Mark Carwardine

WILDLIFE PHOTOGRAPHY MASTERCLASS:

DIGITAL WORKFLOW

Everything you need to know in a few easy steps

DIGITAL WORKFLOW FOR WILDLIFE PHOTOGRAPHERS
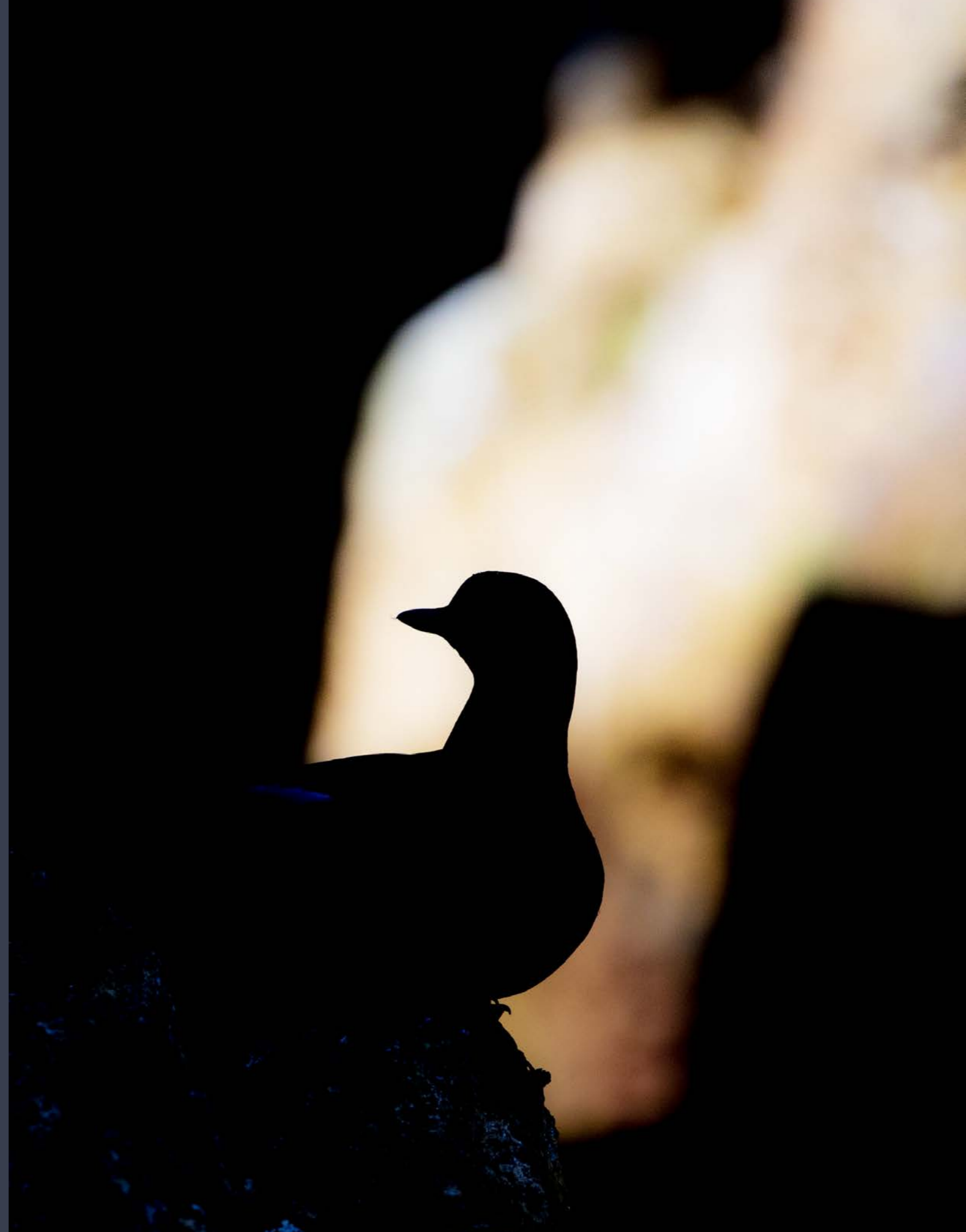**Written and photographed by Mark Carwardine**

Got a question?
Email us at:
rachel@markcarwardine.com

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INTRODUCTION TO THE DIGITAL WORKFLOW

There seems to be a lot of confusion about the digital workflow - turning images from your camera into perfectly processed tiffs or jpegs ready for uploading to the internet, emailing, projecting, printing or publishing. But there needn't be. It's not rocket science. You don't have to spend weeks attending complex workshops to understand and master the basics. And you don't need to know everything. It's like driving a car - you can drive perfectly well without understanding what happens underneath the bonnet.

That's the idea behind this simple little e-book. I have been shooting digitally since 2003 (I was shooting film for an unimaginable number of years before then) and, with the help of a great many friends and colleagues (professionals in the wildlife photography business), have developed a workflow that works really well for me.

This isn't the only way. There are many alternative ways of doing almost everything in this book, and everyone has their favourite systems and techniques. But I hope what I am about to explain will work for you. It's simple. Even better, as you develop your own skills, you can adapt parts (or all!) of it to suit your personal preferences and requirements.

WHAT YOU WILL NEED

To do this properly, you will need:

1) A camera that takes raw files and a CF or SD card to store them on.

2) A downloading device (you slot the card into the device then plug the device into your computer).

3) A computer (laptop or desktop).

4) A colorimeter to calibrate your monitor (don't panic - more about that in a minute).

5) Lightroom (Classic is the version I use).

6) Photoshop.

7) A separate hard drive (or two) to back up all your prize-winning images.

Personally, I use Apple Mac computers (the principles are all the same on PCs - the main difference is the shortcut keys) and Canon cameras (again, the principles are exactly the same - just the file menus will be different).

So let's begin.

CALIBRATING YOUR MONITOR

I know, I know. I know what you're thinking: "I don't want to calibrate my monitor - it sounds like too much hassle, much too complicated and scary". But please don't skip this bit. It's actually pretty easy. Even the first time you do it, it'll only take half an hour (and then it'll take ten minutes once every month). And it'll make a huge difference to your photography.
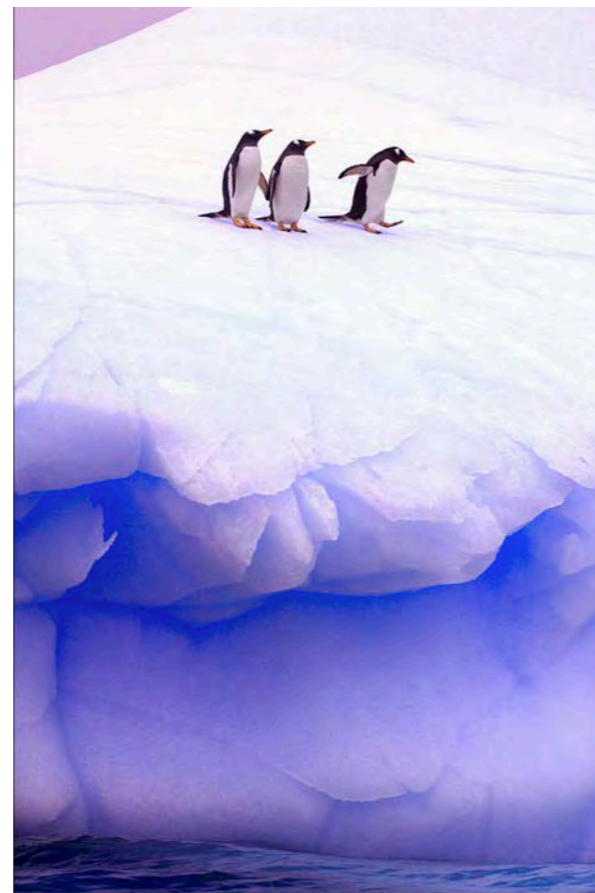
Why bother? All computer monitors see colour differently - they all have slightly different colour biases (look at the two examples on the opposite page). By calibrating your monitor you make the colours the same as the accepted international standard - so what you see on your monitor matches any other calibrated monitor exactly. The companies that make online books, for example, use calibrated systems - so do most magazine publishers. If you don't calibrate, you will spend hours processing your pictures to look perfect on your own computer, but they will look completely different on another computer and the colours will never look right when they are printed.

How do you calibrate? It's easy. You buy a gadget, called a colorimeter, that analyses the colours on your monitor and corrects them. There are a number on the market, but I use the Spyder X Pro (shown here). It costs about £150, but is worth every penny. All you do is download the software, then plug the cable into a USB socket on your computer, hang the gadget over your monitor and click 'OK'. It's not quite as simple as that - the software talks you through a few simple steps first. But it's not difficult. Then you go and make a coffee, while it works its magic (it flashes colours like the control panel on Star Trek) and, five minutes later, it's done. You can even press a button to see the difference: 'before' and 'after'. Then simply set a reminder to do it again in a month or so (every time you knock or move your computer the calibration shifts a little). And hey presto - you have a calibrated monitor!

A FEW BASIC TERMS: WHAT DO THEY MEAN?

It all begins with a 'pixel'

The digital sensor in your camera is made up of millions of tiny, square photo sensors arranged in a grid. Each sensor is called a pixel (short for 'picture element'). Every digital photo is made up of a mosaic of millions of pixels - eg a 20-megapixel camera takes photos with 20 million pixels in them (a megapixel is a million pixels). My Canon 1DX Mk II has 5472 pixels along the horizontal and 3648 along the vertical - about 20 million.

Have a look at the two images on the right. The uncropped 20-megapixel photo of a ruddy turnstone (above) is made up of 20 million pixels. The extreme close-up of one of the bird's legs (below) shows just some of the pixels that make up the overall image. It's like a mosaic of small tiles.

But how many pixels are 'enough'? That depends on what you are going to do with the image, and how big you want to enlarge it. If you blow it up too much you start to see individual pixels (that's called 'pixelation'). Generally speaking, the more pixels the better - the more fine detail in the image.

Also, more pixels mean you can crop tighter, and still get a usable image. Crop out half a 20-megapixel picture and you end up with a 10-megapixel picture. As a very, very (very) general rule, try not to go smaller than about 6 megapixels.

Knowing your 'megapixels' from your 'megabytes'

We've just learned that a megapixel represents a million pixels, or photo sensors, on your camera's digital sensor. A megabyte is completely different - it is a measure of file size or computer memory. Think of megapixels as a measure of picture quality, while megabytes are a measure of how 'heavy' a picture is - how much space it takes up.

Therefore the 'size' of an image can be measured in two ways - in megapixels or in megabytes - and the two figures will not be the same.

The number of megabytes depends on three things:

1) The number of megapixels (the more megapixels in the image the more megabytes it will be in size).
2) The file format (ie whether or not it has been compressed).
3) The amount of compression (more about this later - when you'll learn why jpegs are a good way of using photos - they contain lots of megapixels but take up less memory - but not a good format for processing them).

The number of megabytes directly affects how much storage space an image takes up on your CF or SD card and, ultimately, on your hard drive. It is also an important consideration when, for example, sending it as an attachment in an email (more megabytes take longer to traverse the internet).

Just for interest… in computer-speak, a bit is the smallest increment of data on a computer. Eight bits make one byte (enough to store single character, like 'h') and a million bytes make one megabyte (about the size of a medium-sized novel). Actually, to be pedantic, a megabyte is 1,048,576 bytes - but who really cares?

So what is 'bit depth'?

Bit depth refers to the colour information stored in an image. The higher the bit depth, the more shades of each colour it can display.

Let's consider this in a black and white photograph, which is easier to understand. Everything between jet black and pure white is a shade of grey. The higher the bit depth the more shades of grey in the image - the more steps - between black at one extreme and white at the other.

So a black to white gradient displayed at a low bit depth would look something like this (very blocky and with a noticeable step between each shade of grey - it is 'posterised' or 'banded'):

The same gradient displayed at a slightly higher bit depth would look something like this (better - but not perfect):


For a perfectly smooth gradation, between jet black and pure white, the bit depth would need to be even higher:

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In a colour image, each pixel has a specific individual colour (as shown in the close-up of the fur opposite). Here, the bit depth is a measure of the range of possible colours for each pixel.

Every colour in a digital image is made up of a combination of the three primary colours (red, green and blue). Using these three colours alone, you could create seven different colours (red, green, blue, yellow, cyan, magenta and white - eight if you include black, by removing them all).
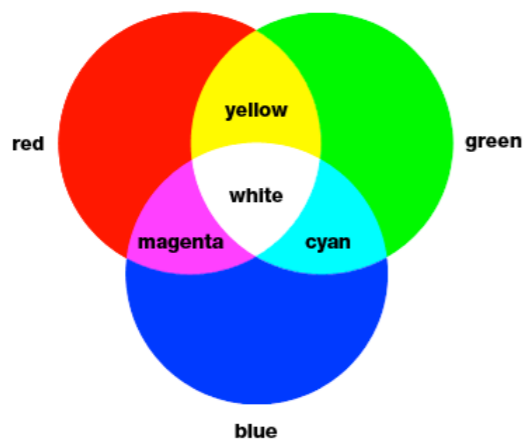
But you can create millions of colours by using multiple shades of red, green and blue. The more colours at your disposal the better the image (the smoother the gradient).

For computer reasons that don't really matter, in a 1-bit image each pixel can show only two colours (black or white). In an 8-bit image, however, each pixel has a potential palette of 256 shades of red, 256 shades of green and 256 shades of blue. Multiply those together (256 x 256 x 256) and you get roughly 16.8 million possible colours. That sounds like a lot, doesn't it?

