

Use of digital imagery by non-specialists (citizen scientists) for marine species and habitats recording and monitoring in Marine Protected Areas MPA Network

Peter Tinsley



PANACHE

Protected Area Network Across the Channel Ecosystem

Tools and Guidelines

Use of digital imagery by non-specialists (citizen scientists) for marine species and habitats recording and monitoring in Marine Protected Areas

Prepared on behalf of / Etabli par



by / par

Author(s) / Auteur(s) : Peter Tinsley

Contact : 01305 217979

ptinsley@dorsetwildlifetrust.org.uk

In the frame of / dans le cadre de



Work Package 4.1

Work quotation: Tinsley, P., Mars 2015, Use of digital imagery by non-specialists (citizen scientists) for marine species and habitats recording and monitoring in Marine Protected Areas, PANACHE project, Dorset, United Kingdom.

Cover photo: Ludivine Têtu / Agence des aires marines protégées



European Regional Development Fund
The European Union, investing in your future



Fonds européens de développement régional
L'Union Européenne investit dans notre avenir

This publication is supported by the European Union (ERDF European Regional Development Fund), within the INTERREG IVA France (Channel) – England European cross-border co-operation programme under the Objective 4.2. "Ensure a sustainable environmental development of the common space" - Specific Objective 10 "Ensure a balanced management of the environment and raise awareness about environmental issues".

Its content is under the full responsibility of the author(s) and does not necessarily reflect the opinion of the European Union.

Any reproduction of this publication done without author's consent, either in full or in part, is unlawful. The reproduction for a non commercial aim, particularly educative, is allowed without written authorization, only if sources are quoted. The reproduction for a commercial aim, particularly for sale, is forbidden without preliminary written authorization of the author.

Use of digital imagery by non-specialists (citizen scientists) for marine species and habitats recording and monitoring in Marine Protected Areas

Title in the other language / titre dans l'autre langue Arial - 10 pt (RGB: 0-110-188)

ABSTRACT

The ease of acquisition of digital imagery in biological recording has created new opportunities for the involvement of non-specialists in recording and monitoring programmes, especially in areas (such as underwater) where it was once prohibitively expensive and specialised. This report offers guidance in the use of relatively inexpensive digital camera equipment on the shore and underwater in order to obtain images that are useful for providing evidence of presence, extent or condition of habitat and species in marine protected areas. As well as image capture, the report covers the cataloguing and storage of digital images and the associated metadata required to enable images to be used as evidence.

RÉSUMÉ

Text – Arial - 10 pt – spacing / interligne simple
Cras elementum ultrices diam. Maecenas ligula massa, varius a, semper congue, euismod non, mi. Proin porttitor, orci nec nonummy molestie, enim est eleifend mi, non fermentum diam nisl sit amet erat. Duis semper. Duis arcu massa, scelerisque vitae, consequat in, pretium a, enim. Pellentesque congue.

Ut in risus volutpat libe Cras elementum ultrices diam. Maecenas ligula massa, varius a, semper congue, euismod non, mi. Proin porttitor, orci nec nonummy molestie, enim est eleifend mi, non fermentum diam nisl sit amet erat. Duis semper. Duis arcu massa, scelerisque vitae, consequat in, pretium a, enim. Pellentesque congue.

Ut in risus volutpat libeCras elementum ultrices diam. Maecenas ligula massa, varius a, semper congue, euismod non, mi. Proin porttitor, orci nec nonummy molestie, enim est eleifend mi, non fermentum diam nisl sit amet erat. Duis semper. Ut in risus volutpat libe Cras elementum ultrices diam. Maecenas ligula massa, varius a, semper congue, euismod non, mi. Proin porttitor, orci nec nonummy molestie, enim est eleifend mi, non fermentum diam nisl sit amet erat. Duis semper. Duis arcu massa, scelerisque vitae, consequat in, pretium a, enim. Pellentesque congue.

Ut in risus volutpat libeCras elementum ultrices diam. Maecenas ligula massa, varius a, semper congue, euismod non, mi. Proin porttitor, orci nec nonummy molestie, enim est eleifend mi, non fermentum diam nisl sit amet erat. Duis semper.

KEYWORDS: marine protected areas, monitoring, digital images, shore, underwater, citizen scientists

MOTS-CLÉS : liste de mots-clés, en français, séparés par des virgules

Contents

I.	General introduction	1
II.	Getting good quality images	3
2.1.	Choosing a camera.....	3
2.2.	Image quality.....	3
2.2.1.	Underwater (macro) species records	3
2.2.2.	Underwater habitat images.....	4
III.	Underwater panoramas	7
	Processing panorama images	7
IV.	Intertidal	8
	Getting the wider view	8
V.	Measurements from photographs.....	12
	Metadata	12
VI.	Tagging images/exif	14
	Geotagging	14
	Post survey geo-tagging	15
	Equipment needed.....	15
	Set up GPS	15
	Synchronise camera clock.....	16
	Processing	17
	Recording depth.....	17
VII.	Cataloguing and retrieving images	20
VIII.	CHDK.....	22
	Other imaging techniques	22
	References.....	24

I. General introduction

Digital photography has revolutionised the use of cameras as a recording tool, especially underwater. Only a decade ago, an underwater camera setup would cost thousands of pounds, be very bulky, complicated to use and limited to 40 photographs per dive – many of which may turn out not to be useful. Currently, even compact digital cameras costing a couple of hundred pounds are capable of taking almost unlimited numbers of photographs, with the opportunity to instantly review the image, and re-take if necessary. Furthermore, the widespread use of cameras in mobile phones has greatly increased the likelihood of opportunistic species or habitat photographs.

As long as a few simple rules are followed, anyone can take useful photographs and a lot of crucial information (date/time, for example) is embedded within the electronic photograph file or can be embedded afterwards – including the name of the recorder and the precise location. Such metadata can be easily accessed and extracted, greatly facilitating the cataloguing and retrieval of images. The digital manipulation of images, either in camera or post-processing, can also significantly enhance images taken in challenging conditions to improve their value as a photographic record.

