLE WORKAROUNDS

Before we look at detailed colour correction, there are a few quick fixes you could apply to help overcome loss of colour that may be sufficient for your needs.

#### 2.1.1 Clip-on Filters

Underwater clip-on lens filters are designed to bring colour and contrast back into your underwater video. These colours are lost as we descend, starting with red, which is why these filters are red or magenta. By bringing the reds back, the GoPro auto White balance is able to select a more accurate white balance when recording clips.

- For Blue waters (Tropical), simply clip on a Red filter.
- For Green waters (UK), clip on a Magenta filter.

The quality of the filter matters. The GoPro original filters are made of glass and are scratch resistant – these are the best choice, but are expensive. Plastic filters are lower cost, but are false economy as the plastic degrades after a few dives – you will end up with soft or foggy images.

If used with a diving torch, then your footage will display a red or magenta hue! You need to remember to unclip the filter if using a torch to light up your subject.

Adding a colour filter to your GoPro is a simple fix to the loss of colours, but there are some limitations - as you will see from the section on White Balance. Despite re-introducing colours, unless white balance is locked, you will experience colour drift.

### 2.1.2 Artificial Light (Torches & Strobes)

GoPro underwater filters are fine for shooting subjects that are more than a couple feet away from the camera, however if your subject is close to the camera, you will get much better video by using video lights. Video (artificial) light brings all the colour back into play.

There are two things to keep in mind when using video lights with your GoPro underwater. The first is to make sure you are close enough to the subject so that it is well lit by the light(s). This is generally less than 2m. The second thing to be aware of is that the GoPro has a minimum focus distance of 0.5m, meaning that you cannot place the camera less than 0.5m from the subject or it will not be in focus (sharp focus is essential for a good video clip).

Here are a couple of examples of inexpensive GoPro Video Light setups:



Your main limitation is that, beyond a couple of meters, video light loses its effectiveness. Worse still, beyond a few metres you may see backscatter as the video light picks up sediment and organic matter between you and the subject.

A video light might be the only option for some subjects, such as inside of a wreck. Otherwise there is insufficient light for the GoPro to operate. Fortunately, many video lights are small and portable (see the example on the right image above).

### 2.1.3 DivePlus+

I can't write this guide without mentioning [Dive+](#) - I know a lot of divers who use this online service for colour correcting underwater video clips (amongst other online services and video cameras).

Basically, you download the phone app (Android or iOS) and setup an online account. Then upload your video clip to your phone and apply the colour correction filter. The results are fairly quick and of reasonable quality. Unless you buy the full version, you end up with a Dive+ watermark in the bottom corner of your clip.

The only disadvantage I can offer for this method is that you have no control over video format, resolution and export options. If you need to edit this into a timeline, good luck!

## 3 UNDERWATER CAMERA SETTINGS

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Before looking at video correction, I want you to consider the simple photographic example below, courtesy of my dive buddy Linda Marsh. You will see the all-too-familiar greenish hue of UK sea water at a depth of around 10m. As we have learned, the density of the sea water has filtered out reds and yellows, leaving us with this rather greenish looking underwater photo.



With some post-processing trickery, we can easily amplify those weaker filtered-out colours. Apps such as Photoshop and GIMP include “*Auto -> White Balance*” which is often good enough to correct most underwater photos with a single click.

### 3.1 THE WHITE BALANCE CHALLENGE

The above photograph captures a single moment in time with fixed lighting conditions at that very moment. Therefore, our lighting conditions are consistent during capture. This is not the case with video.

With video – effectively 1000’s of individual photos (‘frames’) that are captured within a time window of constantly changing lighting conditions – colour balance becomes challenging. The camera sensor will continually re-assess the colour and lighting conditions, and will re-adjust the white balance accordingly.

In other words, during an underwater video capture, the white balance (and therefore colour) will “drift”. Without a consistent colour baseline, colour correction becomes incredibly difficult. Your video camera needs help!

### 3.2 LOCKING WHITE BALANCE

Your underwater video camera is likely to have a “White Balance” setting. Most divers just leave this set to “Auto”. This may be fine above water, but underwater this works against you by contributing to colour ‘drift’. We need to ensure that the White Balance setting is locked to a specific colour value. This makes certain that any fixed reference point, like the grey skin of the seal, becomes a reliable and fixed reference point that exists for the duration of the whole video clip.