But it's nothing compared to a 16-bit image. A 16-bit image doesn't have merely twice as many possible colours (as a

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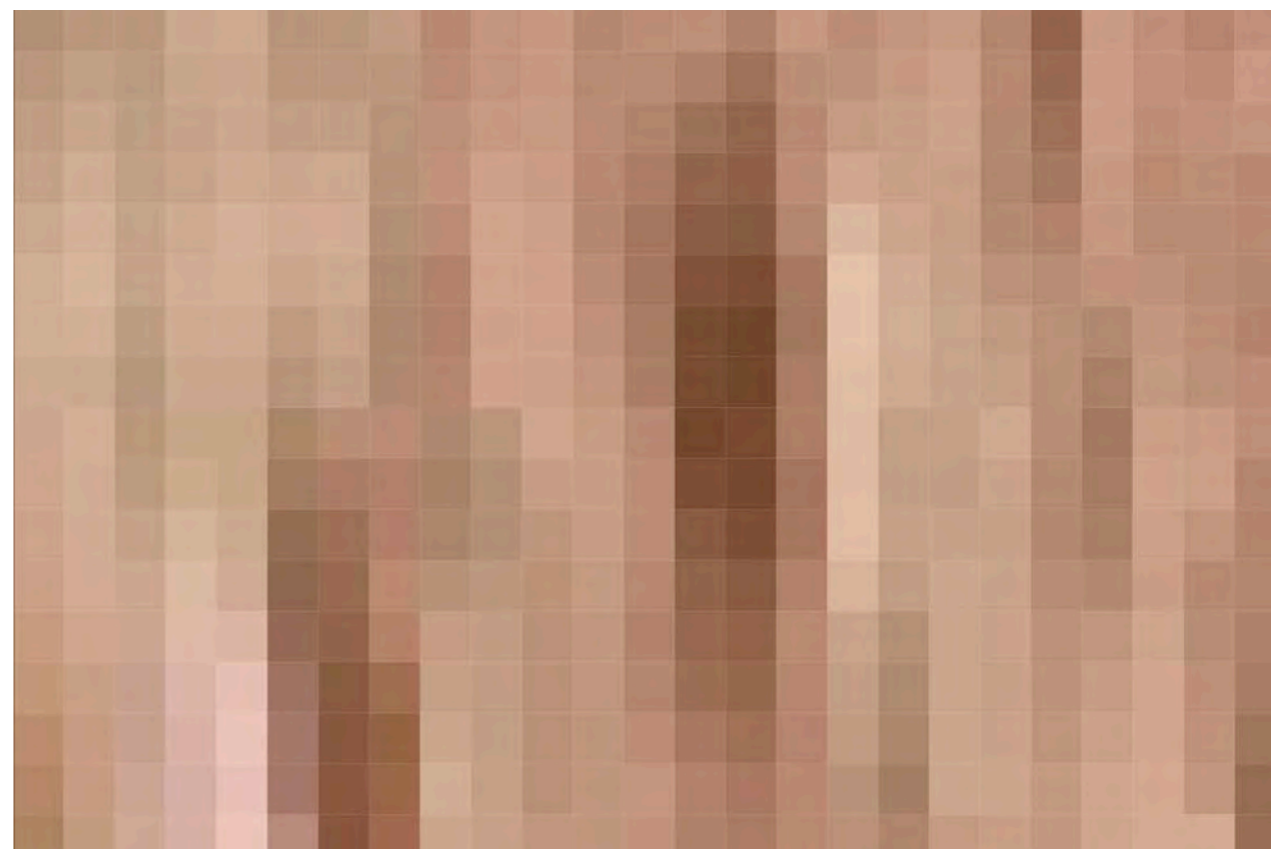
non-computer geek might reasonably assume). It has a palette of 65,536 shades of red, 65,536 shades of green, and 65,536 shades of blue. Multiply those together and you get 281 trillion possible colours. Now that really is a lot.

But why would we need 281 trillion possible colours? After all, our eyes can distinguish no more than a few million, at best. And, for most images, several hundred thousand colours is plenty to reproduce their contents accurately.

Well, the answer is in the processing, when previously hidden differences can start to show. As we process an image - significantly brightening the shadows, for example - we are effectively decreasing the bit depth. And the more we fiddle, the more 'posterisation' appears in the image.
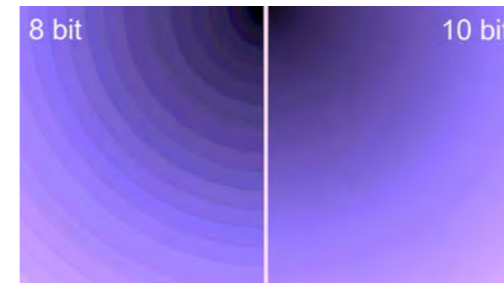
Look at these two images of a moorhen, and you will see the difference. The transitions between shades of colour are smooth in the higher bit-depth image (above), but they show posterisation in the lower bit-depth image (below).

There is a lesson here. If you're shooting in jpeg mode - which only allows 8 bits of colours - the camera throws out a fair amount of colour data before it saves the file. So don't shoot jpeg!

Having said that, you can convert a 16-bit tiff, after processing, into an 8-bit jpeg (for storage and for anything from printing to publication) without losing those perfectly smooth transitions.

Is bit depth the same as dynamic range?

No, I'm afraid it's not. But, luckily, dynamic range is the last technical term you need to understand. (You may also have heard the term 'tonal range' which, for all intents and purposes, is the same as 'dynamic range' - though many computer geeks would argue a subtle difference - so you get two terms for the price of one.)

Dynamic range is the range of brightness levels or tones between the lightest and darkest parts of an image. For example, an average sunlit scene might have a dynamic range of 100,000:1. In other words, there are 100,000 increments between dark and light - the brightest highlight is 100,000 times brighter than the darkest shadow. That is its dynamic range.

If you go into a cave that is so dark you can't see (or photograph) anything then you are outside the dynamic range of your eyes (or camera). Human eyes have up to 18 stops worth of dynamic range; modern cameras typically have a maximum of only 10-15 stops. In a high contrast scene, cameras either capture all the detail in the shadows and 'blow out' the highlights, or they expose for the highlights and lose the detail in the shadows. Fortunately, we can bridge the gap - achieving a higher dynamic range - with a little jiggery pokery in Lightroom and Photoshop. More about that in a bit.

This is important for a number of reasons. In particular, the range between different brightness levels in an image determines its degree of contrast. An image with a low dynamic range tends to look flat. But an image with a high dynamic range gives it extra 'punch', with beautiful jet blacks (the dark areas do not become featureless black blobs) and beautiful bright highlights (the light areas do not 'blow out' and become featureless, washed out blobs).

GETTING YOUR PICTURES ONTO THE COMPUTER

This is where the fun begins.

Lots of rubbish has been written about downloading your pictures - often designed to sell you special downloading software. There's no need for any of that. Just do this:

1. In your camera's menu system, under 'file naming', set it to 'continuous'. If you don't, every time you re-format your CF or SD card the picture numbering goes back to '1'. So you'll end up with umpteen pictures with exactly the same number and will get into a right old muddle. But if you do set file numbering to continuous, the first picture you take after re-formatting will pick up from where you left off. So, if you took 1,000 pictures one day, and re-format in the evening, the first picture you take the next day will be '1001'. Ultimately, you'll have a lovely collection of individually-numbered pictures from 0001-9999.

2. Put your CF or SD card into a simple card reader (there is a picture of the one I use opposite), plug it into your computer's USB, then drag and drop the entire folder onto your desktop.

3. Label the folder - I do it by trip and date - and file it.

4. Finally, back-up the folder onto a separate hard drive. If you're paranoid, like me, back it up twice onto two separate hard drives. And, ideally, keep them in two separate locations.

GETTING THE PICTURES INTO LIGHTROOM

STEP 1 - open Lightroom.

The first thing you need to do is to import your raw photos into Lightroom, ready to edit and process. You are not actually importing the entire files - your pictures don't 'go into' Lightroom - you are just making preview images with links to wherever you put the photos when you loaded them onto your computer. (Bear in mind that, if you ever move your images to another place, you'll have to tell Lightroom where you put them.)

STEP 2 - select 'Library' (from the options top right).

Library | Develop | Map | Book | Slideshow | Print | Web

**STEP 3** - go 'File' - 'Import Photos and Video'.

STEP 4 - we're now going to make a few simple decisions before importing (you only have to make these once and then you can forget about them forever). First, go to the column on the right of the screen:

1) go to 'Build Previews' (under 'File Handling', in the righthand column) and select '1:1'. This generates full-size
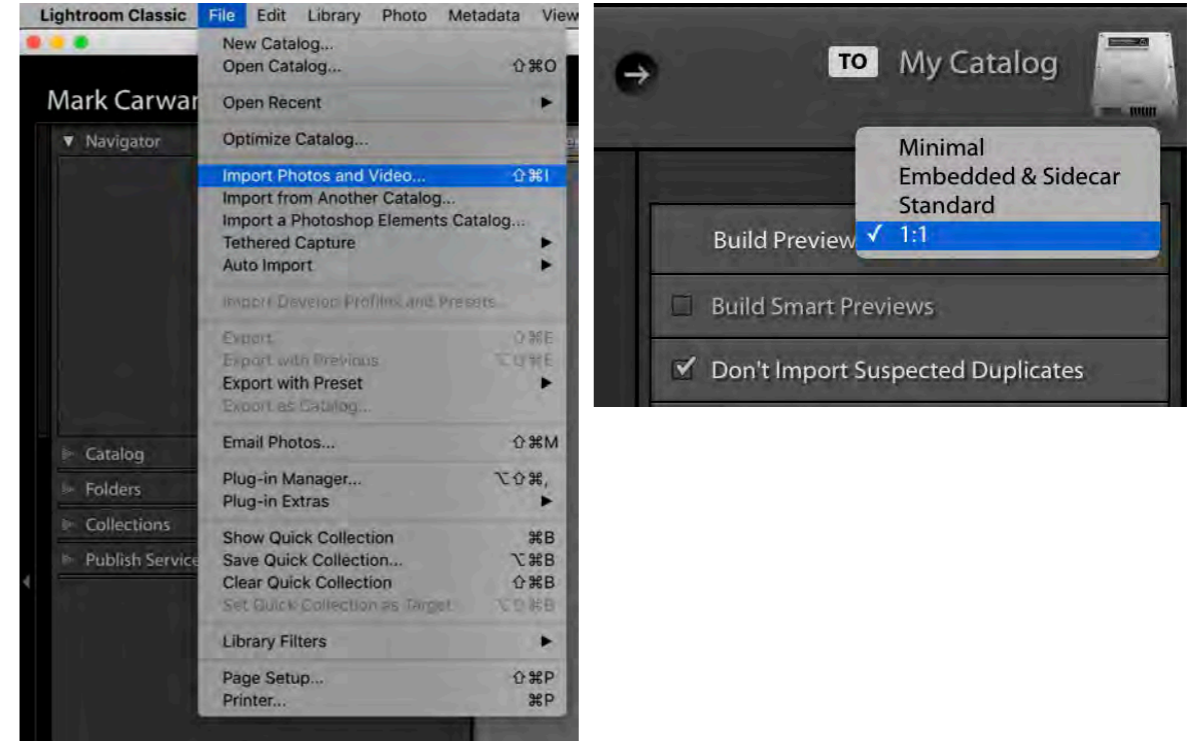
(100%) preview images so that, when you are editing in the Develop tab, and zoom in to see if they are sharp or to check fine detail, you don't have to wait - they zoom in and open instantly. The only real downside is that these full previews take longer to import in the first place. But there's a simple solution to this. You go and make a coffee - or have lunch (depending on how many pictures you have taken) - while they import. It's worth it. If you choose 'minimal', 'embedded & sidecar', or 'standard', the pictures will import more quickly, but you will have to wait forever for higher-quality previews to load each time you zoom in to check the picture in more detail. It'll drive you nuts watching the message "Loading" time and time again.

Out of interest, 'minimal' usually produces the same jpeg previews you see on the back of your camera when you
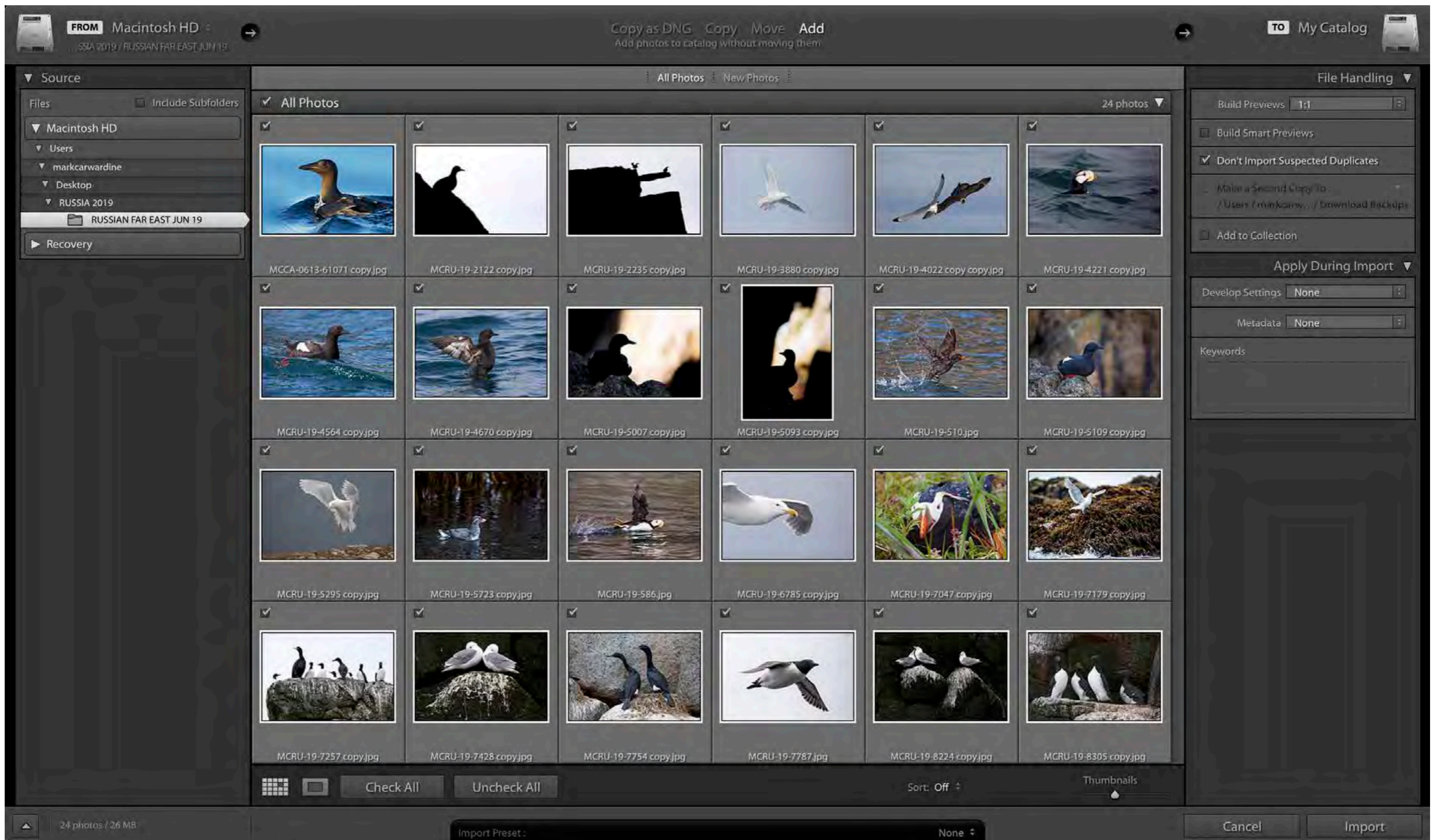
shoot in raw (and its colours are not particularly accurate); 'embedded & sidecar' produces slightly larger previews; and 'standard' produces slightly larger previews again. They save time in the short-term, but waste it in the long-run.