There are two main uses for digital imagery in MPA designation/monitoring - for evidence (of presence, extent or condition of species and habitats of interest) and to raise awareness of the marine environment and support for MPAs among the general public. Photographs are also used as a sampling device and an identification aid (avoiding the need to take a sample or spend too much time in the field). Most of the advice given here relates to acquiring images suitable as evidence, but much of it will also help to produce a better image.

The process for selecting and ultimately designating Marine Protected Areas in England has made use of a considerable amount of data provided by “citizen scientists” – non-professional enthusiasts with varying degrees of training and experience. Not surprisingly, the validity of many of these records has been challenged by opponents of MPAs, or of specific sites. Natural England/JNCC developed “Protocol E” to help assign a level of confidence to records submitted as evidence of the presence or extent of species or habitats for the Marine Conservation Zone designation process. The submission of a good quality, georeferenced photograph with validated species/habitat identification, collected as part of an organised programme such as Seasearch, can count as a record of the highest quality. (see below)



Table 1 - showing basic criteria used to assess quality of point records as evidence of presence extent of MPA feature – from Protocol E supplementary guidance (Natural England/JNCC 2013)

Quality Score	Criteria
3*	Data records were collected using approved standards and interpreted by an appropriate specialist with quality standards applied and documented. Photographic evidence has location stamped into the image, has undergone validation and interpretation by an appropriate specialist.
2*	Data records have been collected by documented methods and interpreted by an appropriate specialist but limited evidence on quality standards applied. Limited information in the methods used for data interpretation, particularly for records collected in a linear fashion such as video tows or diver observation records.
1	Limited information on how data were collected, verified or interpreted; data identified by non-specialists. Data based on local knowledge or anecdotal information with no supplementary verification.



II. Getting good quality images

The following guidance aims to help ensure photographs submitted as evidence for MPA designation or monitoring are as useful as possible

2.1. Choosing a camera

If you are only taking photographs on the shore, almost any camera will do, including mobile phone cameras. There is an argument for using less expensive cameras as continued exposure to the salty atmosphere will take its toll. There are a few options that would be useful:

- Waterproof/ruggedised – will survive an accidental dip in a rockpool (or a deliberate one) and better able to contend with salty wet hands.

- Macro setting – very useful for species ID images

- Built-in GPS – for straightforward geo-tagging of images

If you are going underwater there are a few additional considerations. There are a few fully waterproof compact cameras suitable for diving but housings are available for many mainstream cameras. The things to look out for are:

- Manual white balance – very useful for available light images

- High ISO range – enhanced ability to take photos in low light

- Flash diffuser on the housing – a piece of opaque white plastic on the housing over the camera flash, this will help spread the light in close-up photos

- Macro setting – very useful for species ID and “turf sampling”

- Ability to mount a wide angle adapter lens to the housing – this is an effective, though relatively expensive way to boost the quality of habitat scale images

2.2. Image quality

Most digital cameras are easy to use and require little other than a bit of care to take good quality photographs. Underwater is a bit more challenging but following a few basic rules will help produce clear, sharp images

2.2.1. Underwater (macro) species records

These are probably the simplest underwater photos to take – the subject is usually relatively immobile and small enough to get in close (fish being the exception – the same rules apply, but more patience is needed). It is the distance between camera and subject that is the most crucial factor when photographing underwater – the less water between camera and subject, the brighter and clearer the image. Most cameras have a “macro” setting that allows you to focus down to about life-size - a few to 10cm from the subject. At this range the camera’s built-in flash will usually provide an even enough light (most housings come with a flash diffuser – a piece of translucent white plastic in front of the flash) to produce good results. (see images below)



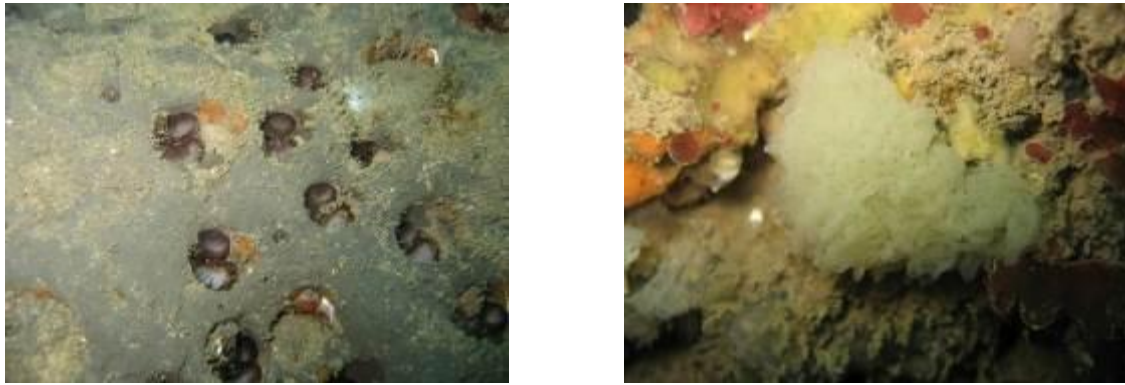


Figure 1 - Images taken with macro setting and built-in flash with diffuser. Canon Ixus 800



Figure 2 - As above with increased camera to subject distance – note the loss of contrast and the increased backscatter. It's not a coincidence that the subject is difficult to get close to.

Once you increase the camera to subject distance much above 15cm, image quality will fall off rapidly – the image will look less sharp, darker and will have a green cast. Unless the water is especially clear, there will also be significant backscatter from the flash.

Set flash to “always on”. Set lens to “macro”. Set program mode to “night time”

Set autofocus to the centre of the image and make sure the main subject is in the centre. The depth of focus is fixed in most compact cameras as there is no adjustable aperture.