Using a GoPro, locking the White Balance can be achieved using the following settings:

GoPro Setting	Value
Protune	On
White Balance	Native
Colour	Flat

If your GoPro or camera does not have Protune, you can instead 'lock' white balance using one of the preset values – say 5000k for example. Or "Sunny Day". It doesn't really matter. The important step is to 'lock' White Balance to prevent the continual automatic adjustments by your camera.

Once Protune is set, you will notice that the resulting footage looks flat and washed out. This is normal - the camera has recorded, with minimum loss of information, data obtained directly from the camera sensor without any in-camera modification. Videographers refer to this as Log-format.

Although we can't see it, we have captured a wide tonal range video. We enhance the colour by manually tuning the footage through "Post-Processing" (section 5).

There's one other setting that will squeeze more tonal range out of the captured footage on a GoPro – "Exposure Value". By slightly darkening the exposure we can avoid blown out highlights. However, if the lighting conditions are very poor, then you may get underexposed footage.

### 3.3 RESOLUTION, FRAME RATE AND ISO

White Balance is only half of the camera settings story. We need to give the camera as much help as possible to grab all of the underwater colour that it can. Unfortunately, there is no "one size fits all" – you will need to experiment within the setting ranges described below.

GoPro Setting	Moderate Low Light	Low Light	Very Low Light
Resolution	2.7k or 1080p	1080p	1080p
FPS (Frames per Second) <sup>1</sup>	50	25 or 50	25
Shutter Speed	Auto	Auto	Auto
FOV (Fields of View)	Wide	Wide	Wide
Maximum ISO	400	400 or 800	800 or 1600
Exposure Value (EV)	-1	-1 to 0	0
Low Light	Off	Off	Off
Spot Meter	Off	Off	Off

Because UK waters are typically low light environments, we need to maximise the amount of light recorded by the camera sensor. To do this, we need to expose each video frame to as much light as is possible. In practical terms, this means slowing down the frame rate, lowering resolution and increasing ISO.

For best results in low light, we need to start the camera at the lowest HD resolution setting of 1080p, and, slowest frame rate of 25 FPS (30 in the USA). This allows enough time for the camera to capture and process frames within low light underwater scenes *at the best possible quality*. If

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<sup>1</sup> For US and other non-European countries, 30 and 60 FPS will be the standard choice.

you're shooting footage that you want to slow down during post production, such as 'slo-mo' effects, then look to increase frame rate to 50 FPS (60 in the USA).

We can also increase the camera sensitivity to light by upping the 'ISO' setting. However, this can also work against us - at 1600 ISO, image noise will appear. Therefore, you should limit the ISO to no more than 800 (but definitely no higher than 1600). You may need to experiment to see which works best for your camera.

So, on the GoPro, why are we disabling the "Low Light" setting? Whilst this appears counter-intuitive, the Low-Light setting makes automatic adjustments to shutter speed. Generally, "Low Light" is used for when you are filming in both bright and darker environments. Remember, we need fixed settings to help prevent 'drift'.

Basically, *any* setting that attempts to make any processing decision on behalf of the user should be disabled.

