

Guidelines for
Macro/close-up
Photography

Peter Warne

A summary booklet to support the
Study Days at Copped Hall
And
Commissioned talks upon macro photography

The challenges and opportunities of close-photography

A short introduction for clarification and a description of the scope of this booklet.

The aim of this booklet is to accompany both my Study Days at Copped Hall and the talks – which include short practical work - I give to various interested groups.

Specifically macro photography describes the rendering of subjects at a ratio of 1:1 or greater. Close-up photography covers the rest; that is subjects captured at lower ratios of reproduction. It honestly doesn't matter much. Both are subject to the same challenges of focus, lens selection, blur, lighting and all those factors that influence most types of photography. In fact many of the techniques described will certainly prove of benefit to still life work and even landscapes.

Camera choice

Until recently a dslr was the preferred choice for close-up work because of its versatility, wide lens selection offering close focus, real manual focus over which there is complete control and a whole selection of accessories with which to ensure crisp images. However, there are now several alternatives which offer the same advantages and include specialist features such as automatic focus stacking (more of which later). They are often considerably lighter which can be a huge advantage.

Lens choice

The most frequent question asked when photographers sign up for close-up photography days is “will I need a macro lens”? The answer is a most definite no. There is a great deal that can be achieved with all types of lenses and they all have their advantages and disadvantages. There is no doubt, however, that a macro lens is a good addition to the collection and will almost certainly be one of the sharpest lenses you own.

So we'll start with a macro lens. As usual there is a large choice and similarly, you tend get what you pay for. There are several features to consider when making a choice.

1:1 focus capability – if a macro lens doesn't meet this criterion it is not a macro lens, which or may not be important.

Focal length – macro lenses are usually prime lens – that is fixed focal length rather than zoom. They come in a range from about 60mm through to 200mm. There will be other lenses which make a claim for macro capability – and they may be good enough in many situations – but see note above. The important criterion is will the lens do what you want it to? If the intention is for static subjects, 60mm may be perfectly good but if the subject is flighty – butterflies for example – it may be better to look to a 100mm lens so that one doesn't have to approach as close. The advantage of a 200mm lens is therefore obvious but they are heavy and expensive.

Image stabilisation is a most desirable property in a macro lens. It will add to the cost but these systems are very good these days and can provide an extra 4 to 5 stops of reduced camera shake.

Lens speed or lowest aperture setting. For reasons described below, close-up images are often taken at high f numbers – often in the range 8 to 16 but most macro lenses are fast with low settings in the region

of f2.8. One might ask why? There are all sorts of technical advantages but the main one is versatility. F8 and above are not always the best selection and it's good to know there are other options available (see depth of field below).

Telephoto lenses – primes and zooms.

Lens manufacturers have responded to the growing popularity of close-up photography and now provide much improved close focus distances. This last term is exactly what it says. All lenses have a limit upon the closest point at which they will continue to focus. There are ways around this but much better to have the close-focus distance *in situ* if possible.

There is another contribution from the telephoto element itself. Even if the close focus point is limited, try setting the lens to maximum zoom and focus will appear to be closer and the subject enlarged. The downside is that the depth of field will be reduced.

The same comments upon image stabilisation, lens speed and focal length still apply.

Wide angle lenses

Wide angle macro photography is very appealing especially for those who want to show the subject in its habitat but there are special considerations.

Most manufacturers make their wide angle lens, especially zooms, to cover a wide range of applications. As such they are not always as technically perfect as required or they are expensive. Owing to the construction of the lens elements these disadvantages cannot always be overcome by the use of accessories such as extension tubes – see below.

The other challenge is that by definition wide-angle lenses demand a very close approach, sometimes almost touching the subject. Most of the time the best subjects are therefore, static. Certainly if you want to keep your temper they will be.