The increasing use of underwater photography has led to a rise in the number of records of some species that are difficult to identify in situ, but can be reliably identified from good photographs – gobies are a good example – the rarely recorded Couch's goby has been confirmed from several photographs in Dorset in recent years. (Baldock & Kay 2012).

2.2.2. Underwater habitat images

This is a more challenging image to capture and is best attempted with a wide angle lens. Wide angle adapters are available for many housed compact cameras but these might cost at least as much as the camera. Such adapters are usually “wet” lenses, which means they can be removed or added underwater, which potentially allows a photographer to switch between shooting modes while underwater, but it is advisable to set up for one approach and stick to it throughout the dive.

Taking flash photographs with a wide angle lens can be expensive and complicated – you need a powerful flash (usually more than one) to light up the scene and careful placement on long arms to avoid lots of backscatter. Thankfully, there is an alternative – digital cameras are amazingly light-sensitive and very good at compensating for loss of colour underwater. Switching to natural light

photography with a wide angle lens makes this much more affordable and much more straightforward. The images have a different look to wide angle flash-lit photographs but often convey the overall habitat better.



Figure 3 - Same scene photographed with flash (left), available light (middle) and available light with white-balance (right)



Figure 4 - Available light photo taken with compact camera and wide-angle adapter at 24m (Gordon Bird). Note the slight vignetting in the corner of the image caused by the wide-angle adapter and the grainy quality caused by the high ISO setting.

The camera flash needs to be turned off and the white-balance needs setting at the depth you are taking photographs. You will need to consult your camera manual to do this but it usually involves taking a photo of something white (eg a dive slate) while at the working depth. If you save raw images

as well as jpegs you can alter the white balance later though this never seems quite as effective as doing it “in camera”.

If you change your working depth appreciably, you will need to re-set the white-balance – the colour-balance changes more rapidly near the surface, so you will need to check your white-balance more frequently on shallow dives.

The downside of this approach is that you will need longer exposure times as you go deeper – to the point where it becomes difficult to hold the camera steady enough. You can increase the sensitivity of the camera (increase the ISO setting to maximum) – this will result in a grainier image but you should still get a sharper picture. Sunny conditions help enormously.

Keep something in the foreground for some detail and point the camera slightly down – you don’t need lots of water in the photo and you need to balance the exposure for the seabed, not the water. One noticeable characteristic of this technique is that the water is usually overexposed. Remember that the point of the wide angle lens is to allow you to get close but still see a wide area – the less water between camera and subject, the clearer the image



III. Underwater panoramas

If you don't have a wide angle lens it is still possible to take useful images of wider scenes by taking several images and stitching them together later. The main things to watch out for here are ensuring enough overlap between images (50% is good) and keeping camera exposure settings (including white balance) constant across the set of images – you really need manual control of exposure as well as white-balance. The rule of keeping the camera to subject distance still applies. This approach works even better with a wide angle lens. Try to rotate around the camera to reduce parallax problems when processing the images.

(you will quickly realise that rotating around the camera has its limitations - a better approach might be that explained below for intertidal mosaics but we haven't tried this to date)

Processing panorama images

If you have a professional package such as Adobe Photoshop, merging the images is simple and straightforward. There are also free tools available that will do a good job – one such is Hugin - <http://hugin.sourceforge.net/>



Figure 5 - Panorama of 5 horizontal images stitched with Adobe Photoshop's Merge tool

IV. Intertidal

On land things are far more straightforward and good quality images are much easier to obtain. It is still worth thinking in terms of species (macro) photos and wider habitat photos. For the former, aim to get in close and consider using a tripod or flash if there isn't enough light, though be aware that flash can cause distracting reflections on wet, shiny objects. For habitat photos, concentrate on what is on the ground – the aim is not to get a landscape photo but a record of the habitat. This will usually mean pointing the camera down.

Getting the wider view

To best represent a shore habitat you often need both enough detail to recognise species and a wide enough coverage to appreciate the make-up of the habitat. One option is to mosaic together a number of overlapping images. For this to work well, the camera need to be pointing vertically down and the overlap between images at least 30% - this equates to a small step sideways or forward.