2) decide whether to tick or untick 'Build Smart Previews' (also under 'File Handling' in the righthand column). This enables you to process your images (in the Develop module) even when your original high-res raws are somewhere else. So, for example, the originals could be locked away safely in a cupboard at home while you work on the smart previews on

your laptop while travelling on the 7.37am from Bristol to London. Later, when you connect your laptop to those original high-res raws, by plugging in the external hard drive, like magic all your processing work is applied to the raws.

3) tick the box next to 'Don't Import Suspected Duplicates'. This doesn't really matter unless you're downloading from the same memory card over several days - it just stops Lightroom importing the same image (or, at least, the same file name) again and again.

4) untick the box next to 'Add to Collection'. Personally, I don't use collections in Lightroom but, if you do, this is where you create a new one or add images to an existing collection.

5) also on the right, you will see a heading 'Apply During Import'. Make sure it says 'None' in the drop-down menu under 'Develop Settings' (unless you want to change all your images to black and white or make other changes as they're imported).

6) under 'Metadata' , all I do here is add copyright information to all the images I'm importing. Simply click on 'New…' in the drop-down menu and write what you'd like to appear in the metadata of every image (see opposite). This is a good idea if you're worried about people stealing your shots. Likewise, you can add keywords (search terms - as shown opposite) to every image you import; I don't bother with this myself because I prefer to do it at a later stage, in Bridge, when I've done a proper edit).
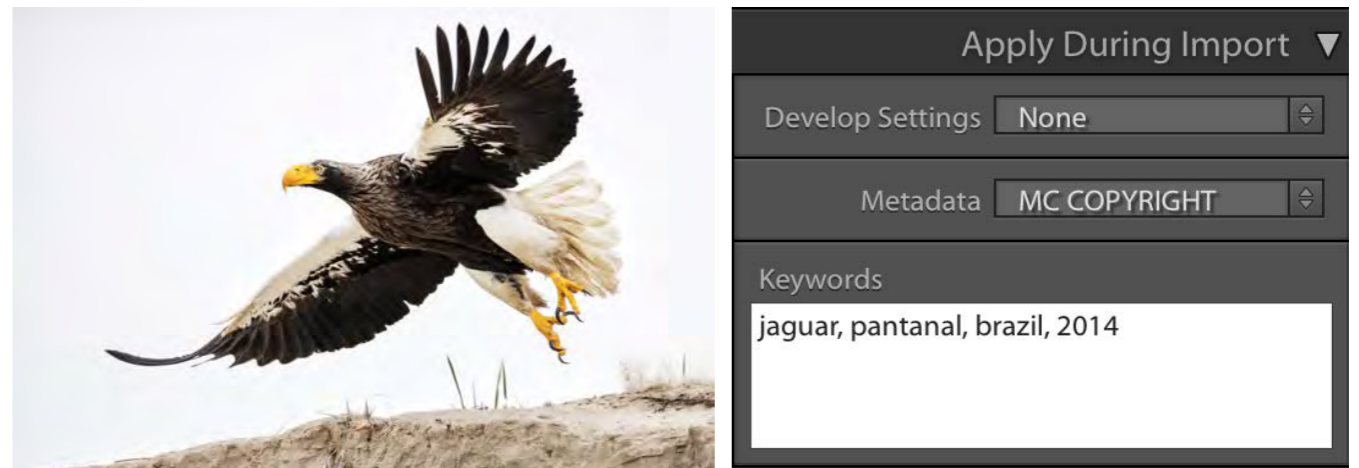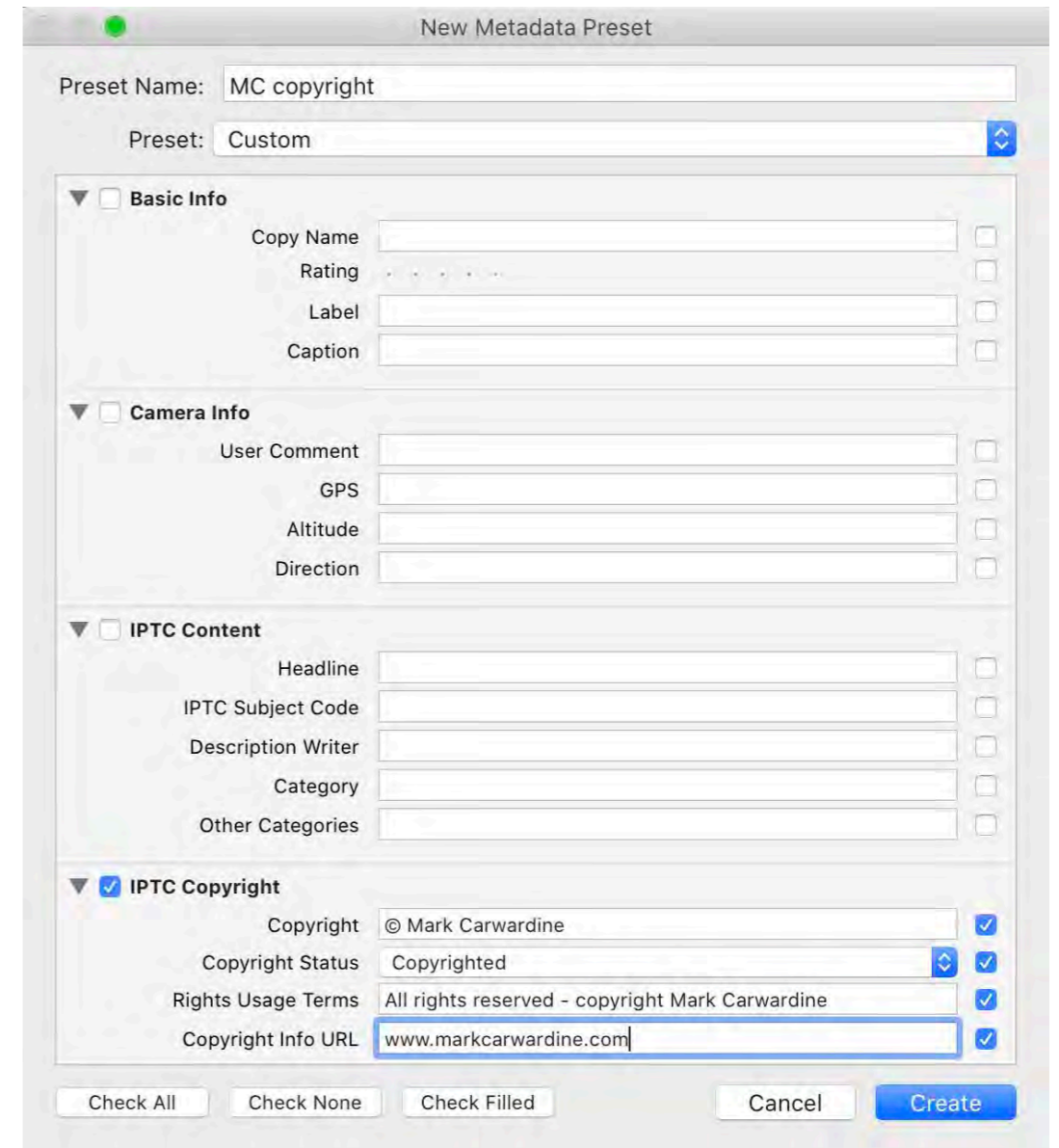
STEP 5 - now we're going to go to the top of the screen:
1) select 'Add' (this leaves your photos in their current location - wherever you have filed them). Out of interest, 'Move' moves them to a new location; 'Copy' leaves the original photos where you put them but makes a copy of the whole lot (putting them wherever you choose in the Destination Panel); and 'Copy as DNG' makes a copy of the whole lot but turns them into Photoshop's own DNG files (you don't want to do that).
2) in the line below 'Add', the default is 'All Photos' ('New Photos' is only useful if you are keeping previously imported photos in the same folder on your card or hard drive - because it will only import the new ones).

STEP 6 - let's move down to the bottom of the screen:
1) make sure all the thumbnails are ticked (in the top lefthand corner of each thumbnail) - or they won't import. If they aren't, simply hit 'Check All' at the bottom of the screen.
2) where it says 'Sort', click on the arrows and select your preference from the drop-down menu (I always pick 'File name' and then the images will appear in the order I took them).
3) you can alter the size of the thumbnails down here as well, to whatever size you prefer.
4) at the very bottom of the screen you'll see 'Import Preset'. You can choose 'Save Current Settings as New Preset' from the drop-down menu and, hey presto,

Lightroom will remember all the settings we've just done - to save you entering it all again every time you import.

STEP 7 - now we're ready to import. Under 'Select a source' (top left) go to 'Source' and navigate to the folder containing your pictures. Highlight the folder and then click 'Import' (in the bottom righthand corner of the screen). You will see the thumbnail previews starting to appear in the central preview area. There's no need to watch - this is when you go and have lunch (if you took a lot of pictures) and come back later when they're done. Congratulations! Your first batch of photos is in Lightroom and, at last, we can do some editing.
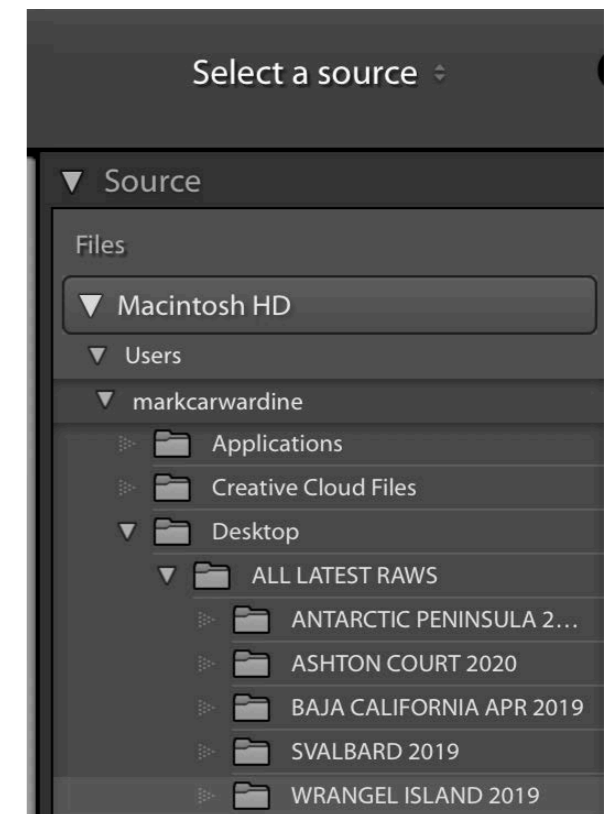
LIGHTROOM MODULE: EDITING TIPS & TRICKS

Editing your photographs - pulling out the ones you want to keep and process - is not as easy as it sounds. There are three main pitfalls: you miss your best shots, you keep too many nearly-made-it shots, and you take far too long.

When you edit is an important consideration. If you edit on the day you took the photographs, you will have a series of images in your mind that you think you took (or, perhaps, should have taken) so you are likely to be disappointed.

Also, you'll pick out the pictures that involved the most blood, sweat and tears. It's all too easy to become emotionally attached to certain images and this is when you are likely to pick 'almost' shots. Just because a picture shows an endangered species and was taken on a once-in-a-lifetime holiday at 4am while you were waist deep in a malaria-infested swamp, doesn't necessarily make it any good. But if you edit a day, a week, a month (or even a year) afterwards, you are likely to make a better selection. Without the emotional attachment, it's easier to separate the fun and challenging shots from the really good ones.
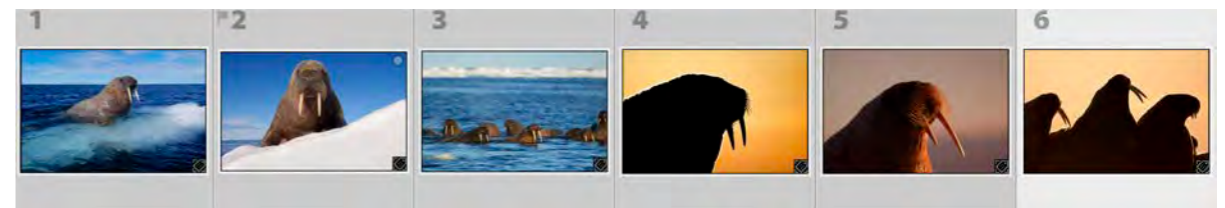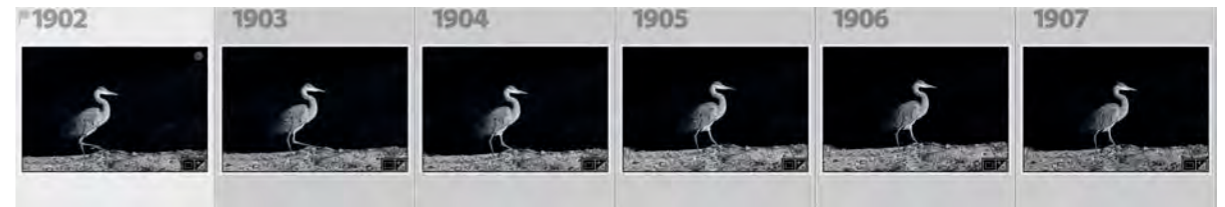
There is no right or wrong way to edit. But I'll tell you how I do it (it's a very efficient system - I don't have the time or the inclination to spend too long editing photographs).

1. Start with a quick overview - whiz through all the pictures (full screen) from one particular shoot (just hit the first thumbnail on the extreme left and tap through) to get an idea of the overall standard and what you managed to get.

2. Don't mark anything with a colour or a flag and, under no circumstances, give it a star rating. I have seen so many people waste away their lives deciding whether to award a photo one star, two stars, three stars, four stars or five stars. There is no reason to do that. You are either going to keep and process a photo, or you are not. It's either a keeper, or it's not - simple as that.

3. Don't delete anything. It's stressful deleting a photograph - what if you suddenly need it for some unimaginable reason in the far distant future? So why do it? If you delete hundreds or thousands of photos during an edit, you'll end up a gibbering wreck. Besides, you'll be wasting your time. Computer memory is so inexpensive these days that I keep everything. I may never look at the RAW files again, but I sleep at night knowing that they are there (just in case).

4. Once I've done a quick overview, I go back to the beginning and start with photo number one. If it's obviously no good (as most are!) I quickly pass on to the next. But if it looks promising, I click anywhere on the image to zoom in and see if it's sharp. Fairly quickly, I work my way through photo after photo - looking for any that jump out (it's the

same technique judges use when judging photo competitions). In this way, you are looking for the good shots rather than focusing on the bad ones.