Super macro – extreme macro

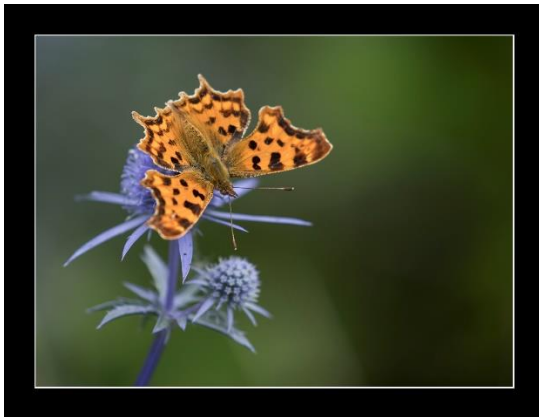
This is an area having a lot of technical creativity applied to it. There is no definition of extreme macro as yet but let's assume it means greater than 1:1. And the easiest way to access this field is by using the Canon MP-E 65mm lens – easy that is if you are a Canon user. The internet has plenty of references to neat ways of reversing lenses, cobbling together microscope lenses for use on cameras and other "Heath-Robinson" creativity but the MP-E65mm is the most practical and that is the only lens described here.

This lens has a range of 1 to 5 times magnification, there is no autofocus nor is there any image stabilisation so although it is a practical way forward it may not be the lens one would want to start with.

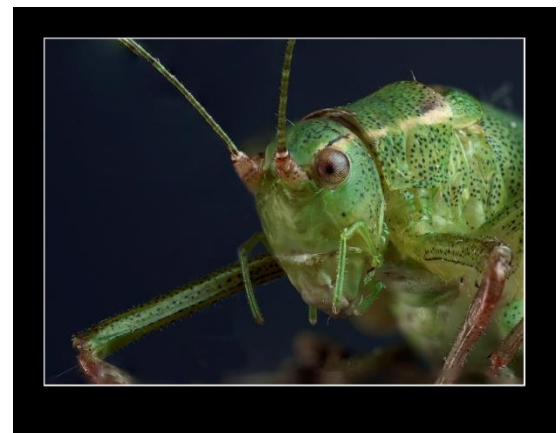
Overleaf are examples of images taken with each of the above lenses.



Canon f2.8, 100mm macro lens with image stabilisation



Telephoto lenses – Canon 100-400mm zoom f [5.6@400mm](#), with image stabilisation



Wide angle Canon fisheye@ 15mm on the left, right Canon MP-E 65mm @ x3 mag.

Depth of Field

The illustrations intend to show the different types of image one can get simply by changing the lens. There is no mention of the f numbers used, only the maximum f numbers of the lens to show its speed. However, there are observations to be made.

In the 2 images at the top the front to back focus – or depths of field - are different from which one can assume the f numbers were different. For the toad image the aperture was f11 while for the bee and bluebell picture it was f5.6. The bee plus flower picture was deliberately taken at a low aperture to throw the focus on the subjects and keep the background blurred. This is an essential part of much photography and is applied to portraits of most varieties to keep the subjects clear. A higher f number (or smaller aperture) was chosen for the toad image because the background was important. It emphasised the habitat in which the animal was found. Its suitability was recognised when it was selected for exhibition in the British Wildlife Photography Awards – habitat classification.

The next 2 pictures were both taken with a telephoto lens at its furthest reach of 400mm and lowest aperture (f5.6). Again there are conclusions to be drawn. First, a telephoto lens is particularly useful in the photography of skittish subjects. The butterfly was stationary at the time of shutter release but a closer approach would soon have seen it fly off. The dragonfly shot shows the insect to be in flight, something that presents its own challenge because they move very quickly. The other observation might be the clean backgrounds in both pictures. This is known as the bokeh, a term which originates from the Japanese language meaning blur. The bokeh is consequential of a low aperture setting but also a property of telephoto lenses which naturally have a lower depth of field compared with the 100mm macro lens.

And so the third row. The image of the mushroom was taken with an ultra-wide angle lens known as a “fish-eye” lens because it sees the world distorted as though looking through a fish eye. This can be a useful effect in its own right but its application in macro photography is to provide a huge depth of field. Everything is in focus from the front blades of grass through to the sky in the background. The final image was taken with the Canon MP-E 65mm using a 3 times magnification. At this level of enlargement the detail can be stunning. Even the cells of the cricket’s compound eye are clearly recorded. The depth of field of the lens is very difficult to control and this image used a stack of 17 separate images – more of which below.

Close-up filters and extension tubes – ways to extend the capability of a lens.