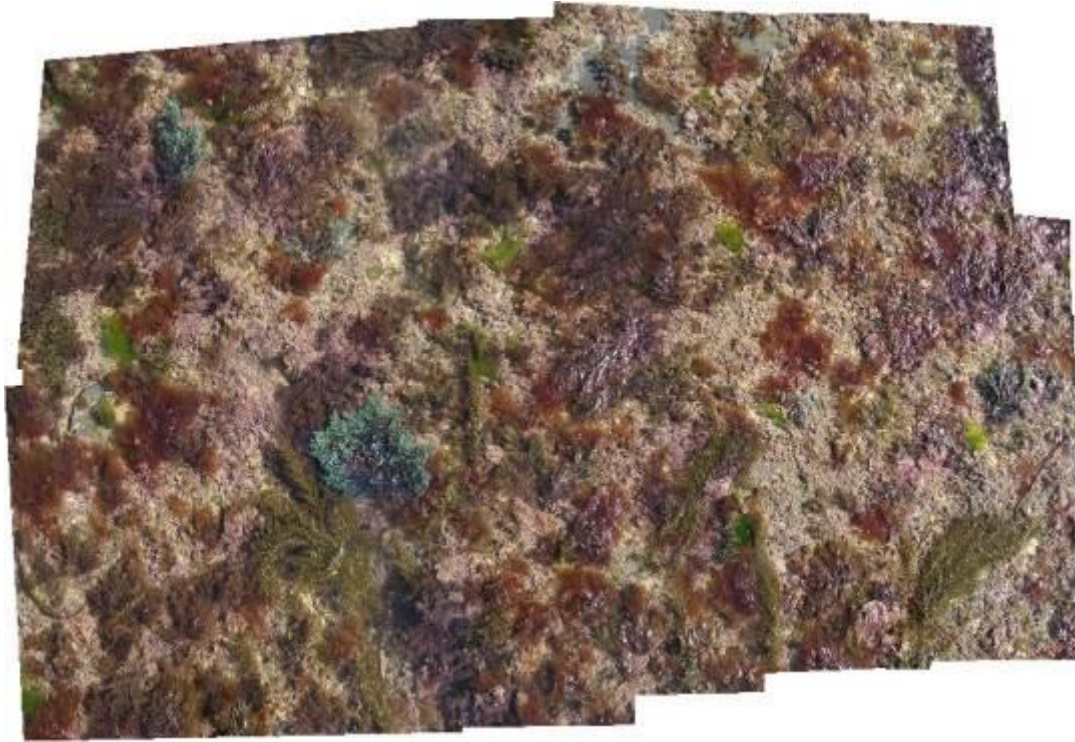


Figure 6 - Mosaic of 25 overlapping images

There is no limit to the size of such a mosaic other than computing power. If the images are taken from a constant height (using a framer, for example) and a scale is included in the image, it is possible to calculate area covered by species or groups and this could form the basis of long-term monitoring to show gross changes in cover over time (Van Rein, 2011b). The downside of this approach is that only the top layer of cover can be recorded – understory species such as red algae and coralline crusts will be under-represented.



Figure 7 - Mosaic of 99 images covering a number of intertidal zones

Mosaicing of images is less effective (and less reliable for calculating areas) when the surface being photographed is uneven or rugged but more specialised photogrammetry software can cope with this – ortho-rectifying the images and even creating 3D surfaces from the images in the process. Agisoft's Photoscan (<http://www.agisoft.com/>) is very effective and easy to use, but expensive. The same can be achieved using a number of open source software packages– [Visual SFM](#), [CloudCompare](#) and [Meshlab](#), for example. There is a good tutorial here to get you started <http://flightriot.com/visualsfm-cmvs-post-processing-tutorial/>. If your aim is to create a 3D model, take more photographs and try to cover all angles of all surfaces – you don't need to worry about parallax.



Figure 8 - Mosaic of 10 images of a rugged scene. The image on the left was created using Photoshop Merge, which is unable to cope with the parallax changes, the image on the right is orthorectified and was produced in PhotoScan

The 3D surfaces created from sets of images can be exported into 3D modelling software and used in awareness/engagement applications.

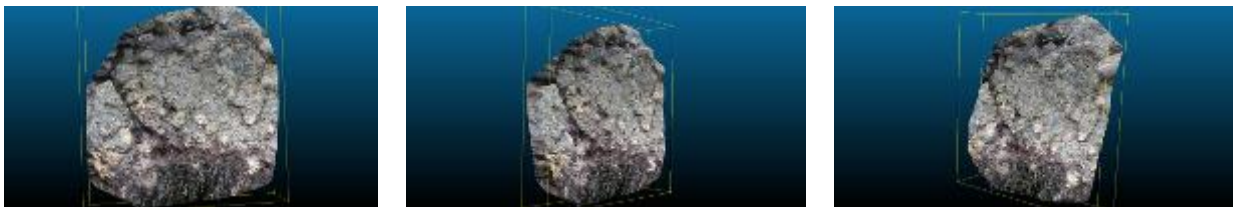


Figure 9 - 3D views of a boulder-face created from 52 overlapping images using VisualSFM and CloudCompare

Another option is to raise the camera to cover a wider area. The easiest way of doing this is to put the camera on the end of a pole. To keep the camera perpendicular to the ground you can use a picavet – a system of slings and pulleys to keep the camera at a steady angle.



Figure 10 - Picavet as used in kite aerial photography

Picavets are more widely used in kite aerial photography, where greater height can be obtained but results are much more dependent on the weather (and risk to the camera is greater). In both instances you need a means to fire the shutter – this could be a remote device using wireless or infrared or you could use the Canon CHDK mentioned earlier to run an intervalometer, with the camera shooting continuously.

A further option that is rapidly becoming affordable is to fit a camera to a small drone. It is beyond the realm of this guide to cover the setting up of drones but the images below show the sort of results that

can be obtained on a section of shore. A lot of useful information and links to software can be found here - <http://flightriot.com>



Figure 11 - 2mm resolution mosaic shot from a drone at 8m height. Covers 270m x 70m section of shore

This level of complexity in image acquisition is obviously moving beyond the realms of citizen science but it opens up a new possibility for using members of the public to help analyse large datasets, rather than collect the data – see the Zoomiverse Seafloor Explorer model (http://www.seafloorexplorer.org/?utm_source=Zooniverse%20Home&utm_medium=Web&utm_campaign=Homepage%20Catalogue)

V. Measurements from photographs

If there is a suitable reference object in the photograph, it is possible to take measurements of objects and this is an area where digital photography has helped to move things on incredibly. A simple ruler in the frame can be enough to take measurements as long as it is in the same plane as the object being measured and parallel to the camera. Any perspective distortion or lens distortion can be removed using Photoshop, GIMP or other image editing software and measurements taken directly from the photograph. This works well for more 2-dimensional objects, such as seafans.



Figure 12 - Images of the same seafan taken 10 months apart. From Worbarrow Reefs Seafan Project 2003-2005

Taking two or more photographs from slightly different angles enables a 3D model to be created from the photographs, which allows for more precise measurements, even volumes – see above for examples of photogrammetry software. The photographs can be taken with one camera (moving it around the subject) though there are advantages to taking multiple shots simultaneously – especially if the subject might be moving, as the seabed often is.

Metadata

A photograph only becomes a record (and therefore, useful) when we know something about the subject (what, where, when) and the photographer (who).

