

Digital Depth-of-Field

Never Get Out of Your Depth Again



By Nick Melidonis

If you are into landscape and macro photography in a serious way, then the topic of depth-of-field is one you have to address. Many of us have marvelled at the classic grand landscapes of photographers such as David Muench, Jack Dykinga and Art Wolfe to name a few, with their strong foregrounds with sharp detail all the way to the distant horizon. Ansel Adams and the landscape photographers of the Sierra Club prided themselves on being part of the f64 set when using their large format film cameras.

We all know that the smaller the aperture, the greater the depth-of-field and landscape photographers are used to using apertures from f8 to f22 to get the required depth-of-field. If you have a camera with a depth-of-field preview button, you can depress it prior to taking a shot and check what is actually in focus before pressing the shutter.

Image Quality And Aperture

The new high-end digital sensors are so good these days that we are getting to the stage where the digital file is starting to reveal defects in even the best professional lenses.

In fact, to get the best out of our lenses we need to select each lens's optimum aperture. This is usually found when the lens is stopped down (closed down) one or two stops from wide open (the maximum aperture), around f8 for a standard zoom lens.

If you're not sure what the optimum aperture is for your lens (and the optimum aperture can change

for different zoom settings), here's how to find out: place your camera on a tripod and photograph a subject with lots of detail using every aperture from wide open to the smallest one. You will be amazed at the difference in resolution from one aperture to the next, especially at the edges of the image.

I find with most of my lenses that the best quality is achieved at around f8. When I was shooting with film many years ago, I didn't bother to check this, but enlarging a digital image to 100% in Photoshop makes it really easy to check all your lenses in this way.

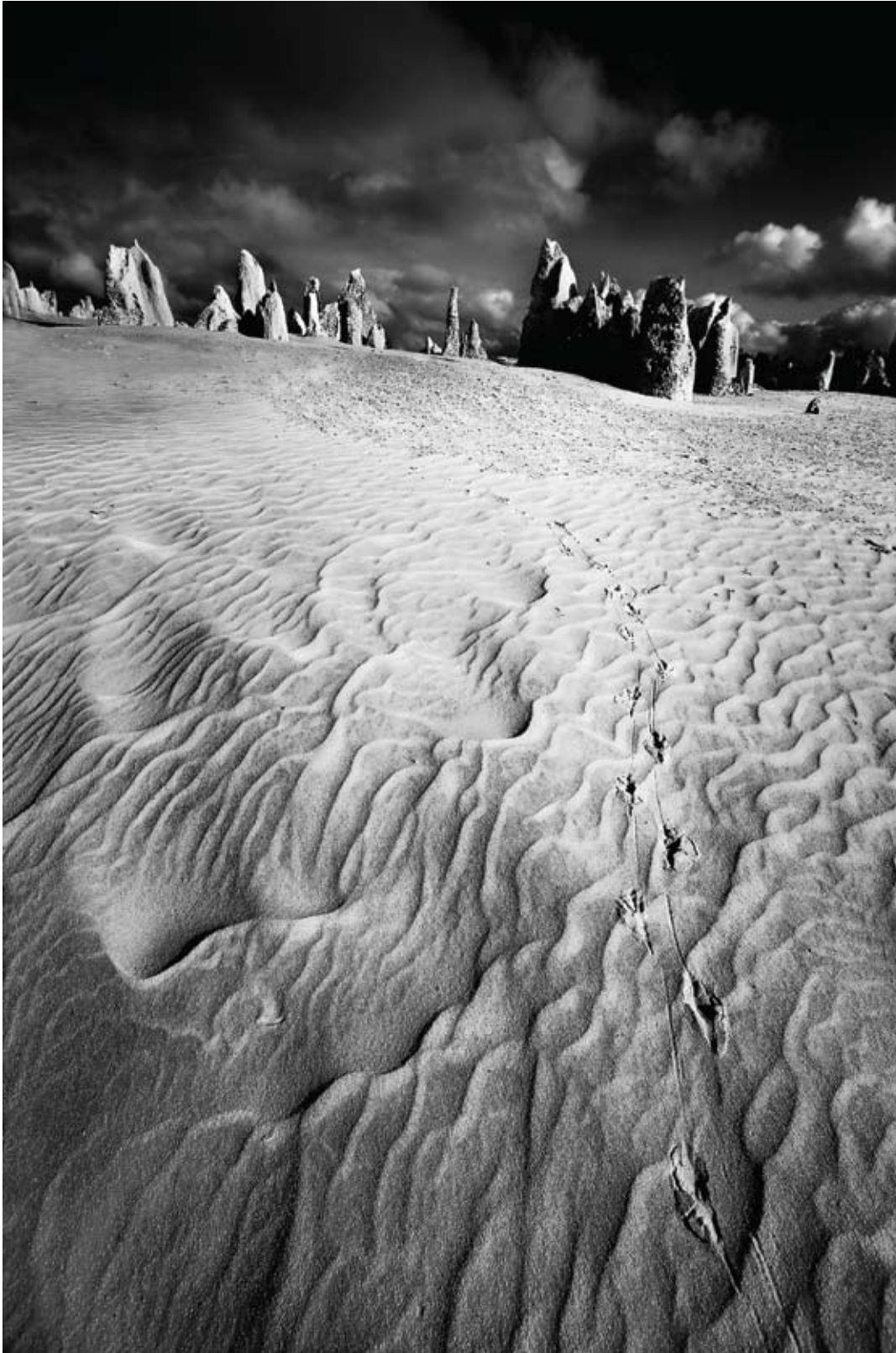
This now leaves us in a dilemma: we want maximum depth-of-field in many landscape and macro photographs, but we also demand a high quality image. An aperture of f22 or f32 may give us the required depth-of-field, but if we want the very best quality our lenses were designed to give and the quality needed to make large prints, our optics may fail us if we choose an aperture smaller or larger than f8.