5. If I do like the look of a particular image, and it's sharp, I compare the next few images in the series - the similars - and pick the best (and only the best). Unless you have the first genuine pictures of the Loch Ness Monster, there is no need to keep every single image. Try to pick the one that stands out from the crowd - because the light is slightly better, there is no unsightly shadow, the eyes are sharper, there is no distracting twig in the background, or for a whole host of other reasons.

6. There's an old joke - from the days of slide film - that the more rejected slides thrown into the rubbish bin, the more professional the photographer. In other words, you have to be your own harshest critic. You have to be honest with yourself and edit ruthlessly. You'll be showing your 'bests' to other people. It doesn't matter whether you're showing to family, friends or magazine editors, they will be more impressed (and less bored) if you show them 20 genuine prize-winners rather than 20 genuine prize-winners mixed up with 180 nearly-made-its. The risk is that the prize-winners will be lost in the melee - and the overall impression is less impressive. Everyone takes mediocre images - even the most famous photographers in the world - but the professionals are clever and show only their best. Then everyone thinks they are brilliant. That's what you should do, too.

DEVELOP MODULE: EVERYTHING YOU NEED TO KNOW

What you can't do in Lightroom

Unfortunately, you can't make bad photos look good (which is why it's important to get them as close to perfect in-camera - just like in the old days of slide film). And the really bad news is that you can't make blurry pictures look sharp.

But what you can do is to make significant improvements and turn a great picture into an even better one.

A quick word about honesty and manipulation

I feel very strongly - and, admittedly, this is a personal thing - that wildlife photographers should be scrupulously honest in their processing.

Photographers have been manipulating their images since the earliest days of their art. This iconic portrait of US President Abraham Lincoln, taken in 1860, is one of the first cases of serious fakery - it's actually a composite of Lincoln's head grafted onto someone else's body.


But, until quite recently, there was an assumed truth in photography. People believed that 'the camera never lies' and that what they were seeing was an accurate record. But digital has heralded a new era in which manipulating photos has become routine.

The technology is so good these days that it's easier than ever for photographers (and art editors) to make significant changes to pictures without most people ever knowing. Indeed, it is actively encouraged by the adverts for some digital manipulation software: one memorable slogan tells us to "Spread Lies".

Does any of this matter? After all, most of us assume that fashion, advertising and even paparazzi photos are likely to have been doctored in some way. We live in a world where airbrushed celebrities rule.

But many of us in the wildlife photography business believe that there should be a tacit understanding between the photographer and the viewer that what you see in a picture represents the truth, the whole truth and nothing but the truth. Sadly, some professional photographers will add or remove anything that makes an image more commercial. If they think that a polar bear would look better in a snowstorm, they use computer wizardry to include some falling snow. If two baby tigers would be better than one, they simply add a second. And then they try and pass their heavily manipulated images off as genuine. The camera may never lie but, sadly, some photographers do.
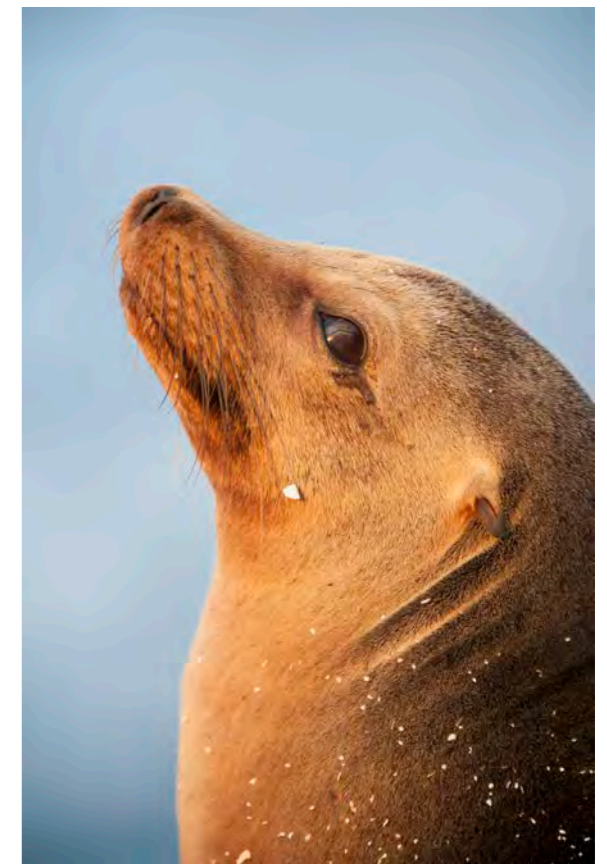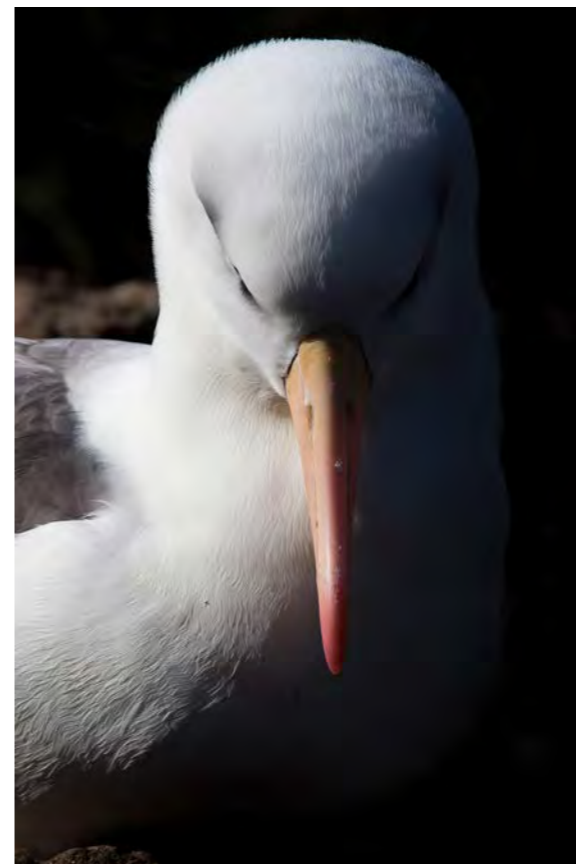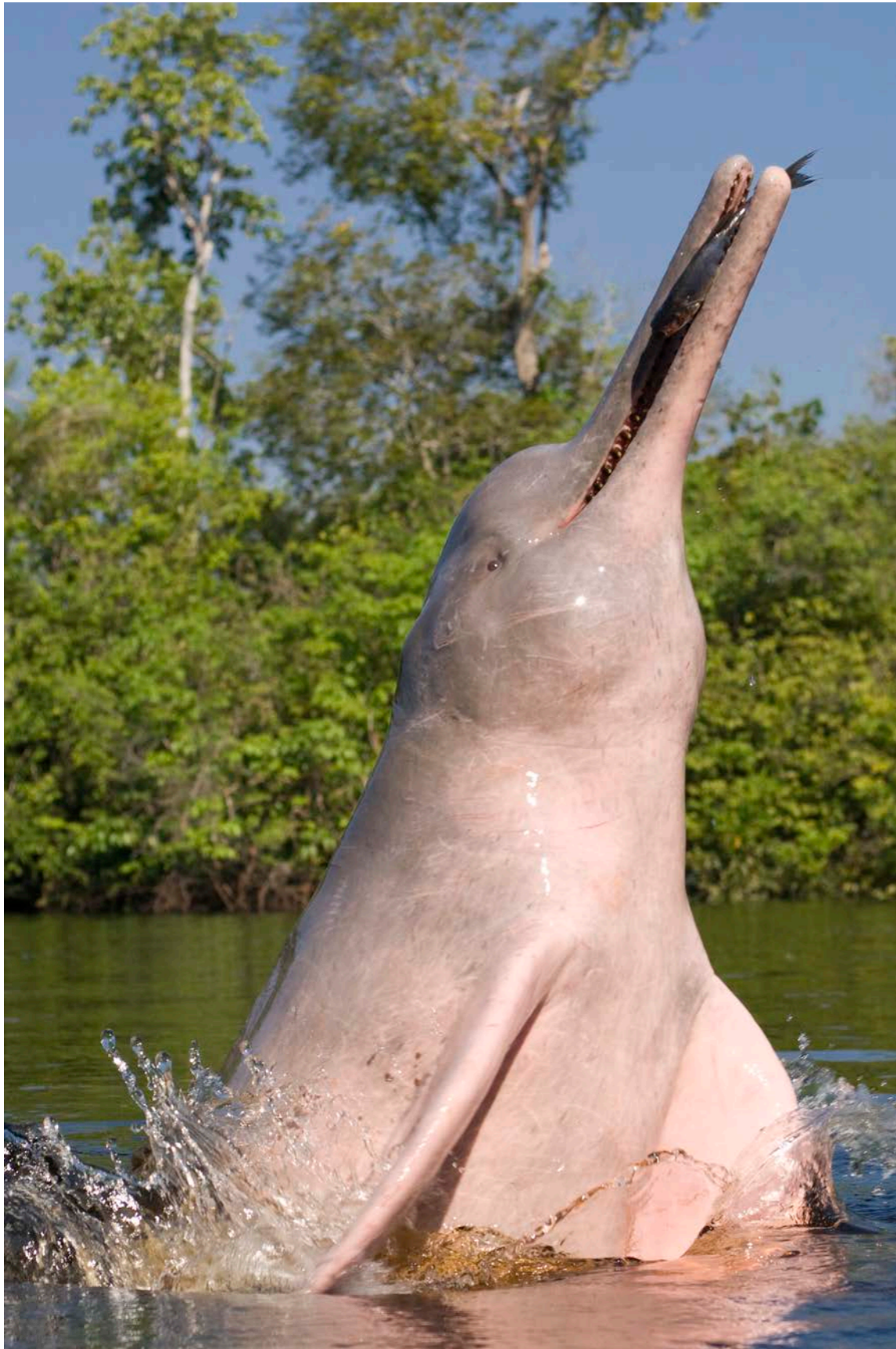
At this point, I ought to admit that creative computer (rather than photographic) skills can produce beautiful results. And one might also argue that it's all art, after all, so the aim should be to make pictures as appealing and eye-catching as possible. Nevertheless, lying about images has two serious repercussions.

First, deceitful photographers steal the trust that should be inherent in wildlife images. Once a few fake photographs have shaken your confidence, you begin to doubt everything you see. In this respect, the culprits do themselves a disservice, too - as far as I'm concerned, all of their images become suspect. And the magic and sheer awe goes out of the window.

Second, digitally manipulated images raise the bar in wildlife photography to an unnaturally high level. Everyone begins to demand better and better shots based on the artificial ones they've seen before. This puts enormous pressure on other photographers to compete, either by slipping into the world of digital manipulation themselves or by pushing their subjects to the limit, in a vain attempt to achieve the impossible.
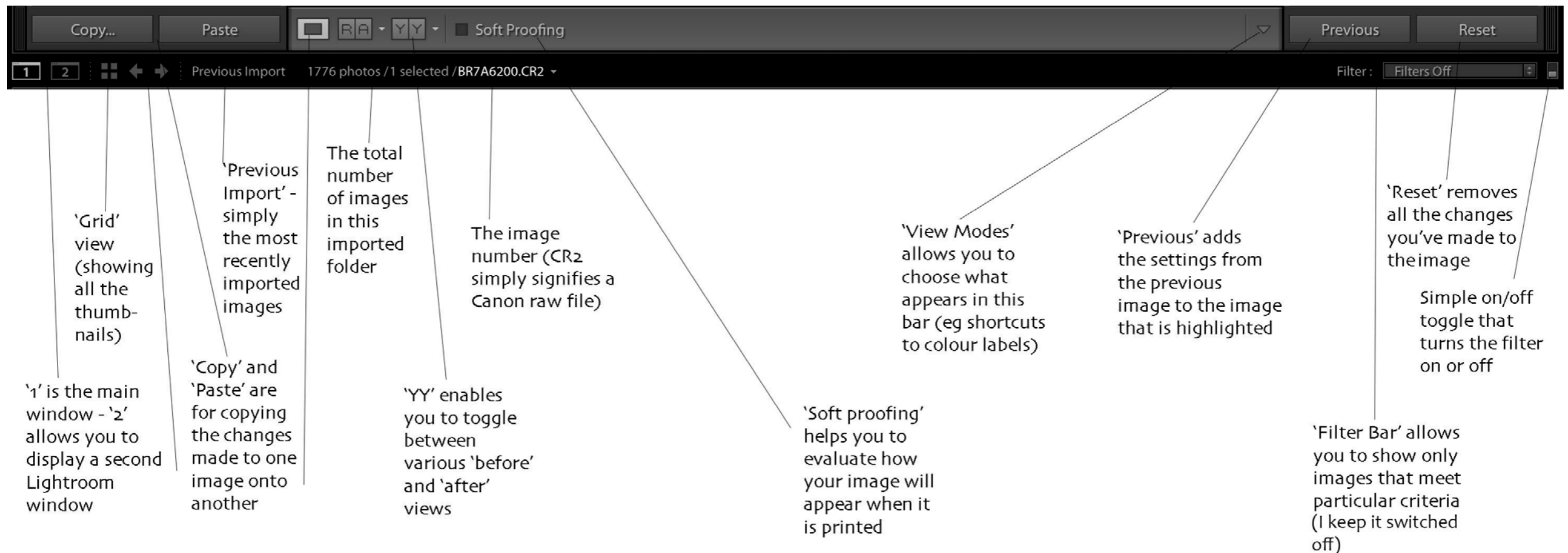
So what is OK? It's largely a matter of degree. Most photographers use image-editing software to enhance their photos. I do myself - and this is exactly what we're going to talk about next. But there are two particular lines that I am not prepared to cross: never add anything (such as another cub or a moody sky) and never remove anything (such as a distracting branch or someone's elbow). That's a simple rule, but it's critical if we're going to keep wildlife photography ethical.

Processing raw files

Before we get into the nitty-gritty of the Develop Module, there's one thing to bear in mind: don't feel obliged to make adjustments unless they are absolutely necessary. Just because there are lots of fun-looking sliders doesn't mean that you have to use them all, let alone slide them to the farthest extremes. Less is more. The trick is to get as close to perfection as possible in the camera - and to process subtly in the computer.

Getting to know your way around the Develop Module

We'll work our way through each part of the Develop Module in turn - that's all the dials and sliders on the right of the screen. But first let's run through all the other relevant bars and buttons, just to make sure you know your way around. First, the bit at the bottom of the screen (the **Toolbar**). You can toggle through a more expansive set of options (which include flagging and colour marking) that can appear and disappear along the bar, but I'm going to keep it simple - we'll cover everything you need to know to get started (in fact, I cope perfectly well without ever using any more than this).