The following information is essential :

Date/Time - this is automatically stamped into the date “tag” in the image file, the only proviso being that the camera clock is correctly set¹. Most cameras also have an optional setting that will allow the date/time to be visibly stamped into the image itself, though this is no longer necessary. The exif field that holds the date/time information does not include the timezone so there is some potential for confusion around daylight saving and timezones. It only really matters when you are using an accompanying GPS track to geo-reference your images - the best solution is to be consistent - use the same timezone/daylight saving settings on your camera as on your GPS and on the computer you will

¹ Most cameras have an internal battery that keeps the clock running even when the main batteries are run-down or removed, avoiding the need to reset the clock each time you change the batteries. This may run out on older cameras, resetting everything, including the date/time, to default.

use to process your images. If you are using a cameraphone, the time should be synchronised to network time. To be doubly sure, use UTC on all three devices.

Get used to setting your camera clock at the beginning of each trip, ideally to a GPS – the camera clock will drift slightly over time. Once the camera time is more than 24 hours adrift, geotagging can get a bit complicated.

Recorder – ideally we need to know not just who took the image but who identified the species or habitat depicted and who validated that identification.

Content – the name of the species or habitat depicted – preferably from an agreed list, such as MSBIAS (for species) or EUNIS (for habitats)

Location – we need to know as precisely as possible where the image was taken. On land, this can be automatic if the camera has a built in GPS or can be added subsequently from a GPS track if a hand-held GPS unit is carried by the photographer. It is more difficult underwater, but there are well-tried methods for geo-locating underwater images.

Copyright – optional. If you want to retain copyright over your images, fill in this field



VI. Tagging images/exif

Some of the above information is automatically inserted into the image file when the photograph is taken. The rest should be added as soon as possible. The recommended approach is to add the metadata to the image using standard exif tags. There are many options for cataloguing/editing your images and as many different ways of adding “tags” or metadata to your images but the choice of fields is fairly standard. The challenge is in achieving consistency in how these are used and in the terms used. Many of the fields are free text but the usefulness of the metadata is greatly increased if these fields are restricted to limited vocabularies – think of the problems associated with searching for *Eunicella verrucosa* images where the range of options could be pink seafan, pink sea-fan, pink sea fan, broad seafan, *Eunicella verrucosa*, *Eunicella veruccosa*, *E verrucosa* etc.

Recorder: - The name of the person who took the photograph. This goes into the “Author” or “Creator” field. The assumption will be that the person named here is the one that identified any species or biotopes listed.

Content: - add species names to the keywords field. To ensure correct spelling and consistency, use the MSBIAS lookup tool (<http://www.marinespecies.org/msbias/aphia.php?p=search>) to select species names. Separate species with a comma – you can add as many as you want, but stick to those that are clearly identifiable from the image. If you are able to identify biotopes, add these to the “Description” field. Use the JNCC biotope expandable hierarchy to ensure consistency (<http://jncc.defra.gov.uk/marine/biotopes/hierarchy.aspx>). You can add more than one – separate with a comma. You can also add free text to the Title or Caption field

Location – the “Location” field can be used to add a suitable location name – ideally from a controlled list, such as the OS gazetteer (<http://data.ordnancesurvey.co.uk/datasets/50k-gazetteer>) There isn’t yet a comparable marine gazetteer lookup facility. This field is optional – the really useful tags are the GPS Lat/Long fields, covered in the next section

If you don’t have access to image software that allows you to edit metadata, there is a free package available here (<https://github.com/hvdwolf/pyExifToolGUI>). You will need to download both the exiftool programme and the GUI

A simpler alternative, and one that covers many of the issues raised above, is to submit your images online as part of a record using one of the online reporting tools developed for PANACHE e.g Seasearch on-line recording tool or as part of a custom-designed image cataloguing system – see below

Geotagging

Knowing the location of recorded images is crucial for recording and monitoring using photography. There are many cameras now fitted with an integrated GPS which will automatically log Lat/Long and altitude data to the relevant exif fields. This facility is also available with many cameraphones. If you are using a GPS enabled camera on the shore, geo-tagging of your images will happen automatically. The only thing to be aware of is that some image editing software can corrupt the exif data associated with images – if you crop or otherwise edit your images, you may lose this crucial information.

If you are using a camera without a built-in GPS, it is relatively straightforward to tag your photographs using the tracklog from a separate GPS kept close to the camera, but this requires a bit of care and organisation.

Post survey geo-tagging

Equipment needed

GPS with tracklog facility and USB/wireless connection. This can be a standard hand-held GPS unit or a purpose-built GPS logger. If using more than one camera/GPS pair, each GPS needs to be identifiable so that each track can be the appropriate set of images. The tracklog is a series of points recorded at set intervals. By finding a trackpoint close in time to the time a photograph was taken, it is possible to deduce the location of the photograph – this can be done automatically with freely available software.

An example section from a gpx tracklog is shown below

```
<trkpt lat="50.6408" lon="-1.91548">  
  <ele>11.5</ele>  
  <time>2009-05-08T13:01:00Z</time>  
<trkpt lat="50.6427" lon="-1.91523">  
  <ele>11.6</ele>  
  <time>2009-05-08T13:02:00Z</time>
```

Digital camera. The storage card used in each camera needs to be identifiable to ensure it is matched with the correct GPS tracklog – record this information at the start of the survey

Set up GPS

How you set this up will depend on the make and model of your GPS unit. You need to make sure that the tracklog is active and may need to set the logging method. This can be either a set time period (e.g. logging position every 5 seconds) or based on a change in position (e.g. logging every time position changes by 5m). Because of the way the geo-tagging software works (matching to the nearest time in the tracklog) it is probably best to use the former method. The tracklog needs to be saved in either gpx or NMEA format. You also need to be aware how many points you can record (do you need to free up memory at the start of each survey?) and what happens when the memory is full (does it stop recording or overwrite older data?)

Each time you switch on the GPS, check the tracklog settings. On some models you will see a “breadcrumb” trail on the screen to show that the tracklog is active.

Check battery status – ideally you will have fresh batteries for each day.



Synchronise camera clock.

There are two approaches to this. Both require the GPS to be switched on and to have acquired satellites - the GPS time will then be accurate. Check the time display settings on the GPS and the camera – is it set to local time or UTC? It doesn't matter which as long as you know and you are consistent – choose one and stick to it.