Telephoto and Macro Lenses

Without going into the theory of optics, we also know that telephoto lenses have an inherently shallow depth-of-field compared to wide-angle lenses. This can be very desirable if we are trying to isolate a face in a portrait or a flower from the background, but it may not be what we want in a landscape or a macro study.



I placed a fluorite crystal specimen on a copy stand and used a Canon EOS 5D and a 24-105mm lens to take a series of photos at different focus points at an aperture of f6.3. The three images here are (in order), the first and last files of a sequence of 12 images with the red circle showing where I focused for each. The last image is the Helicon Focus composite with minor enhancement in Photoshop.



An example of the large depth-of-field made possible by Helicon Focus. The dawn tracks of fauna at the Pinnacles in Western Australia were captured in sharp focus and converted to black and white.

To achieve extensive depth-of-field with a telephoto lens, we need to use a very small aperture, but as noted above, this will compromise image quality. And even if we do use $f32$ with a telephoto lens, we may still not get the required depth-of-field. The same situation applies to macro photography when photographing fine detail in a flower or an insect: a tiny aperture may give the desired depth-of-field (depending on the focal length of the macro

lens or the extension tubes used), but the image quality may not be there.

Hyperfocal Distance

When we focus on a point, objects in front of and behind this point can appear to be in focus as well. How well focused and how far the focus extends in front and behind depends on the aperture we choose and its depth-of-field.



Helicon Focus

For digital photographers, there is a software solution for situations when the subject is stationary and you can shoot a series of frames. I found it at www.heliconfocus.com and was amazed at the results it provided and the easy, intuitive workflow.

The approach is the same whether you are shooting a close-up with a macro lens or extension tubes, shooting through a microscope or shooting a landscape in the field.

The software comes in different versions and at the time of writing, the basic or Helicon Focus Lite is US\$115, the pro version (allows extra retouching and batching) is US\$250, and if you want higher processing speeds, you can buy the Pro Processing version for US\$300. Frankly, I found the Lite version did all that I wanted and probably this would be the same for you.

Using Helicon Focus is a breeze and if you follow the simple steps outlined below, you can get amazing results easily.

Step One – Capturing The Sequence Of Images

Place your camera on a tripod and switch to manual mode for the exposure. This will prevent fluctuations in the exposure for your stack of images. A cable release, remote control or time release is advisable to prevent shake and to get a good sharp result. Set your lens or camera to manual focus. Choose an aperture. I'd probably choose the aperture for your lens which gives the highest quality (probably around f8).

Now start to take a series of exposures, progressively changing the focus point slightly in each shot so that you capture all the points within an image that you want sharp. In my first attempts, I didn't shoot enough steps in between and the results were not as good, so don't be afraid to shoot lots of images with just a slight variation in the focus.

A suggested format is to start with the point closest to you that you want in focus and then progressively move to the furthest point you want in focus. For landscapes, start with the nearest object that you want in sharp focus and progress to the distant horizon. It's not unusual to shoot up to 40 images in a sequence.

A tip, similar to what I use for stitching landscapes, is to take a photo of your hand at the beginning of the sequence and another hand shot at the end, otherwise you could get confused when trying to find the sequence of images in a browser amongst all your other images.

The software works with JPEGs, TIFFs and with RAW files in both 8- and 16-bits per channel which is very good if you want high quality results. For ease of processing, I copy the series of images to a separate folder.

Step Two – Selecting The Images

Open the Helicon Focus software and browse to the folder containing your sequence of images with the *File>Add New Item* command.

I took a series of photos of a doorway at the Bayon Temple site in Cambodia with a tripod, Canon EOS 5D and a 24-105mm lens at 60mm and f8. The first image was focused on the closest doorway and the final image on the stone wall in the far distance. Again Helicon Focus was able to produce a very good composite image resulting in sharp details from the near doorway all the way to the far wall over 40 metres away.