So you the photographer are fascinated by close-up photography but you don’t want to go to the expense of buying a macro lens. What can you do with existing kit?

Well it will involve money but considerably less than that required for a lens.

The cheapest method is to use a reversing ring to turn a lens around on the camera in which position it will act as a magnifying glass. It’s cheap and works but the big drawback is that there is no communication between the lens and the camera. Unless the lens itself has a manual aperture ring all images will have to be taken with the lens wide open. There are many excellent articles on the internet for this type of photography with some stunning images but it does take a lot of practice and so this article will pass to more practical methods.

The next option is the use of close-up filters. These screw into the filter thread at the front of a lens and increase the close-focus range to provide a larger magnification of the subject. They are usually sold in a pack of 3 strengths (measured in dioptres) and will probably cost under £20. Apart from cost they also have the advantage that autofocus and exposure still work between lens and camera. On the downside they come with 2 disadvantages. You will need a set for every lens you own – or rather every lens with a different sized filter thread. And what you gain on the close-focus end you lose on distance. So if suddenly something rare flies into shot at a distance, the lens won't focus on it.

The other option is to use extension tubes. A bit more expensive but they will fit every lens because they sit between the camera and the lens which has a universal fitting. It turns out that moving a lens further away from the focal plane of a camera increases the close-focus distance of that lens. Once again what you gain on close-focus you lose on distance but you only need one set of tubes in your kit for all your lenses.

Extension tubes come in a wide price range and have various practical advantages on offer. The strong advice here is don't buy cheap! Cheap rings will have no electronics with which to communicate with the camera but in the past there have been reports of the coupling mechanisms doing untold damage to the lens junctions of expensive cameras. The best advice I can offer is to buy a set of 3 extension tubes from Kenko which are available from Amazon at about £100 although cheaper sources are also available. They are available for Canon and Nikon cameras and more recently Sony E-mount lenses and there are even sets for micro four thirds systems. They will fit all your lenses and preserve electronic communication between the camera and the lens.



The illustration shows the 3 tubes as supplied (just 2 tubes for Sony and micro four thirds systems) and each increase in tube size increases the close-focus range. Also as shown the tubes stack together to increase the sum of the individual effects although you may find it is self-limiting by about 48mm. In keeping with all magnification effects there will be a concomitant reduction in the depth of field.

Extension tubes have wide applications and I frequently use a tube tagged on to my macro lenses.

In summary

Most lenses can have some application in close-up photography. Indeed they should all be used so that the properties of their individual optics can be exploited.

Depth of field increases with increasing f numbers and decreases with increasing focal length. One can add to this that depth of field decreases with increasing proximity to the subject.

The close-focus range of any lens may be increased with accessories. The versatile choice is the use of extension tubes.

The avoidance of blur.

Most if not quite all macro photography depends upon sharp focus. If it's an insect the focus is usually on the eyes although wing tips have recently proved popular. If it's a flower the stamens are popular focal points with blurred petals and the gills of fungi are often singled out for attention. These comments emphasise the scope for creative focus in close-ups but one thing is sure – the intentionally sharp area has to be sharp.

Three things in particular can affect focus; sharp focus by the camera, motion blur from camera movement and motion blur from subject movement.

How to focus on a subject.

Consider first static subjects where you have a solid foundation (not much of that at Copped Hall I'm afraid but it's principles we're teaching) and all the time you need.

First of all a solid tripod. Don't economise on your purchase of a tripod. There seems to be a wide variety of tripods made of thin flimsy material which have no place in any type of photography let alone close-up imaging. There are also tripods where the central column is reversible so that the camera can be mounted close to the ground. This is particularly advantageous in the field for flower and fungi photography. There are those that insist a spirit level is an essential component of any tripod. I have never found this to be case for close-ups although it is very useful for panoramic landscapes.

Tripod heads come in a variety of styles and will be an essential purchase for most tripods (some do come with a head supplied but they tend to be at the flimsy end). The most popular is a ball head where a ball is held in place in a housing and the whole thing can be locked with a lever. They are the easiest to adjust but have one great drawback for close-up work. No matter how tightly the ball is fixed by the lever it always slips slightly from the point at which it was set. Remember one will be trying to focus on very small subjects which ideally you want to keep within the frame. Even the slightest slip can take part of the subject out of the viewfinder.