To synchronise, either:

1 – Sync camera clock to GPS time. Using camera setup menu, set the camera clock to GPS time, to the nearest second. You will need to repeat this every day

or

2 – Take a photograph of the GPS screen showing the current time. You need to be able to see hours, minutes and seconds and preferably date. (problems occur if the date is set incorrectly or the camera clock is out by a significant amount). You will need to do this for each survey day and with each camera/GPS pair.

The advantage of the latter method, especially if using more than one camera/GPS pair, is that you have a record of which GPS unit is paired with each camera, but you should ensure this information is recorded anyway for each survey event.



Figure 13 - The image above shows GPS time as 08/05/2009 12:59:43

The DateTime from the image exif data is 2009-05-08T13:01:02Z – a difference of 1:19s

Once this is done, you only need to make sure the GPS stays close to the camera. This is obviously more difficult underwater as the GPS needs to stay on the surface. The only option is to tow the GPS on a surface marker buoy – the accuracy of the tracklog will depend on water depth and how tightly the SMB line is kept during the dive. The GPS will work inside a protective cover – even a rigid polycarbonate box, such as an OtterBox.



Figure 14 - Hand-held GPS unit in waterproof box fixed to inflated innertube and towed alongside SMB

There is some debate as to the best way to tow a GPS unit but a small inflatable ring (such as a scooter innertube) makes a good platform.

It is good practice to take a photograph once you have reached the seabed, to mark the start of the survey, and a final photo before leaving the bottom to mark the end. The tracklog can then be clipped to these times to better indicate the stretch of seabed covered by the survey.

An alternative approach is to fix a small GPS logger to the delayed SMB. If the logger is activated before the dive, it will lose satellite reception when the diver enters the water (marking the start of the dive) and will regain reception after the SMB is deployed, which could mark the end of the dive or an interesting feature seen during the dive.

Processing

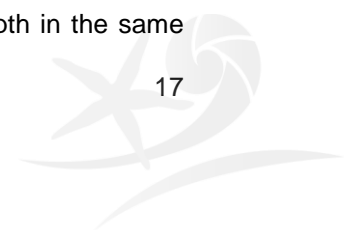
<https://code.google.com/p/gpicsync/>

The above link will take you to the GPicSync home page – this is a free open source utility that will geo-tag your photographs by matching the date/time from the image to the nearest position on an accompanying GPS tracklog. Full instructions are on the site, as well as a list of alternative geo-tagging programs. It is useful to use the Google Earth/Google Maps export to check the results are as expected – if something goes wrong it is usually either a timezone/daylight saving issue or using the wrong GPS tracklog.

It may be that you only have one position for all images from one dive – the position of the shot-line or a single position logged by the boat skipper during your dive. This is still worth using to tag the images (you can use GPicSync to tag all images in a folder with the same position) though the confidence in the positions will obviously be lower.

Recording depth

As well as Latitude and Longitude, the exifGPS tags include GPSAltitude. This will be populated automatically from the GPX track when using GPicSync or from a GPS enabled camera on the shore but could theoretically be populated from an exported dive computer log to show depth in the same



way that GPicSync uses the GPS's tracklog but the lack of a widely used common export format from dive computers makes this a more complicated task. An easy to use tool could be developed based on one of the more widely used dive computer file formats and expanded to cover other file formats if it proved useful.

A photograph with all the above embedded metadata is a biological record and could be used "as is" to support MPA designation or monitoring. Protocol E (see above) appears to put a lot of weight on a GPS position embedded in an image, this isn't necessarily highly accurate (as in the case of a surface towed GPS on a deep dive). There needs to be a means of quantifying the accuracy of the Lat/Long position written into the exif GPS fields.

An option is to make use of the GPSDOP exif tag. DOP (dilution of precision) is a measure of the confidence in the precision of the position recorded. Some GPS units will record a DOP value as part of a tracklog and it may be written into the exif GPS fields by a camera with an integrated GPS. It is suggested here that the GPSDOP tag could be used as shown below to indicate the confidence rating of an embedded GPS position – the tag can be written to using exiftool. The table below is taken from Wikipedia

Table 2 – Table of DOP values with suggestions for quantifying the positional accuracy of marine images

DOP Value	Rating	Description	Suggested meaning relating to marine images
1-2	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.	Images taken on shore survey with clear view of open skies
2-5	Good	Represents a level that marks the minimum appropriate for making business decisions. Positional measurements could be used to make reliable in-route navigation suggestions to the user.	Images taken on shore survey with restricted view of sky
5-10	Moderate	Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.	Surface towed GPS in less than 10m of water
10-20	Fair	Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.	Surface towed GPS in greater than 10m of water. Single position for all images in dive where divers moved less than 50m
>20	Poor	At this level, measurements are inaccurate by as much as 300 meters with a 6 meter accurate device ($50 \text{ DOP} \times 6 \text{ meters}$) and should be discarded.	Surface towed GPS in deep water with current greater than 1kt or single position for all images in dive where divers drifted more than 50m (ideally a start and finish position would be provided for drift dives but the exifGPS tags can only take a single position)

One of the most important lessons learnt about tagging, especially geo-tagging survey images is to process them as soon as possible after the survey. If you find yourself a week or two later with a number of un-named gpx files and folders of photographs, it is very difficult to work out which track goes with which set of photographs. Equally, once your backlog of un-processed images starts to build up, it becomes increasingly unlikely that you will ever deal with it.

VII. Cataloguing and retrieving images

Collections of digital images can grow extremely quickly – you could easily end up with tens of thousands of images in a single year. This is when you begin to realise the value of tagging images as soon as they are acquired. You will also need a system for storing/filing images – preferably one that will make it easy to find specific images at a later date and include adequate provision for backup.