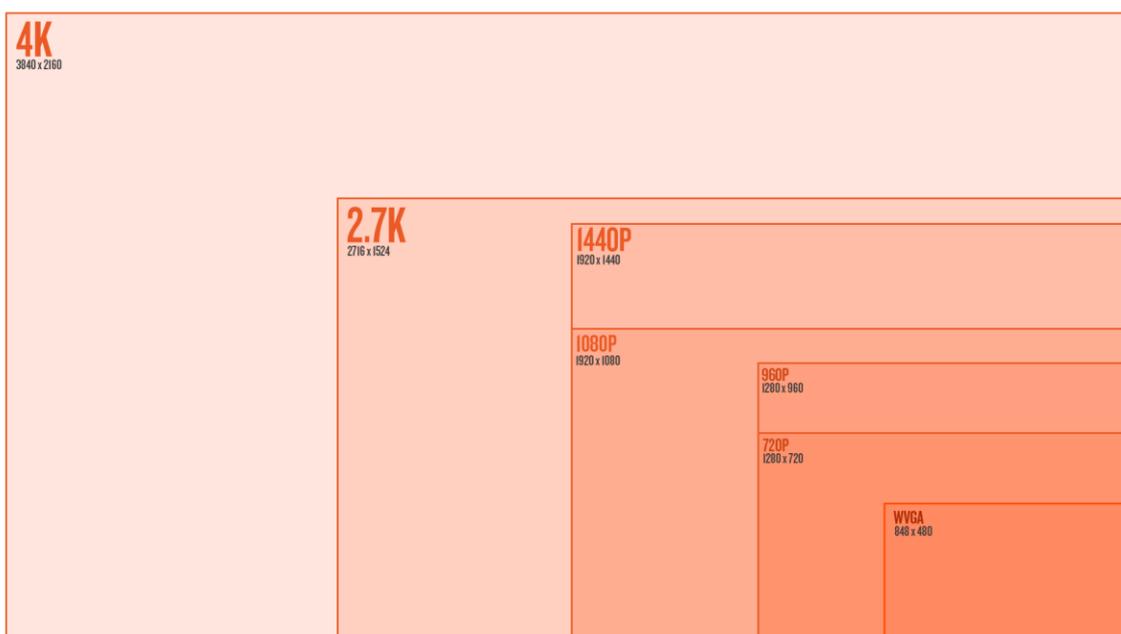
### 3.4 AVOIDING BLACK BARS ON YOUR VIDEO

I have purposefully ignored non-widescreen aspect ratios within this guide. I have assumed that playback will be to a modern display – these are nearly all widescreen format now (16:9 ratio). To avoid black borders appearing within your video clips as a result of mixing aspect ratios, you need to select a 16:9 ratio resolution, not 4:3. The 16:9 resolution choices are:

- 4k: 3840 x 2160
  - 2.7k: 2704 x 1520
  - 1080p: 1920 x 1080
  - 720p: 1280 x 720
  - 480p: 854 x 480
- Try to avoid these two non-HD resolutions if possible!*

Some cameras may support the higher frame rates, but may struggle to process video capture quickly enough in low light conditions. 1080 should be your minimum choice of resolution for HD playback. Please try your own experiments with increased resolutions above 1080p.

The diagram below provides a size comparison of each resolution setting.



### **3.5 ADDITIONAL SETTINGS TO CONSIDER**

Newer GoPros come with EIS (electronic-image-stabilization) aka "Hypersmooth". This may work against you in low light environments. When you combine long exposure times (slower frame rates) with a shaky camera, you may see blurring from frame to frame as the EIS tries to compensate. Your mileage may vary – please try your own experiments.

You should also consider disabling camera sounds/beeps and all but the rear LED's on your camera. Why? These may distract or startle wildlife – we don't want that, so switch them off!

To save battery drain, you may wish to timeout the preview screen after 1 minute (or disable it altogether). Remember that your GoPro/Action Cam has nearly 180 degrees field of view – so long as you point the camera in the general direction of your subject, you'll capture your target (more on that later).

### **3.6 PRE-DIVE CHECKS**

Finally, before jumping in the water, you need to double check your video setup:

- Full Battery?
- Plenty of space on your memory card?
- GoPro is attached and secured to your dive kit?
- White Balance is locked and ready?
- Correct resolution has been selected?
- If taking video lights, are they charged up and working?

And, be careful where you leave your GoPro lying around on a boat deck – I've seen them crushed by cylinders when divers sit down!

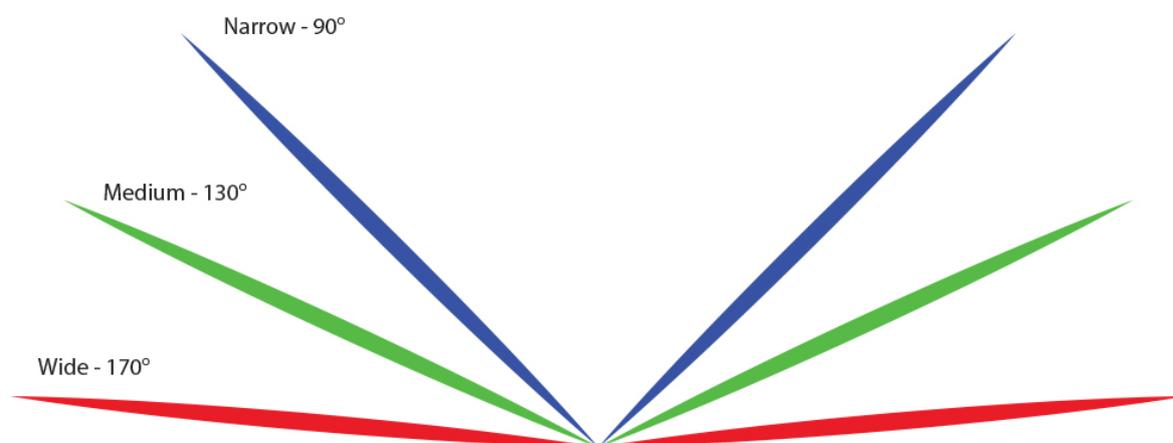
## 4 COMPOSITION

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So, we've now configured our action camera to its optimum settings for UK waters – now let's shoot some great video! This section will introduce you to a few basic composition tips that are relevant to action (wide angle) cameras.