A second type is the pan and tilt head which again is very quick to adjust but the adjusting levers are often outsized at this macro scale of operation. They are better suited to landscape work.

A geared head is a perfect answer for macro work. The Manfrotto Junior geared heads are extremely well made and will provide an accurate non-slip alignment with the subject. In fact many photographers now use these versatile heads for most of their photography. They have 2 disadvantages; cost and weight. The unit pictured usually retails at about £150 and if working in the field the heaviness does accumulate by the end of the day.



A second choice for support especially outside is a monopod which can often find a place in forest and field vegetation where a tripod can't be used or at least struggles. Again a head is required but a ball head is probably the best compromise in this setting.

Focus techniques

Static subjects; with your tripod and head in position and the subject in the viewfinder switch the lens to manual focus and the camera to Live View or back-screen focussing. With the subject on the screen magnify its image to 5 or even 10 times and turn the focus ring on the lens until the appropriate areas are in sharp focus. Try to avoid touching the camera again and release the shutter with a cable release or some other remote device. This technique will not only provide sharp focus but will avoid mirror-slap on those dslr with a mirror. The very act of using Live View locks up the mirror so that one doesn't have to ferret about in the menus to find how to lock it up independently. Mirrorless camera users of course don't suffer from this problem. Firing the camera remotely has obvious advantages in that there is no disturbance of the camera from pressing the shutter release mechanism.

There is currently some debate about the necessity to switch off the image stabilisation on a lens if it is used on a tripod. This is apparently because modern lens are much better at detecting when a lens is already stable. In my experience IS continues to work when the camera is on a tripod and throws the subject – so carefully prepared – out of focus. Switch IS off when the camera is on a tripod.

One other method takes some practice but can be a very useful field technique. It is most appropriate for the use of a camera with a monopod and those situations where a flighty subject is almost out of reach. Imagine a butterfly lying in a bramble patch; the area is choked with bramble stems and other vegetation which if moved will cause the insect to take flight. So set the camera lens to manual focus and pre-adjust to a 1:1 or 1:2 ratio. Attach the camera to a monopod and carefully plant the pole in the vegetation without touching the focus. With the subject in the viewfinder move the monopod backwards and forwards until a sharp focus is obtained and release the shutter. I said it takes some practice.

Moving subjects

There is no "fits-all" answer to this question and in many situations one is duty bound to seek out the most appropriate method by trial and error. So here are some options.

Fast moving subjects such as dragonflies in flight are challenging. However, they usually fly when the sun is shining so there is plenty of light about. Like all photography a little knowledge helps. Many of the larger dragonflies fly rapidly and often far from the banks of a pond. However, some are inquisitive and the southern hawker for example will come to examine photographers and hover there. In these cases use autofocus and extended point focus points.

Other dragonflies do not approach so closely but may still hover. Try to capture these moments and use manual focus – they are too distant for autofocus – and don't necessarily go for maximum zoom. Modern dslr generate large files open to severe cropping without compromise to the final image so use this potential.

A tripod will almost certainly be inappropriate in these situations but may be suitable in others where the motion is not so rapid. Emergent insects – those emerging from larval or pupal cases do move but not

fast and so are open to autofocus. Arrive early at a site when the insects are cool and try to find adults roosting – these too move slowly until they warm up.

Insect photography often benefits from low angle shooting – recall looking for a tripod with a reversible central column. However, there are other methods such as putting your wellies on and sitting in a pond with a tripod half submerged. One can go further with fisherman's trousers and walk out into a pond level with the surface. In these situations use autofocus.

Returning to blur

The tendency for blur to be accentuated by macro photography is well founded but hand-held shots with adequate sharpness can nowadays be achieved if one switches on image stabilisation. So blur due to camera movement can in many ways be anticipated and catered for. There often isn't even any need to use fast shutter speeds.