The hyperfocal distance is the closest distance at which we should focus so that infinity is also in focus. You can find depth-of-field and hyperfocal distance tables on the internet (e.g. www.dofmaster.com/charts.html) or sometimes with the data sheet that comes with your lens. Some lenses also have focusing marks which indicate the hyperfocal focusing point for various apertures.

I find using hyperfocal distance tables a pain in the posterior to carry out into the field, so often I just choose a point about one third of the way into a scene to focus on and then use my depth-of-field preview button to see if I achieved my desired depth-of-field.

With the exception of perspective control lenses and view cameras, at this point we have exhausted the conventional means available to us to extend our depth-of-field. And even if we selected the smallest aperture on our lens (ignoring the quality implications) to achieve maximum depth-of-field, it may still not give us the depth-of-field we want.

But there is a solution!

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Richard White has been involved in photography for over 25 years. He is a Double Master of Photography with the AIPP, an experienced teacher and lecturer and has taught workshops locally and overseas since 1995. In 2003 he received a Victorian Arts Council Grant for overseas study and won the Victorian AIPP Landscape Photographer of the Year Award. He is also a master darkroom printer, an exhibitor of landscape photography and is collected Australia wide.

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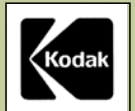
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Helicon Focus at work in the sand dunes at Sossuvlei, Namibia.

In the Open window, select the images you want to use (click and shift-click) and then click 'Open'. A preview window will show the images selected. You can choose to select all the images you shot or leave some out.

Step Three – Combining The Images

Click the 'run' button and watch the composite image starting to form – it's rather fun. The website contains some amazing animation examples of the progressive images building into a composite of an insect's eye and a rifle barrel that is angled towards the camera.

If required, you can make some minor changes to radius and smoothing sliders (see below) and run the set again

Step Four – Saving The File

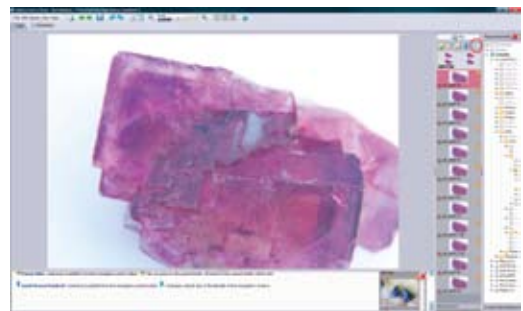
Click on the final composite image in the output list you want to save and use *File>Save*. You can save as JPEG, TIFF, JPEG 2000, BPM and PSD

Radius And Smoothing

Within Helicon Focus you can change the Radius and Smoothing sliders. Of the two, the Radius is the most important as it defines the size of the area around each point which the software uses to determine if the point is in focus or not. Use a radius of around

Finding The Hyperfocal Distance

If I had a 100mm focal length lens and chose an aperture of f16, the hyperfocal distance table would tell me that I could focus at 6.4 metres from the camera and still keep infinity in focus as well. The hyperfocal distance changes for each aperture (the smaller the aperture, the closer the hyperfocal distance becomes) and for each lens focal length. As a rough rule of thumb, this also means that at f16 the nearest point that would appear to be in sharp focus would be about two thirds of the hyperfocal distance. In this case, that would be approximately 4.2 metres from the camera. This means that, at f16, everything from 4.2 metres from the camera all the way to the distant horizon (infinity) would be in focus.



This is the interface for the Helicon Focus software. The red circle at the top marks the icon used to browse for the folder containing the sequence of images with different focus points. Note they all appear on the right hand side and you can see any one you choose in the main area.



Once you click on the "run" button (circled in blue), the Helicon Focus software starts to process each of the images (circled in red on the right hand side) and you can observe the composite image (circled in red in the main display area) building up to the final image.

3 to 6 for images containing a lot of fine detail. For images that contain mainly coarse features, you can try higher values of around 10 to 15.

The smoothing slider determines how the software combines the focused parts. A low level of smoothing produces sharper pictures, but you may find some artifacts in the transition areas, whereas a high level of smoothing will result in a slightly softer image, but without visible transition areas.

The good thing about the software is it doesn't take long to produce a composite image and you can try a couple of variations with different radius and smoothing settings (appropriately labelled) to taste.

And there it is, a digital solution to obtaining the depth-of-field you require while still maximising the quality capabilities of your lenses.

Nick Melidonis is a Master of Photography and has twice won the AIPP Australian Landscape Photographer of the Year. He is also the 2005 WA Landscape Photographer of the Year. Nick leads photo tours to the Greek Islands and in 2008, two new tours to Andalucía in Spain, and Egypt, Jordan and Dubai (see his website). He conducts seminars and workshops and is available as a speaker. You can contact Nick at nickphoto@iinet.net.au or visit his website at www.nickmelidonis.com.

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