You can store images in folders based on date, subject, photographer etc., but this approach quickly becomes inflexible and finding images becomes challenging. This is where a purpose built Digital Asset Management System (DAMS) comes into its own. There are many such packages available, here we will look at one widely-used, free and open source package – ResourceSpace.

ResourceSpace is a completely web-based system – images (or other media) are uploaded by contributors to a server-based filestore and accessed via a web-browser interface. The filestore is a single folder – all of the image sorting, filing and retrieval is based around metadata. The system is completely configurable and can include any number of custom fields – including controlled vocabularies as mentioned earlier.

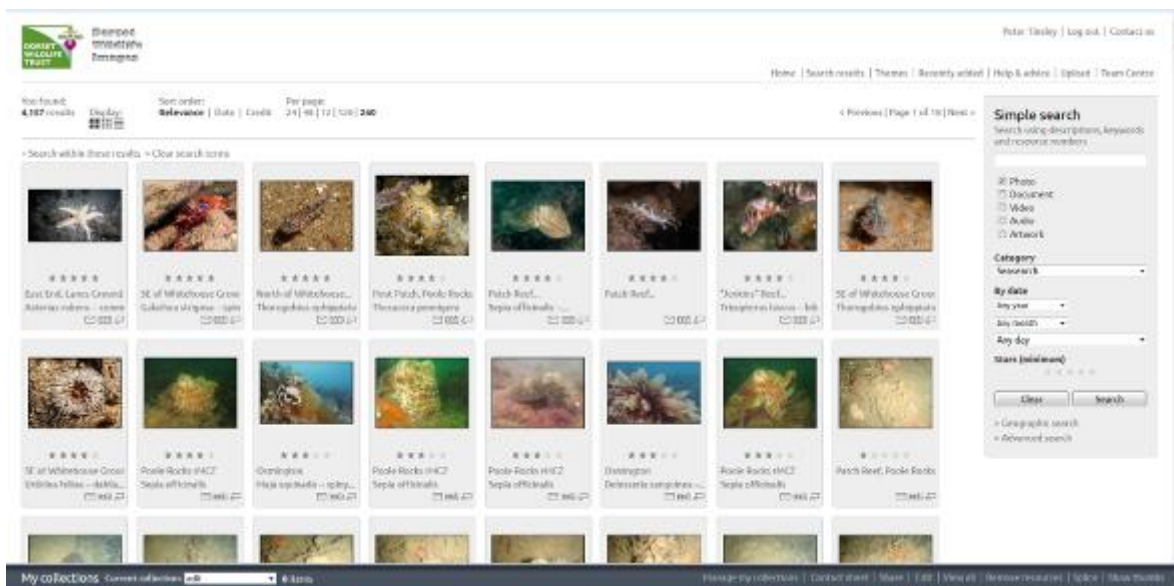


Figure 15 - Screenshot from Dorset Wildlife Trust's ResourceSpace image catalogue



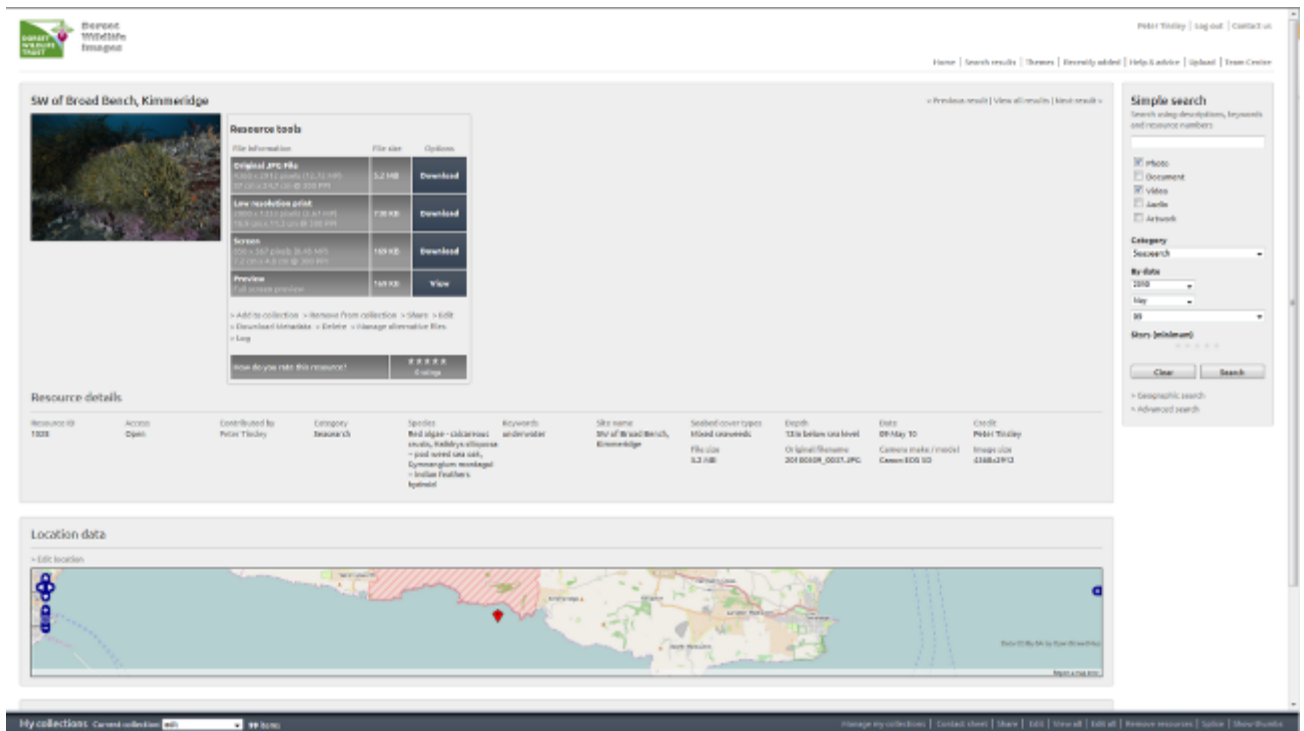


Figure 16 - Screenshot from DWT ResourceSpace “Resource details” page

ResourceSpace can extract metadata (date/time, keywords, GPS location etc.) from files as they are uploaded and/or can be used to add or edit metadata. Groups of files can be edited together to save a considerable amount of time. Searches can be very simple – a single word or phrase can be searched for in all fields simultaneously or more refined searches can be carried out. There is also the facility for map-based searches of geo-reference images.