The same cannot be said if the conditions are against you. Wind is the enemy of close-up photography and if it's too strong you might just have to pack up and try another day. Insects don't like strong wind either so there won't be much about anyway. However, if you have travelled especially to find that rare orchid there may be things one can do. One is build a protective tent with fabric and sticks that come to hand. This has the added bonus that one can ensure a clean background and even generate a light tent with the sensible use of a flash gun. The other option is to choose one's subject carefully. Fungi are quite stout subjects and resistant to disturbance by wind.

There are other accessories which promise to steady or restrain botanical subjects by clamping the stems with a bendable arm attached to a fixed point. The best known of these is the Wimberley Plamp (see illustration). It consists of a strong clamp for attaching to a tripod and a less rigid clamp for a plant stem linked with a flexible arrangement which allows adjustable movement between the two. Two improvements have now been made; the plant clamp has been reduced in strength and Wimberley now supply a stake for pressing into the ground for clamping the end previously fixed to a tripod. Both these changes were very much needed because now one can change position (of the tripod) without pulling a rare orchid out of the ground. It all comes at a price. The plamp retails at £50 and the stake is a further £25. Personally I make do with a notched stick!



Wimberley Plamp

Lighting the subject

My experience is that most macro subjects require some form of lighting whether that be a fortunate alignment of the sun or artificial sources. Realise that you are very close to the subject, want to pick out minute detail and that light may find it hard to penetrate the set-up you have prepared. And there are many ways of injecting light.

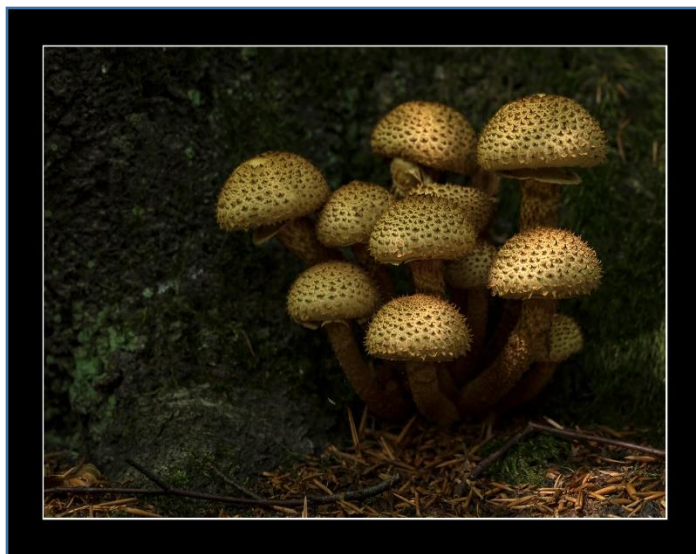
Sunlight or daylight through a window.

This can be the kindest and most creative form of lighting but it relies on nature playing along.

Flash is best used alongside daylight – it tends to give harsh images on its own but again there is good and not so good practice.

In this image of a shaggy scalycap the sun shone through the trees but at so diffuse an angle as to throw most of the fungus into darkness. A burst of **off-camera flash** was required to pick out the caps and throw the background into darkness. This picture prints wonderfully well with a lot of detail in the caps. The fact that the specimen is newly emerged helps.

The image was taken with a 100mm macro lens set to an aperture set to f5.6. The camera was mounted on a tripod and the shutter speed was 1/200.



Off-camera flash.

Most cameras are capable of using flashlight or flash to provide artificial lighting to a photograph. Internal flash units (pop-up) are often a feature of smaller cameras but are usually too weak and too harsh to provide pleasing results. They may, however get one out of trouble.

Another option is to fit an external flash, a speed-light, to the hot-shoe usually fitted to the top of the camera. The disadvantage to such a set-up is that the light may often overshoot a small macro subject.

To overcome this limitation many macro-photographers use a ring-flash. A flash system that sits around the lens itself and therefore must be directed at the subject. These flash systems often suffer from low guide numbers (16 for example compared with perhaps 60 for a Speedlight). And even when they can be set up to provide asymmetric lighting the final result can be rather flat. (Expensive mini-flashlights supplied by Canon for example are an exception.)

Another option is off-camera flash where a remote Speedlight is positioned or held at an angle to the camera and fired either with a lead attached to the hot-shoe or remotely with one of the many radio transmitter systems available. With this system the light can be directed precisely at the subject and has the advantage of providing transverse light which will pick out small shadows and enhance textural details.