'Grid' view (showing all the thumb-nails)

'Previous Import' - simply the most recently imported images

The total number of images in this imported folder

The image number (CR2 simply signifies a Canon raw file)

'View Modes' allows you to choose what appears in this bar (eg shortcuts to colour labels)

'Previous' adds the settings from the previous image to the image that is highlighted

'Reset' removes all the changes you've made to the image

Simple on/off toggle that turns the filter on or off

'1' is the main window - '2' allows you to display a second Lightroom window

'Copy' and 'Paste' are for copying the changes made to one image onto another

'YY' enables you to toggle between various 'before' and 'after' views

'Soft proofing' helps you to evaluate how your image will appear when it is printed

'Filter Bar' allows you to show only images that meet particular criteria (I keep it switched off)

Navigator

Double-click on any of the thumbnails to make it enlarge. Then, in the top lefthand corner of the screen, go to 'Navigator'. Try clicking on each option to see what happens:

- 'FIT' - your image neatly fills the available space, but with a grey background.
- 'FILL' - your image neatly fills the available space, but without the grey background.
- '1:1' - your photo will zoom into 100% view.
- '3:1' - your photo will zoom in even further (and further still if you pick a greater ratio from the drop-down menu).

I set it to 'FIT', to see the whole image from edge to edge. You'll notice that the cursor becomes a magnifying glass. Now, when you click anywhere on the image, it zooms in (jumping to '1:1') so that you can examine the area where you clicked closely (eg for sharpness). Click again, and it zooms back out.
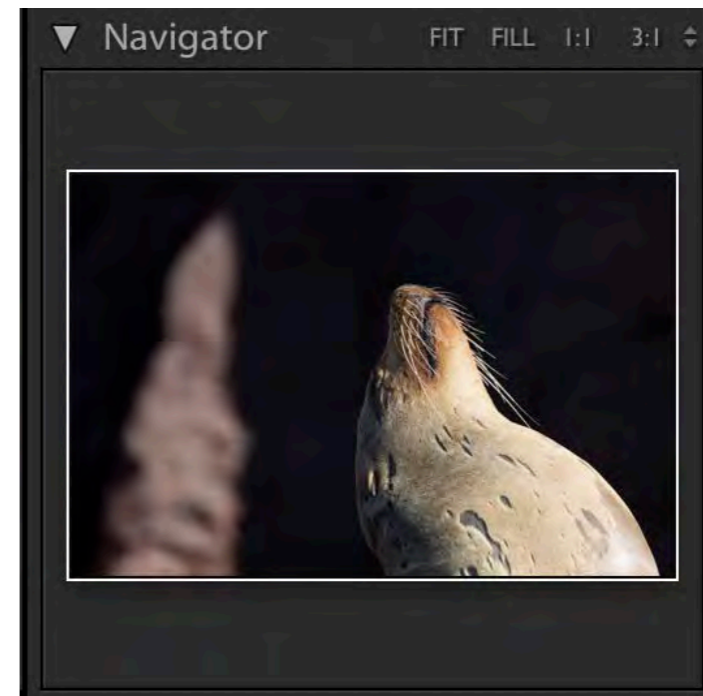
Useful shortcuts

(just tap the appropriate letter on your keyboard)

G - grid view (to see all the thumbnails)

E - full screen / loupe view (to see one main photo)

L - toggles between showing everything and showing only your photograph ('lights out' mode)

F - shows your photo filling the entire screen (tap F again to go back to the 'normal' view)

I - toggle through information about the photo (such as exposure settings, lens, file number etc)

C - compares two photos side-by-side (they both have to be highlighted)
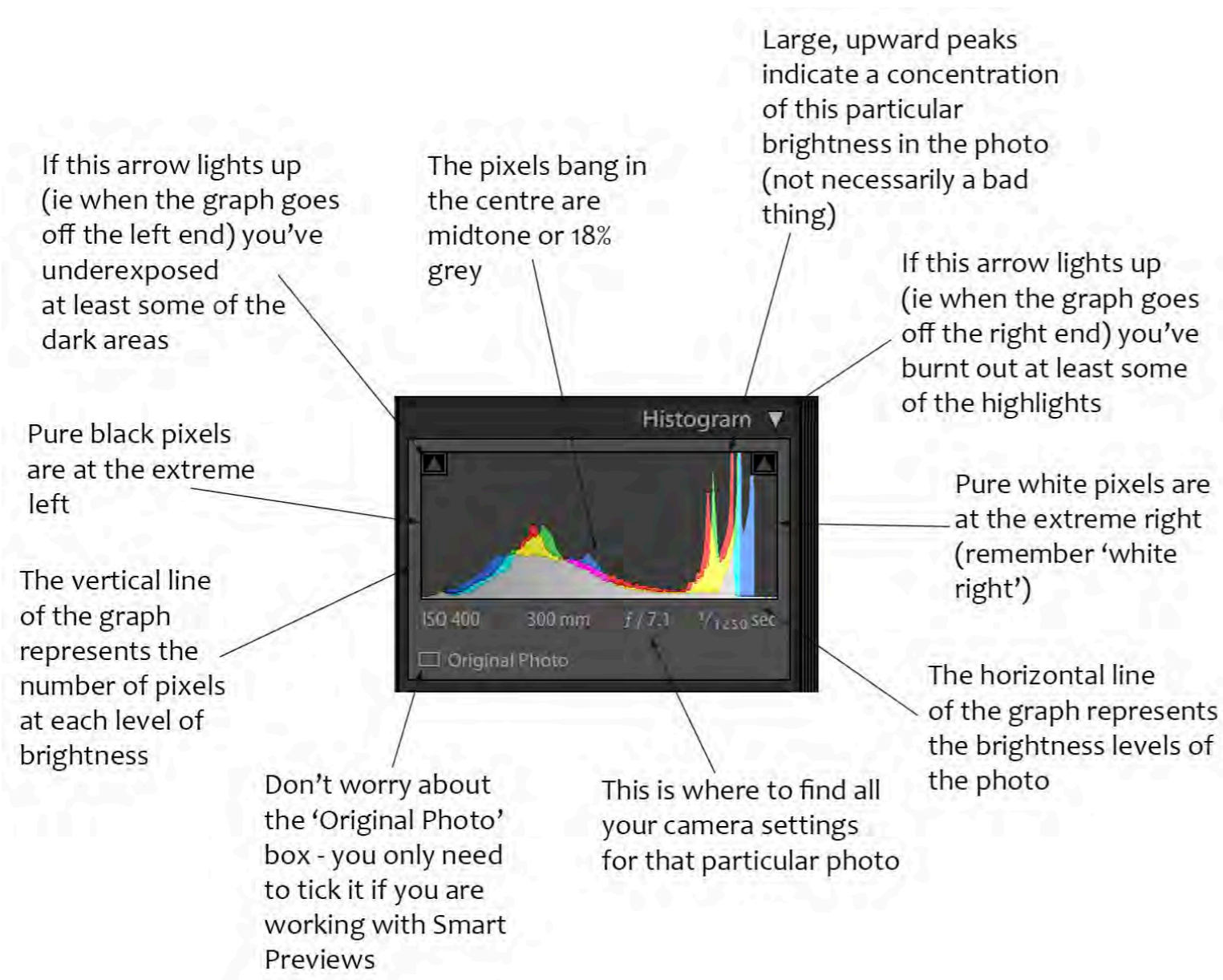
N - compares more than two photos side by side

Histogram

Surely, I don't need to explain how to use a histogram? Oh, alright then, just a quick explanation (as you'll need to keep a beady eye on the histogram when you make certain adjustments to the photo later on).

I should come clean here - there is a difference between the 'right' way to read a histogram and the 'practical' way. I'm going to tell you about the practical way.

If this arrow lights up (ie when the graph goes off the left end) you've underexposed at least some of the dark areas

The pixels bang in the centre are midtone or 18% grey

Large, upward peaks indicate a concentration of this particular brightness in the photo (not necessarily a bad thing)

If this arrow lights up (ie when the graph goes off the right end) you've burnt out at least some of the highlights

Pure black pixels are at the extreme left

Pure white pixels are at the extreme right (remember 'white right')

The vertical line of the graph represents the number of pixels at each level of brightness

The horizontal line of the graph represents the brightness levels of the photo

Don't worry about the 'Original Photo' box - you only need to tick it if you are working with Smart Previews

This is where to find all your camera settings for that particular photo

The histogram is simply a graphical representation of the brightness levels of your photo - all the way from the darkest shadows to the brightest highlights - with all the other brightness levels in between. The horizontal line of the graph is a measure of the brightness, and the vertical line is the number of pixels of that brightness. So the shape of the graph shows how many pixels are of each particular brightness along the range. It can be any shape - that doesn't matter. What you're looking for is the graph going off either end (if it's off the lefthand side at least one part of the image is too dark and is recorded as jet black with no detail - if it's off the righthand side at least one part of the image is too bright and is recorded as burnt out white). These aren't necessarily bad things - remember you don't always want (or need) a 'perfect' exposure. But you need to know in order to decide what, if anything, to do about it.

Now try and remember this basic explanation for when we use histograms later on.

## Cropping and local adjustments

Crop Tool
Hit this with the cursor and a frame will appear around your image. Then hit any corner of the frame and drag it in and out to your desired crop. You can also put the cursor just outside one of the corners (two little arrows appear) and rotate the frame. When the Crop Tool is open, you'll see a useful option called **Angle**. Hit this and then draw your cursor along the line of the horizon and let go - it automatically straightens. When you have finished, just press 'Done' (bottom right of the image). The crop will automatically be to the original ratio - but, if you prefer a different ratio (square, for example) simply hit the little padlock to unlock it, then hit the arrows next to 'Original' and select whichever ratio you like.

Spot Removal
Hit this with the cursor and a circle will appear over your image (you can alter its size with the square brackets on your keyboard). Make sure 'Heal' is selected (not 'Clone) then touch the dust spot you'd like to remove and let go. Lightroom automatically picks another part of the image to replace it. If it doesn't quite work first time you can move the selection around the image (with your cursor) until you find a better match (fine-tuning with the 'Size', 'Feather' and 'Opacity' sliders, if necessary). You can also 'paint' with your cursor to remove larger areas than a spot.

Graduated Filter
This works just like a graduated neutral density filter on your lens. It is great for adjusting the exposure (and other elements) over part of the image only. When you hit the icon and move your cursor over the image, it becomes a cross. Then drag the cross from one part of the image to another. Three lines will appear. Simply move the exposure slider (or, indeed, any of the other sliders) and you will see the effect: a graduated change from dark to light (or light to dark, depending on which direction you moved the slider). You can change the area of the image affected, or the 'steepness' of the gradient, by moving one, two or all of the three lines.
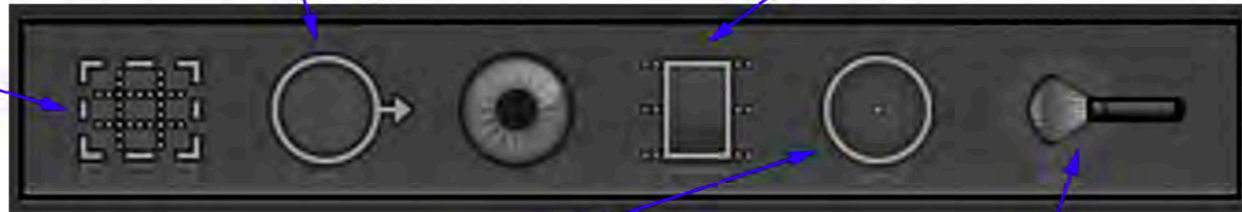
Radial Filter
This is for making adjustments to small or specific parts of your image. Hit the icon with your cursor, move across to the image and then drag the cross to 'pull out' a circle or oval shape. You can adjust the shape by pulling on one of the square corners, twist it by moving the cursor slightly to one side and then dragging the arrows, or move the whole thing by putting your cursor in the middle and dragging it. Then you simply make your adjustments with the relevant sliders. You can use the 'Feather' slider at the bottom to change the 'subtlety' of the edges. (ie how much they fade away). And by ticking or unticking the 'Invert' box you get to choose what happens inside or outside this shape.

Adjustment Brush
A local adjustment tool that allows you to 'paint' changes to an area of your image. Hit the icon, paint the area, make the changes with the sliders and hit 'Done' (bottom right of the picture). Under 'Brush', you can alter the size of the brush (with the 'Size' slider), the softness of the edges ('Feather' slider) and the opacity of the 'paint' ('Flow').

Red Eye Correction
The icon that looks like an eye does exactly what it says on the tin. Hit this with the cursor and then hit the centre of the eye and drag down a little. Let go of the mouse and the red will disappear (if it doesn't, try fiddling with the 'Pupil Size' and 'Darken' sliders until it does).

Basic picture-wide adjustments

'Basic' adjustments are the most useful adjustments in Lightroom. They adjust exactly what they say - across the entire image - with simple 'more or less' sliders. You can choose between Colour and Black & White, but I always work in colour (preferring Nik software for converting to black & white).

When making an adjustment (exposure, for example) try pushing the slider too far and then gradually pulling back. You can return to where you started (ie how the image was shot) simply by double-clicking on the word (eg 'Exposure'). Alternatively, open up 'History' (in the lefthand panel) and go back as many steps as you wish. Remember that less is more - try to make the picture look as natural as possible (just because the sliders go all the way to the right, or left, doesn't mean you have to push them all the way).

In case you're wondering, this is what each slider does:

- **Temp** - short for 'Colour Temperature' and one of four ways to adjust the **White Balance** (WB). White balance is the camera's interpretation of the colour of the light (which is warmer at sunrise, for example, and cooler in the middle of the day). Moving the slider to the right makes the image warmer (more yellow), and moving it to the left makes it cooler (more blue). Alternatively, you can pick the shooting conditions (eg 'Cloudy' or 'Tungsten') from the white balance presets in the drop-down menu under 'As Shot' ('Auto' simply lets the computer take a guess at the correct white balance). Or you can hit the **White Balance Selector** (which looks like a dropper) and hit a neutral target on your image; the best way to do this is to open **Navigator** in the lefthand panel (to see a small version of your image) then, as you hover the dropper over different parts of your image, it shows what it would look like if you clicked in that particular spot.

- **Tint** - the fourth way to adjust **White Balance**. It's a little more difficult to use than **Temp**, but can be useful. Moving the slider to the right makes the image more magenta, and moving it to the left makes it more green (just as it shows on the slider itself).

- **Exposure** - this one isn't rocket science - it adjusts the overall brightness of the image. But do bear in mind that it largely affects the mid-tones of the image (not so much the highlights or shadows). Moving the slider to the right brightens the

image, and moving it to the left darkens it.

- **Contrast** - moving the slider to the right increases contrast - ie dark areas become darker and light areas become lighter - and moving it to the left decreases contrast. It also makes colours punchier. It's a great way of improving flat- and drab-looking images. As with **Exposure**, it affects mainly the midtones.