There is full user-management built in to the system so that you can control who can upload/edit images, who can see/download images.

There are various ways of setting up ResourceSpace – Dorset Wildlife Trust is running it on an Amazon EC2 instance, set up following the instructions here - <http://rsinthecloud.com/guides/instance.php>, though it is now possible to launch a machine image pre-configured with ResourceSpace, which greatly simplifies the process - <https://bitnami.com/stack/resourcespace/cloud/amazon>

Once you have the system up and running, you can configure and adapt it to your specific needs – see here for details - http://wiki.resourcespace.org/index.php?title=Main_Page#System_Administrator.27s_Guide

The DWT example is available here - <http://rs.dorsetwildlifetrust.net/RS/> - select “General Users” if you wish to apply for an account.



VIII. CHDK

It is worth mentioning the case of Canon compact cameras as these can be “hacked” to expand their capabilities. The Canon Hack Development Kit (CHDK) is saved on the camera SD card and allows the user to override or expand a number of camera settings and to program the camera with scripts – a large number of which are available. This can include an intervalometer, allowing you to leave your camera for a period, taking photos at regular intervals; motion detection, where the camera fires only when something crosses the field of view; or even 3D photography, linking two cameras together to take stereo-images. More details on <http://chdk.wikia.com/wiki/CHDK> but bear in mind that there is a (small) risk you could damage your camera.

Other imaging techniques

There is a long tradition of collecting specimens, particularly of seaweeds, and preserving them through pressing and drying to create a reference collection. To some extent *in situ* photography has replaced the need to make collections but some groups, especially seaweeds, are difficult to photograph clearly underwater and may be collected for identification. As an alternative to pressing and drying and to some extent, as a replacement for a microscope, a flatbed scanner can take clear, high-resolution images of largely one-dimensional objects such as seaweeds and many hydroids and bryozoans.

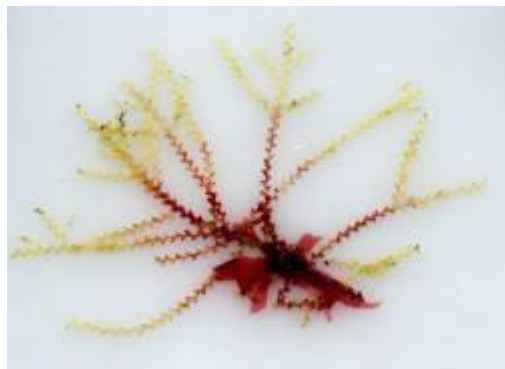


Figure 17 - Flatbed scanner image of hydroid



Figure 18 - Flatbed scanner image of Chondrus crispus – from An Ocean Garden: The Secret Life of Seaweed by Josie Iselin

References

Baldock, L; Kay, P 2012. [New records of some rare British and Irish gobies \(Teleostei: Gobiidae\).](#)

Marine Biodiversity Records, Vol. 5, p1

Tinsley, P, 2005. Worbarrow Reefs Seafan Study 2003-2005 – A Dorset Wildlife Trust Report

Van Rein, H. B., Schoeman, D., Brown, C. B., Quinn, R. and Breen, J. 2012. Development of low-cost image mosaics of hard-bottom sessile communities using SCUBA: comparisons of optical media and proxy measures of community structure. *Journal of the Marine Biological Association of the United Kingdom* 92 (1): 49-62. DOI: 10.1017/ S0025315411000233

Van Rein, H. Schoeman, D. S., Brown, C. J., Quinn, R. and Breen, J. 2011b. Development of benthic monitoring methods using photoquadrats and SCUBA on heterogeneous hard-substrata: A boulder-slope community case study. *Aquatic Conservation* 21 (7): 676-689. DOI: 10.1002/acq.1224.





PANACHE

Protected Area Network Across
the Channel Ecosystem

PANACHE is a project in collaboration between France and Britain. It aims at a **better protection** of the Channel marine environment through the **networking** of existing marine protected areas.

The project's five objectives:

- **Assess** the existing marine protected areas network for its ecological coherence.
- **Mutualise** knowledge on monitoring techniques, share positive experiences.
- **Build** greater coherence and foster dialogue for a better management of marine protected areas.
- **Increase** general awareness of marine protected areas: build common ownership and stewardship, through engagement in joint citizen science programmes.
- **Develop** a public GIS database.

France and Great Britain are facing similar challenges to protect the marine biodiversity in their shared marine territory: PANACHE aims at providing a **common, coherent and efficient reaction**.

PANACHE est un projet franco-britannique, visant à une **meilleure protection** de l'environnement marin de la Manche par la **mise en réseau** des aires marines protégées existantes.

Les cinq objectifs du projet :

- **Étudier** la cohérence écologique du réseau des aires marines protégées.
- **Mutualiser** les acquis en matière de suivi de ces espaces, partager les expériences positives.
- **Consolider** la cohérence et encourager la concertation pour une meilleure gestion des aires marines protégées.
- **Accroître** la sensibilisation générale aux aires marines protégées : instaurer un sentiment d'appartenance et des attentes communes en développant des programmes de sciences participatives.
- **Instaurer** une base de données SIG publique.

France et Royaume-Uni sont confrontés à des défis analogues pour protéger la biodiversité marine de l'espace marin qu'ils partagent : PANACHE vise à apporter une **réponse commune, cohérente et efficace**.

- www.panache.eu.com -

Financed by / financé par



PANACHE Project partners / Partenaires du projet PANACHE