The main objections to the use of flash is that it can produce a harsh lighting which often falls off rapidly to give no background details – backgrounds may often be black which may add to the starkness of the image. One option is to use a diffuser; a layer of gauze or other cloth which can spread the light and soften its impact to provide gentle shadows and highlights. One can buy diffusers which push on to the flash head. These are rarely very effective. It is preferable to use a larger diffuser which may be fitted to the flash head or placed between the flash and subject. Another solution, especially in a studio setting is to use LED lights.

LED lights

The lights illustrated may appear to be rather excessive for macro photography but they provide a wonderfully even light thanks to the large diffusers on the front of the hoods. The other advantage is that they are a constant light source allowing one to set up the whole image, identify the most suitable exposure and establish sharp focus. They have no application in fieldwork but are extremely useful for static or torpid subjects (moths in the early morning) in the studio.

The arrangement can be augmented with supplementary lighting such as an LED torch or a Speedlight usually set to a low output.



Another interesting combination which is particularly popular with those who specialise in photographing flowers is to use large LED lights in combination with a light-pad (Minisun or Tingham). In this style the subjects are lit from both above and below (back lighting). The results can be striking.

They come in various sizes from A5 to A2. The A3 size seems to be a very good compromise between cost and providing enough space in which to work. A4 can be somewhat restrictive.

There is also a variety of specialist lighting kits available on the internet. One of these is Adaptalux; a collection of light-tubes which can be moulded to provide lighting in discrete areas of a macro subject.

The illustration gives a feel for the product. Light tubes which can be of various colours and fitted with diffusers of varying intensity for softer light. Oh and the diffusers can be supplied in various colours. The control unit can house 5 tubes so that with the diffusers there is a wide range of lighting effects which can be created.



My experience with this equipment is not extensive but the early impression is that it is a bit flimsy and the lights lack power. Having said that it might well appeal to those whose macro interests extend beyond wildlife subjects.

Enhancing depth of field

To recap, depth of field is the term which describes the area of focus within one's image – front to back sharpness is another term. It is influenced by the focal length of the lens, the higher the focal length the shallower the depth of field. It is also reduced at low compared with high f numbers and similarly lowered as the camera to subject distance is reduced. So a telephoto lens pushed close to the subject and fully opened (low aperture) incurs all those influences on depth of field.

The temptation then might be to try to use a wide angle lens set to f16 to offset the factors which reduce depth of field. This arrangement can certainly provide an increase (see images on p3) but it is not always the end result that one is seeking. So there is a conundrum – low f numbers provide a shallow focus such that much of the subject will not be sharp. Yet these settings are most likely to provide a pleasing bokeh, a blurred background which throws attention onto the subject and removes background distractions.

One answer is to stack and combine several images which have been taken by moving the focus point repeatedly further into the plane of the subject. The recipe below is the simplest way to prepare stacked images.

Set up the camera on a tripod in position to take a picture of the subject.

Set the aperture to f5.6 (for example or whatever gives a flattering bokeh).

Set the focus to manual and turn off image stabilisation.

Manually set white balance and exposure and set the file type to RAW.

Focus on the outer edge of the image (that edge closest to the camera).

Release the shutter and examine the image for sharpness, composition, distractions, exposure...

Discard that image, make any adjustments and take the first image.

Then move the focus ring so that the focus point moves further into the image.

Take another image

Repeat the process to accumulate enough files to cover the range of focus you require.

Take one final image with your hand over the lens to signal the end of the sequence.

On to the computer – this method is for Photoshop users but other methods are available.

Download the images and load them into Photoshop layers

In the layers panel, left click on the first file and with the shift key depressed left click on the last file to highlight all the files.

Go to the edit drop-down menu and click auto-align layers (this is necessary because the alignment will have changed with each focus step. Click auto in the pop-up menu.

When the alignment has been notified go to the edit menu again and this time left click auto-blend layers followed by stack images.

When the computer has finished its work there will still be a collection of files in the layers panel so flatten these and save the resulting file.

The usual edits may now be made to reach the final image – save your work.