### 4.1 FIELD OF VIEW (FOV)

One of the first blunders that most action camera users make is to rapidly move the camera to follow the action. This results in shaky and blurry video that is incredibly difficult to view during playback – your viewers will hate you! **Remember** - your camera has nearly 180 degrees of view in 'SuperWide' setting. Even when shooting at a medium FoV, you have a huge 130 degrees view in front of you. This is more underwater peripheral vision than you get from your own eyes!



In practical terms, all we need to do is switch on the camera and point it in front of us and hold it as steady as possible. Resist the temptation to follow the action – relax and let the camera capture the movement in the scene in front of you.

1. Start capture and simply point to front
2. Avoid rapid (or any) arm movement – steady hands
3. Capture scene movement, not arm movement!!!

### 4.2 Focus

Unless you have a macro attachment on your action camera, its minimum focusing distance is about 1m. This means that any subject closer than the length of your arm will be blurry! The key to avoiding blurry footage is to hold the camera steady and maintain a distance of at least a metre (a torch might help in low light environments).

If your subject is quite small, rather than trying to get closer, resulting in out-of-focus footage, you could always crop and zoom the video during post processing. This may yield better results.

### 4.3 LIGHTING

Video lights are a great idea for capturing full colour at the 1-2 metre range. If you do use one with your camera then make sure it has a wide beam. If you use a torch as a make-shift video light then it should be zoomable – otherwise you will find that the middle of the torch beam “burns

out” the centre of your footage. Ideally, you need a soft and diffused light for good video. **Note** – remember to unclip any lens filters otherwise the torch will pick-up the magenta/red tint!!

This is not a recommendation – I use a Suptig underwater video light from Amazon. I’ve had mine since 2017 and it makes a good back-up torch. I have used mine at 45 metres – and it still works!



#### 4.4 WHAT MAKES A GOOD VIDEO?

If you’re producing videos for public viewing (social media channels), then before we jump into post-processing, let’s take a moment to consider a few ideas for composing video capture to help us create engaging productions.

We’ve all seen those 5-minute long videos of turtles slowly lulling about in the Red Sea. They’re great for about 10 seconds, then become a bit dull after that point. These sorts of videos are fine for your own consumption, but not well-suited for broadcast or social media. How do I know that? Barnsley BSAC has regularly posted videos since 2015. Our social media analytics has given us some good evidence on what works and what doesn’t.

There’s no real magic formula, but here’s what has worked well for us:

- Tell a ‘story’ – have a beginning, middle and end...
- Keep your videos short – the sweet spot is between 1 and 2 minutes
- Include variety – underwater, jumping in, team meals, on the boat, travel to site etc.
- Add an uplifting music soundtrack – its more engaging
- Avoid captions – they are distracting. Just use an entry title and exit credits
- Colour correct – adds the WOW factor!

By way of an example, here are the best and worst performing club videos:

1. <https://www.facebook.com/dearnevallydivers/videos/1043906032425538/> - 3200 views
2. <https://www.facebook.com/barnsleybsacdivers/videos/435939913259415/> - 70 views

The Farnes (first) video hits all of the sweet spots. Consequently, people who viewed it shared it out to their wider communities. The Egypt video, at >4mins is way toooooo long, it dwells on dolphins for nearly a minute, it has captions – basically a really good example of how not to produce a video!!!

So, what can we do to create engaging dive trip videos? As a starting point, here are a few ideas (but please add your own):

- **Selfies** – consider pointing the camera back towards you when you enter the water, or, going through a swim through or entering a wreck. The wide field-of-view will capture both you and a good chunk of the surroundings. These shots can look quite dramatic.
- **Entries and Exits** – film you and your buddy taking a giant stride off of the boat. Or film the exits back up the ladder or lift. Not only does this add variety, it also provides a good record of boat features and arrangements for other divers considering a similar future trip.
- **Panoramas** – you’ve just arrived at a stunning dive site at the side of Loch Creran on a beautiful sunny day. Why not capture the landscape with a 7 second slow pan across the vista?
- **Angles** – you can achieve many different results by altering the filming angle: Shoot upwards towards the surface as your dive buddy descends with the sun behind them - this creates an amazing silhouette. Shoot upwards towards the surface to capture your buddy breaking the water as they enter. Capture your buddy dropping down the shot-line!
- **Approaches** – this one takes a bit of bravery, but try attaching your camera to a ledge or wreck. Then circle back around and swim towards your camera for the ultimate underwater selfie!!
- **Journeys** – we drive through some of the most amazing scenery in the UK – stick your camera up onto the dashboard and film some of the breath-taking roads and mountains.