- **Highlights** - an incredibly useful slider to adjust the brighter parts of an image. Moving the slider to the right lightens the highlights, and moving it to the left darkens them (it helps you to recover blown out (or 'clipped') highlights.

- **Shadows** - another invaluable slider to darken or lighten the darker parts of the image. Moving the slider to the right makes your shadows brighter, and moving it to the left makes them darker. When I take a photograph, I usually expose for the highlights and then use **Shadows** to bring out the details in the darker parts of the image.

- **Whites** - I rarely use this slider, but many photographers swear by it. It's a way of setting the white point of the image (the parts that are 100% pure white with no visible detail). The trick is to adjust the whites to the point just before you clip them (ie before you lose all the detail in them). There are two ways of doing this (rather than doing it by eye - which can be nigh on impossible). First, try pushing the slider to the right until the small triangle in the top righthand corner of the histogram lights up (that's the point at which you start clipping the whites). Second, hold down the Option key (Alt

on a PC), hit the Whites slider - and the image goes black; then push the slider to the right until some coloured or white patches start appearing (that's the point at which you start clipping the whites).

- **Blacks** - this is another slider I rarely use, but many photographers do. It's a way of setting the black point of the image (the part that is 100% pure black with no detail visible). You use it in exactly the same way as the **Whites** slider (except you push the slider to the left until the small triangle in the top lefthand corner of the histogram lights up and the image goes white when you hold down the Option (Alt) key). The aim of the **Whites** and **Blacks** sliders is ultimately to spread the image information across the whole histogram to give it more punch (which is something I prefer to do with **Levels** and **Curves** in Photoshop).

- **Texture** - an alternative tool (rather like **Clarity**) for adding punch and detail to your images. Quite simply, it accentuates everything.

- **Clarity** - think of **Clarity** as intelligent **Contrast**. It controls local midtone contrast. Basically, it makes the edges more defined (or less defined), bringing out the texture and detail in your photo. It can add punch and apparent sharpness to an image, but use it with caution as it can also make it look horribly artificial (with halos around objects and weird shadows around clouds). And you may need to increase **Exposure** slightly if you increase **Clarity** as it tends to make
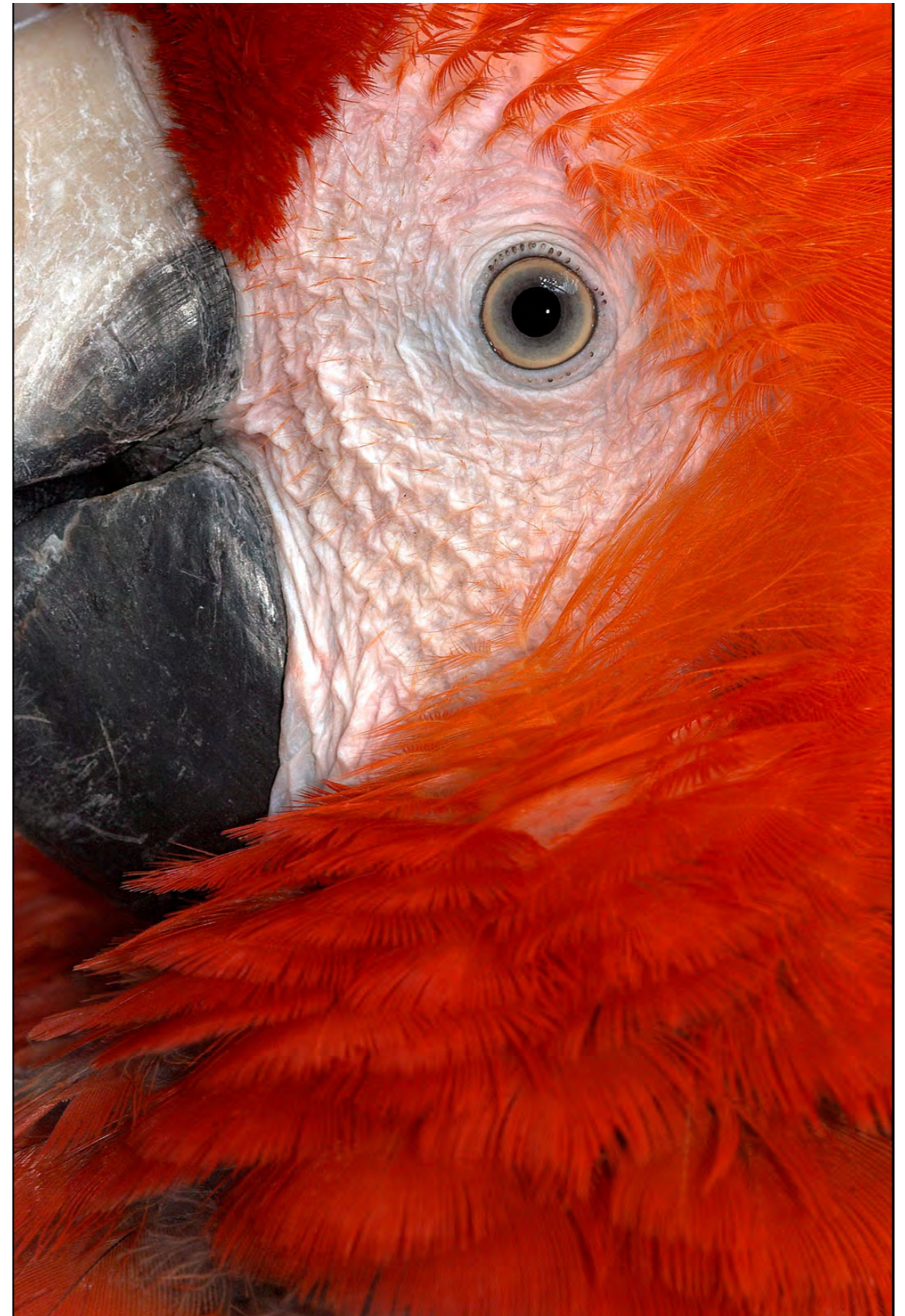
the image a little darker. Use **Clarity** on people's faces only if you want to make them look more wrinkled.

- **Dehaze** - removes atmospheric fog or haze (or creates it artificially). But it's more than that - I use it as an alternative way of adding contrast and sometimes apply it (sparingly) to non-hazy images. Push the slider to the right for more contrast (or to cut through the haze), and to the left for less contrast (or to add haze).

- **Vibrance** - think of Vibrance as intelligent **Saturation**. It boosts the saturation only of the colours that need boosting (ie the less saturated ones) and applies less saturation to the colours that are already very well saturated. Push to the right for more saturation.

- **Saturation** - increases or reduces the saturation of all colours equally (ie it makes every colour in the image more vivid). Push the slider to the right to make all colours more vivid, and to the left to make them less vivid. In my experience, more photographs are ruined because they have been over-saturated than for any other reason. Try to keep it looking natural - more isn't necessarily better.

There are no magic settings for any of these sliders - it all depends on the image and how you want it to look. Practise by pushing each slider to the extreme right and then left and slowly pulling back, to see what happens. Don't forget - you can return to where you started simply by double-clicking on the word (eg 'Exposure' or 'Vibrance'). And use them all sparingly.

I never use **Tone Curve** (a colour correction tool to adjust tonal values). You can do similar adjustments, more easily, in the **Basic Panel**. However, I do tweak the image using the **Tone Curve** (ie **Curves**) as a final step in Photoshop to give some extra punch (which we'll cover in a few minutes).

I never use **Split Toning**, either. It's designed mainly for black and white images (and I do all my black and white processing in Nik software). Some photographers use it to add weird and (depending on your point of view) wonderful effects to colour images as well.

Hue, Saturation and Luminance (HSL)

This is where you fiddle with colours - making them brighter, more vivid or just plain different. Simply push the relevant sliders to the right for greater effect, and to the left for less effect. The little **Targeted Adjustment Tool** (top left, under **Hue**) is handy - hit it with the cursor and then hit the part of the image you'd like to alter (eg the sky) and it will change that precise colour and nothing else. Otherwise, any changes you make will be to the selected colour across the entire image.

The **Hue** sliders let you completely change colours ('hue' is just a fancy word for 'colour'). You can turn red to orange or blue to green, for example.

The **Saturation** sliders increase or reduce the saturation (vividness) of each colour independently. It's like adding more paint to a painting.

The **Luminance** sliders brighten or darken particular colours in the image ('luminance' is just a fancy word for 'brightness').

If you hit **All** you simply get a different layout (the **Colour Panel**) for the same tools.
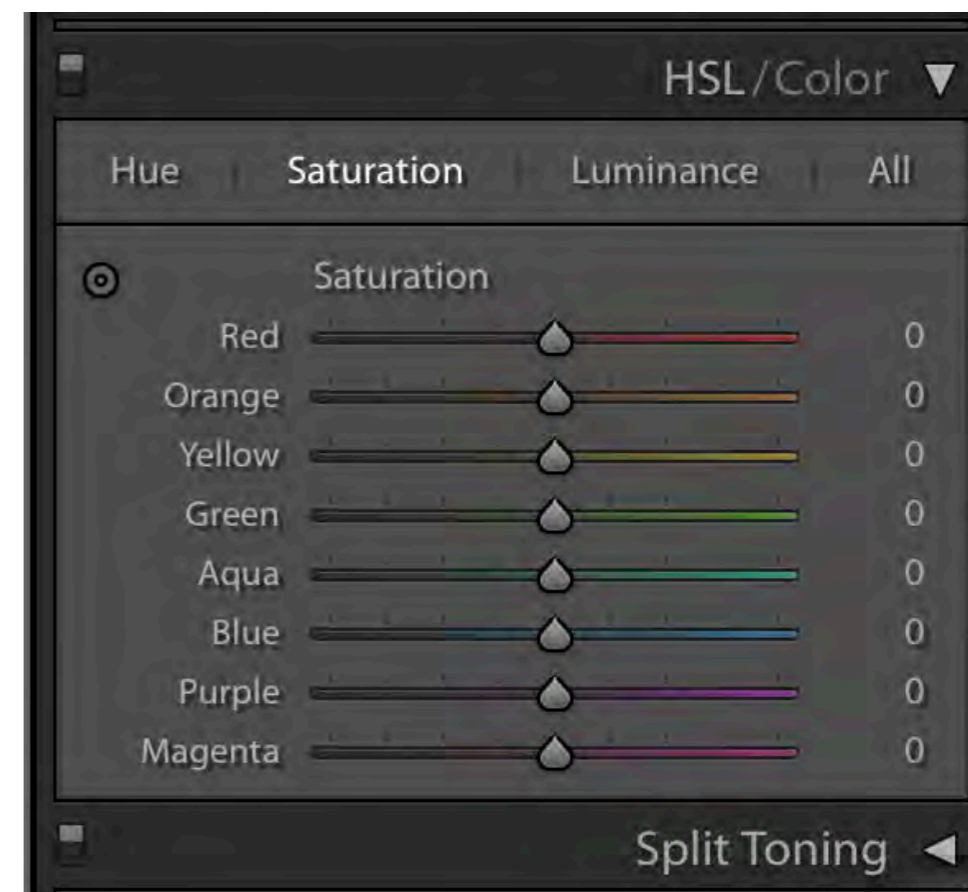
Sharpening

This makes the image crisper or sharper. It's better to zoom in (1:1) - by hitting the cursor anywhere on the image - to see exactly what you are doing (and it's effect) when you are sharpening. There are four sliders:

- **Amount** - this does exactly what it says - it controls the amount of sharpening (by increasing edge definition). I have my Amount slider set to 40 and never go higher than 70 (the default amount is 25 - which is barely perceptible).

- **Radius** - this slider determines how many pixels will be affected (out from the edge). I always leave this set at 1.0. If you push it too high you tend to get horrible halos.

- **Detail** - one advantage of never changing the **Radius** slider is that you never have to change the **Detail** slider either (it is supposed to minimise the impact of those horrible halos).

- **Masking** - this can be a useful slider for some subjects (although I normally leave it set on zero). It allows you to control exactly where the sharpening is applied. Hold down the Option key (Alt on a PC) and then hit and hold on the **Masking** slider. Your image will turn pure white. With Masking set to zero, this shows that sharpening will be applied evenly to the entire image. Keep pressing the Option (Alt) key and move the slider to the right. You'll see bits of the image start to appear in black - these are the bits that will not be sharpened. It works very well on human portraits, for example, keeping the bits that are supposed to be soft (such as skin) unsharpened (they'll go black) but sharpening areas that need to show sharp detail (such as eyes and hair - which will remain white).

Noise Reduction

This is really the opposite of sharpening - it softens the image. I don't use this tool, because it affects the entire image and makes it look unsharp (and a little weird, if you push the slider too far to the right).

There's a much better way of reducing noise - by doing it selectively. Hit the **Adjustment Brush** and double-click on 'Effect' (to reset all the sliders to zero). Then drag the 'Noise' slider all the way to the right. With the cursor (now a round target that you can make bigger or smaller with the square brackets on your keyboard) simply paint over the problem areas (noise tends to be worse in shadows - showing as red, green and blue dots - especially if you've cranked up the Shadows slider or shot at a high ISO). Zoom in to check the effect, and slowly pull the slider back. You are looking for a happy medium - not too noisy and not too blurry.