If all that seems a bit complicated...

There are automatic and semi-automatic software packages which will do the job for you.

I have used Helicon focus which works very well. It has the advantage that if coupled to a computer it will calculate the number of images that need to be taken to ensure sharp focus between 2 points that you select. It will then – at the touch of a button – take all the images and then combine them using its dedicated stacking software.

There are other packages such as Zerene stacker which is very popular with some photographers. I have to say I have found Helicon focus easier to use and for me provides better results. I currently use Photoshop's own stacking software.

Ultra-macro

With care the above method can work well for macro photography at or around the 1:1 ratio. If the magnification is greater, however, the alterations in focus can make alignment less satisfactory. For ultra-macro photography one of the best methods is to use a focus rail so that the camera moves further into the subject rather than the focus alone.



The illustration shows a Velbon slider just one of a host of products of varying cost and efficiency. The camera is mounted on the cork pad and screw heads just visible on the other side of the unit can be turned to move the whole thing over a screw thread and bring the camera and lens further into the subject. This unit is mid-price and works well although the turning knobs can be a bit stiff which can influence the positioning of the set-up. This will result in blur so care is required.

This set-up was used to take the bottom right image of a cricket shown on page 3 using the Canon MP-E 65mm lens at x3 magnification. The slider is widely available for about £80.

In my experience the use of a slider is a sufficient demand upon my time and patience and provides good results if used carefully. Of course it is always possible to do better and electronically controlled units are available. They do the same thing but much more delicately and the camera can be advanced in units as small as $2\text{ }\mu\text{m}$ – that's 2 millionths of a metre or a thousandth of a millimetre. Understandably these units increase the cost even more – between \$500-1200.



Macro Rail Package

Includes Power Supply and Motor Cable



Composition

The usual rules of composition can apply to close-up; golden ratios, placing the subject on a third and so on. In fact, an eye for composition can set one's images apart from those that produce merely a record of your encounter. However, these are standard tools and there are some that are particularly beneficial to close-up photography.

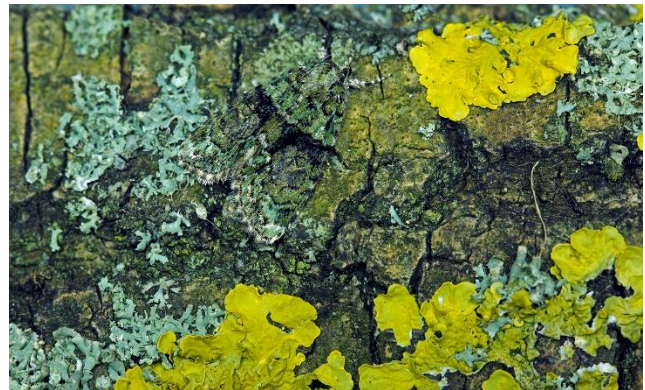
Think about the background



A clean bokeh is much more likely to provide a pleasing response than one which is cluttered and filled with distractions. This can prove a challenge in the field when a grasshopper refuses to rise out of the long grass but selective focus may still be the way forward. Select a low f number and make the subject the focus. Don't worry about grass in front or behind the subject because if both are out of focus one can achieve a beautiful muted effect. Manual focus will almost certainly be required for such an image and the forward/backward focus technique is very useful in these situations.

In the studio create an infinity curve on which to rest the subject. Choose an appropriate colour paper of about A3 size. Prop the top edge against a vertical surface – a computer screen works well – and bend the paper away from the camera to create a curve. Fix the front edge with bluetac or something similar. This technique avoids an ugly line which is unavoidable if one uses two pieces of card – one vertical and the other flat.

Another useful method of elevating an image is with the use of props. I keep a collection of pieces of bark with and without lichen and small logs with and without bracket fungi just for setting up a close-up subject in the studio. There is a moth in this image – a tree lichen beauty – and the image is intended to show just how effective the camouflage is when the moth is resting on a lichen encrusted piece of bark. The image is a 3 stack image.



There is very much more to write on the subject of close-up and macro photography and any number of books and internet articles to help you discover more. However, the fundamentals described above should provide a sound basis from which to progress.