Above all – tell a “story”, be creative and use your imagination!!!



## 5 POST PROCESSING

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Hopefully you've now pieced together a good collection of underwater video clips. Unless you've used colour filters or lighting, most of your underwater videos will require some form of colour correction or enhancement. If you have used GoPro Protune with native white balance, then colour correction is necessary.

This section sets out a number of techniques for building a reasonably polished video production that will hopefully bring your underwater colours to life!

### 5.1 VIDEO EDITING TOOLS

In order to post-process video footage, you need a [Non-Linear Video Editor](#). There are quite a few choices out there:

- Adobe Premiere
- Da Vinci Resolve
- Final Cut Pro
- KDenlive
- Shotcut

I highly recommend [Shotcut](#) – it is free (GPL), cross-platform (Windows, MacOS and Linux) and includes all of the necessary features for creating a reasonable polished production. Crucially, it provides advanced white balancing and colour grading capabilities.

**Note** – you will require a fairly good computer to post-process video. At the time of writing (2020) I'm still using my trusted Lenovo X230 i5-3320M (2.60 GHz) with 8Gb RAM. I use a 24" Monitor via the laptop display-port. It's good enough, with some preview stutter.

### 5.2 COLOUR BALANCING

There is way too much content to cover in this guide, so please head along to the Barnsley BSAC YouTube channel and watch the [Shotcut](#) tutorials on colour-correcting Underwater footage:

- [Video Processing Workshop Part 1](#) – Basic colour correction with Shotcut
- [Video Processing Workshop Part 2](#) – Advanced editing with Shotcut

### 5.3 ADDING A SOUNDTRACK

The likelihood is that you will be looking to post your creation onto one of the popular social media platforms to share with your trip buddies. These platforms prevent the use of any copy restricted music. Gone is that great Coldplay track you had lined up!!

Not to fear – YouTube realised that copyrighted soundtracks would be a huge potential blocker for uptake of its community channels. They have solved this problem by creating one of the Internet's largest online libraries of unrestricted copyright music – the YouTube Audio Library:

- <https://www.youtube.com/audiolibrary/music>

This library has hundreds of free-to-download music tracks, sorted by music genre, mood, instrument and duration. You will need a Google account to access it.

## 6 PUBLISHING YOUR MOVIE

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So, you've now put together a nice featurette of your dive trip, with some cool background music and captions! It's time to release it to the world!

The first point to mention is that video files tend to be big! Simply copying the media file to your trip buddies is likely to be very difficult – they would each have to download the entire file before they can view it. What we really need to do is to host our video with a media 'streaming' provider.

Streaming media is multimedia that is constantly received by and presented to an end-user while being delivered by a provider. [YouTube](#), [Vimeo](#) and [Facebook](#) all provide streaming services that allow us to upload and playback our video.

Set yourself up with an account on one of those services and simply upload your video. You can set various privacy options to decide who can view and comment on it. Then share the link e.g.

- <https://youtu.be/lzN597TyPhM>

Of course, this is an entirely optional step - you may wish to keep your videos private for your own personal viewing. A media provider is still a good option as it creates a backup, and allows you to stream the video to your own personal devices. At the same time, you can mark the video as private so that it cannot be accessed by other people.

## 7 A FINAL NOTE

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The ideas presented within this guide have been developed over a number of years, since 2015 and it has been a slow process involving lots of experiments and many failures! Please bear this in mind, and do not blindly follow the recommendations. I encourage you to experiment and try out different techniques to see what works best for you – at the very least this guide will act as a good starting point.

If you do discover a new and effective technique for improving underwater video capture or production, then please let me know at <https://barnsleybsacdivers.co.uk/contact-us/> and I'll include it (with credit) in future versions of this guide.

I hope this guide has given you some good ideas for improving your scuba diving trip videos, and I hope you get some great results. Thanks for reading, and safe diving!

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<https://www.facebook.com/barnsleybsacdivers/>  
<https://www.youtube.com/user/BarnsleyBSACdivers>