Noise Reduction	
Luminance	0
Detail	50
Contrast	0
Color	25
Detail	50
Smoothness	50
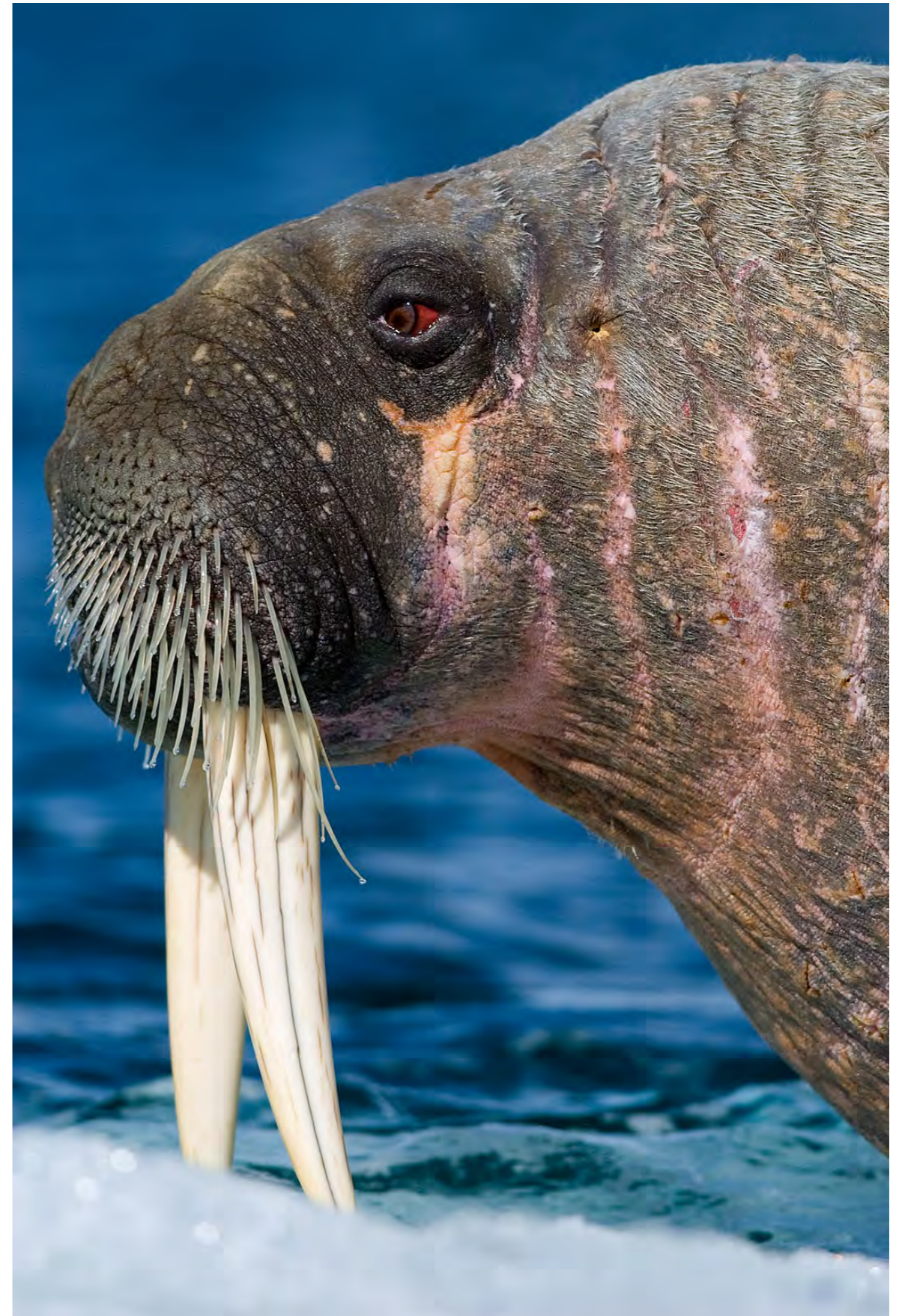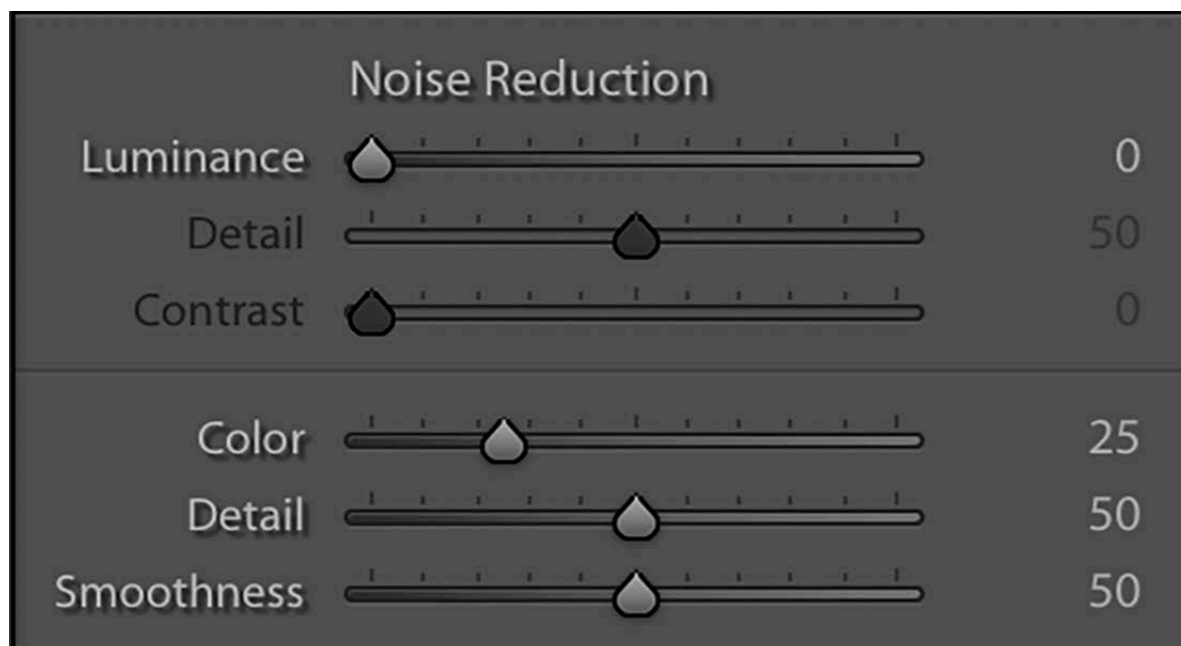
Lens Corrections

Lens distortion problems, such as curvy horizons and edge vignetting (darkening of the corners), can easily be fixed here. This tool is especially useful if you are using a very wide wide-angle lens.

Simply hit profile and then tick the box **Enable Profile Corrections**. Lightroom will search its database of lenses, each with their own particular fixes, and sort the problem. If it picks the wrong lens, simply help it out by selecting the appropriate make and model from the drop-down menus. You can fine-tune the adjustments with the two sliders under 'Amount' ('Distortion' and 'Vignetting').
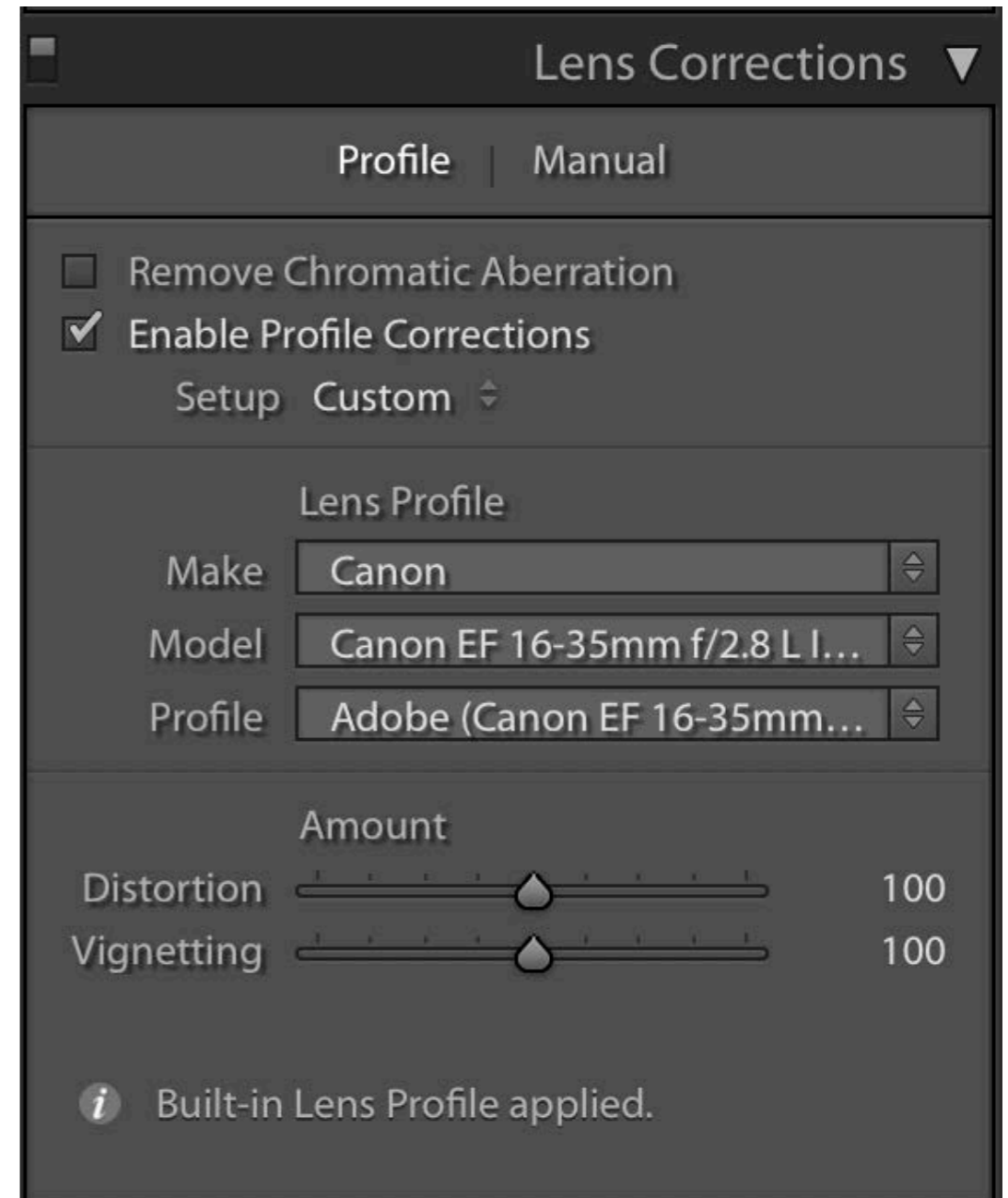
You can remove chromatic aberrations here, too - a fancy phrase for those horrible colour fringes that sometimes appear around the edges of things in an image. These are a lens problem, but are exaggerated by pumping up the contrast or clarity. Simply tick the box **Remove Chromatic Aberration**.

And finally… the Copy and Paste buttons

The **Copy** and **Paste** buttons (at the bottom of the lefthand panel) do exactly what they say on the tin: they allow you to copy all (or some of) the adjustments you've made to one image and paste them onto another image. All you do is this:

- process the first image
- click the 'Copy' button (a new window appears)
- untick the boxes for the settings you don't want to copy
- click 'Copy'
- highlight the image you'd like to apply these settings to
- click the 'Paste' button to apply them to this new image

There is another way of doing the same thing:

- process the first image
- highlight the second image
- hit the 'Previous' button (at the bottom of the righthand panel) to apply the same settings

Incidentally, the 'Reset' button (you'll find it next to the 'Previous' button) simply removes all the changes you've made to the image and resets it back to the original unprocessed image.

And there is a third way:

- process the first image
- highlight the second image
- go 'File' then 'Export with Previous' (more about exporting from Lightroom on the next age)

EXPORTING FROM LIGHTROOM

Your image is perfectly processed and looks wonderful. But it is still a raw file - and not quite finished. Now you need to turn it into a tiff (for a few final adjustments in Photoshop):

- with the image highlighted, go to 'File' then 'Export'
- a new window will appear (shown on the next page)
- select your preferences (I'm about to tell you what to select)
- hit 'Export' (bottom right) and your tiff will appear in the folder of your choice, ready to process in Photoshop.

Here are the preferences to pick for **Export**:

Export Location

'Export To' should say 'Specific folder'. Then pick where you want the newly-made tiffs to go (I make a special folder on the desktop) and find this under 'Choose'. Make sure the two boxes ('Put in Subfolder' and 'Add to this Catalog') are unticked. And leave 'Existing Files' saying 'Ask what to do'.

File Naming

Tick the box next to 'Rename To' and then set it to 'Custom

Name - Original File Number' in the drop-down menu. Then under 'Custom Text' make up a file name. Leave 'Extensions' (tif, jpeg etc) as 'Lowercase'. See what I do in the example on the next page - MCCA-19-3906.tif - which stands for Mark Carwardine (MC), Canada (CA), 2019, followed by the original number of the raw file, for easy reference.

Ignore **Video**.

File Settings

Image Format should be 'TIFF'. Compression should be 'None'. Colour space should be 'sRGB'. Bit Depth should be '16 bits/component'. And leave the 'Save Transparency' box unticked.

Image Sizing

Leave 'Resize to Fit' unchecked. Resolution should be 300 pixels per inch.

Output Sharpening

Leave 'Sharpen For' unchecked.

Metadata

'Include' should say 'All Metadata' from the drop-down menu.

Watermarking

Leave 'Watermark' unchecked.

Post-Processing

'After Export' should say 'Do nothing'.

AN OVERVIEW IN BRIDGE

Suppose I have 1,000 raw files to process from a particular shoot. I work through them methodically, processing the ones I like and exporting them as tiffs as I go - one at a time - until I've been through the whole lot. Only then do I start work in Photoshop. In other words, I don't keep switching between Lightroom and Photoshop.

Once the raws are all done, I have a folder on my desktop of nearly-finished tiffs. The number varies from shoot to shoot, of course, but out of 1,000 raw images I might end up with 50-100 tiffs.

The next thing I do is to open the folder in Bridge (which comes with Photoshop) using the folder tree at the top. Then I can see thumbnails of my selection of all the best images. Inevitably, I will drop a few at this stage - because they are similars or aren't as good as the best of the best. But I will keep most and process them in Photoshop.

I don't use Bridge to do anything, as such. But it's useful for sorting and to see all the tiffs from the shoot. I simply double-click on the first image and it opens in Photoshop.

FINAL PROCESSING OF TIFFS: LEVELS & CURVES

Many photographers do all their processing in Lightroom. As you will have gathered by now, I don't. I process the raws in Lightroom and then tweak the tiffs in Photoshop.

Even though the two programmes are built by the same company - and are designed to work together - the images in one can look different to the same images in the other. Very often, tiffs exported from Lightroom look flat and dull in Photoshop. This can be because the colour spaces are different but, either way, I prefer to finish off in Photoshop.

I do three main things in Photoshop: **Levels** and **Curves** (which add punch to the image - it definitely doesn't look flat and dull afterwards) and removing dust spots.

There are heaps of other cool tools - one of my favourites is the History Brush, for example - but they'd fill another book. You certainly don't need them to do most of your natural history photo processing.
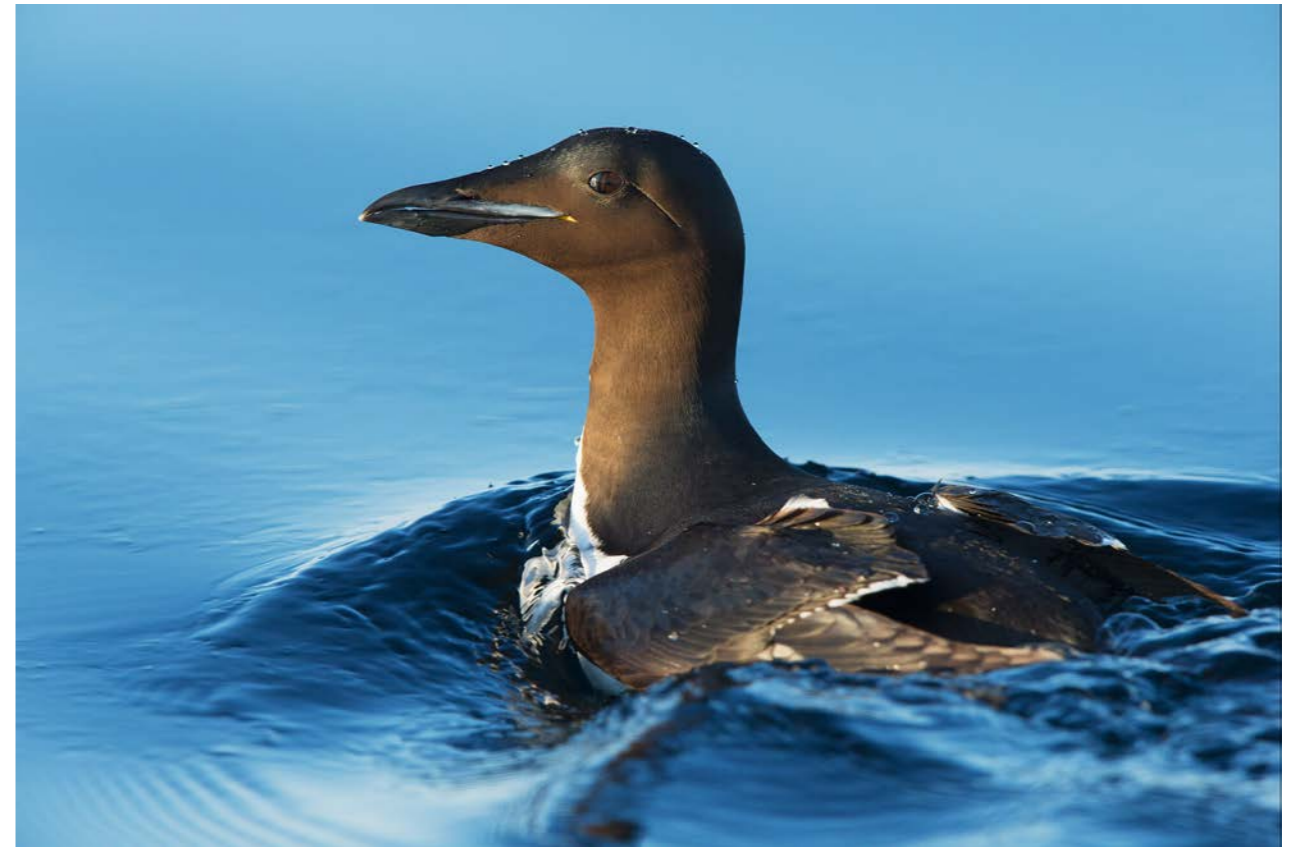
The single biggest problem I see when watching people on my wildlife holidays process their images is that they look flat and lifeless - they lack contrast. But this is easily solved, using Levels and Curves. Get this right and your pictures will look much, much better - they'll have extra punch and far greater impact. Look at the two example below, if you don't believe me. The one on the left is before using Levels and Curves and the one on the right is after.

This final stage in processing effectively adds contrast. But, in doing so, it makes the image appear sharper, makes the colours more vibrant and expands the tonal range. The Contrast slider in the most recent version of Lightroom can do this, in theory, but I find I get much better results using Levels and Curves in Photoshop.

Levels

Open your image in Photoshop and go Image - Adjustments - Levels (or hit Command L). You'll see a histogram (as shown on the next page).

There are three arrows or triangles at the bottom - one on each end and one in the middle. If the histogram (ie the white, 'mountainous' part) doesn't reach the edges, all you have to do is to hold the end triangles with your cursor - one at a time - and drag them in towards the middle until they touch the 'mountainous' part. In this particular histogram, it doesn't touch the righthand side, so I simply drag the righthand triangle towards the middle until it does (as shown). Do not touch the middle triangle. Then click OK. And that's it.
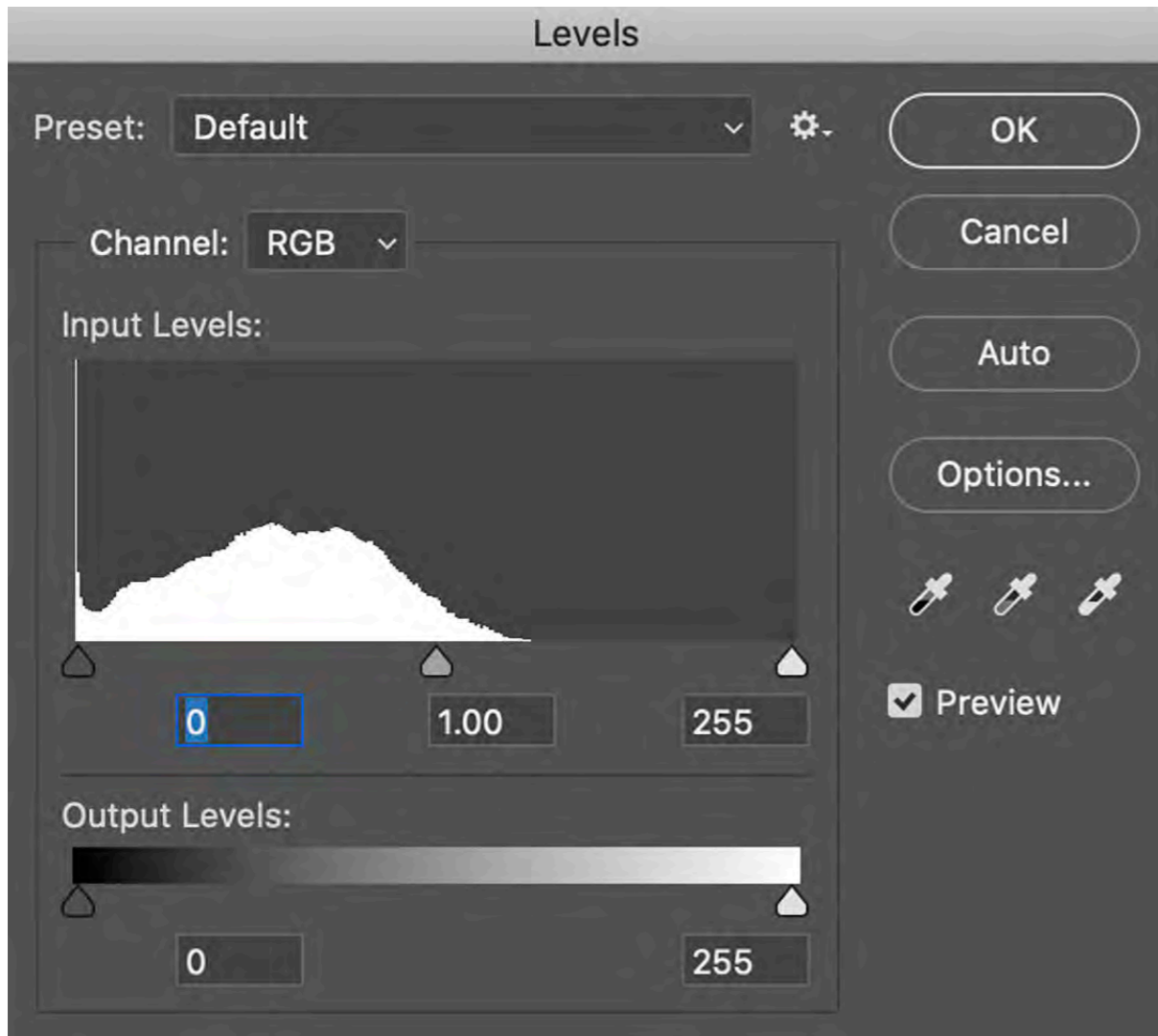
By adjusting Levels, you are expanding the tonal range of your image - ie the range of brightness levels or tones between the lightest and darkest parts. You increase the whites as far as you can (without clipping the highlights) and increase the blacks as far as you can (without clipping the deepest shadows too much (a little clipping of the blacks doesn't usually matter). Effectively, you are increasing the contrast in the darker areas (using the left, correspondingly dark triangle) and increasing the contrast in the highlights (using the right, correspondingly light triangle). If you move either triangle too far, into the 'mountainous' area, you will clip the image (and lose detail in the darkest shadows or brightest highlights, depending on where you went too far).

Curves

Open your image in Photoshop and go Image - Adjustments - Curves (or hit Command M). You'll see a faint histogram on a grid, with a straight diagonal line cutting through the middle:
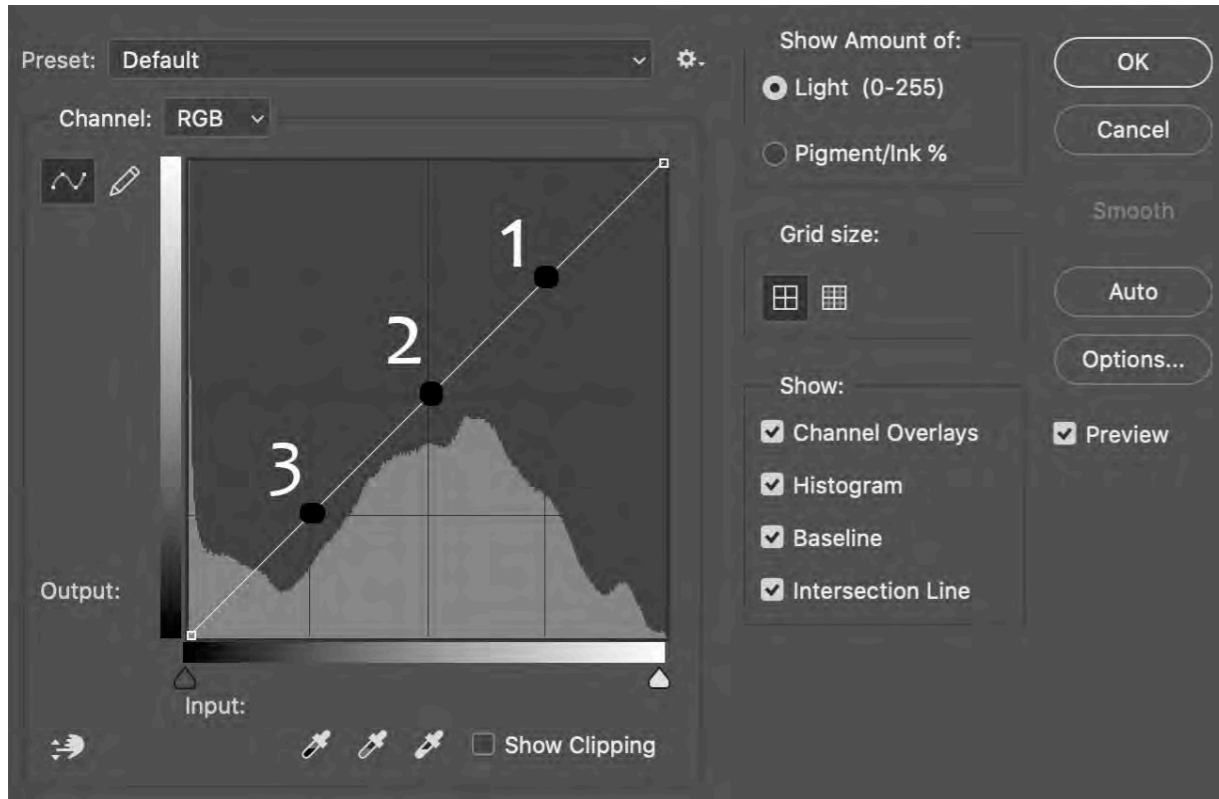
What you have to do is to turn the straight line into a gentle S-shaped curve. The steeper the curve, the stronger the contrast (the greater the punch). You'll see the diagonal line goes through three points where the background squares meet (I've marked these in the illustration above with three black dots). To make the image more contrasty, you touch the line with your cursor - first at point 1 - and drag it upwards into a curve (this does the highlights). Then you touch the line with your cursor again - at point 3 - and drag it downwards into a curve (this does the darks and shadows). Don't touch the middle dot

(point 2). You have to watch what happens to the image as you change the shape of the curve and judge, by eye, how far to push it upwards or downwards. Once you've finished, it will look something like this (and your image will be transformed):
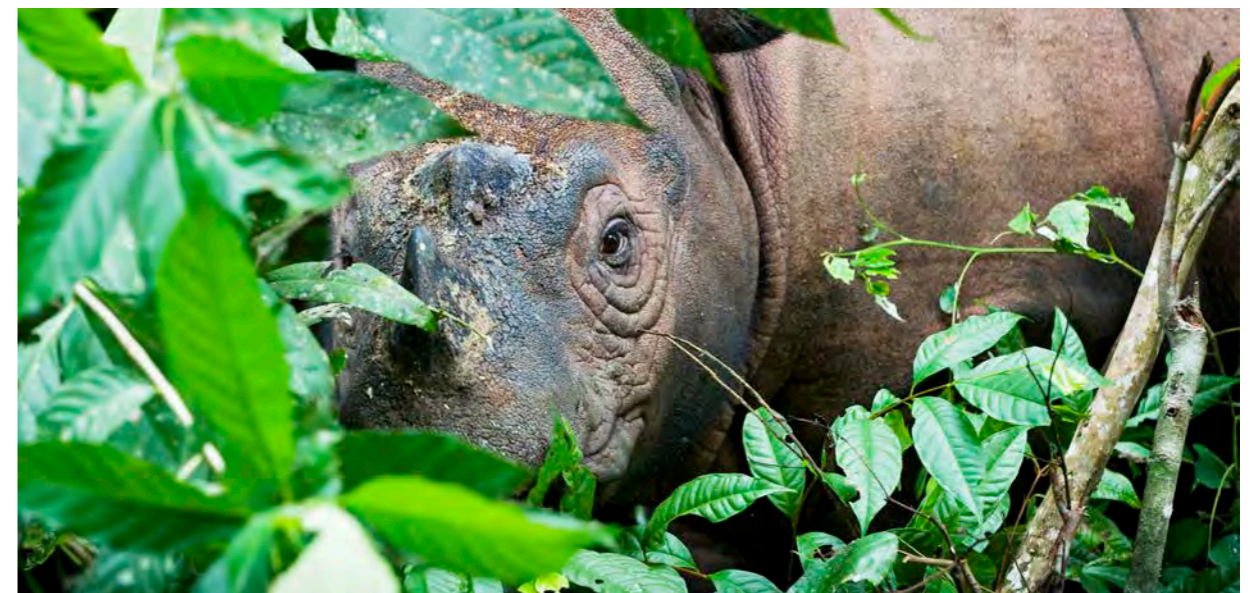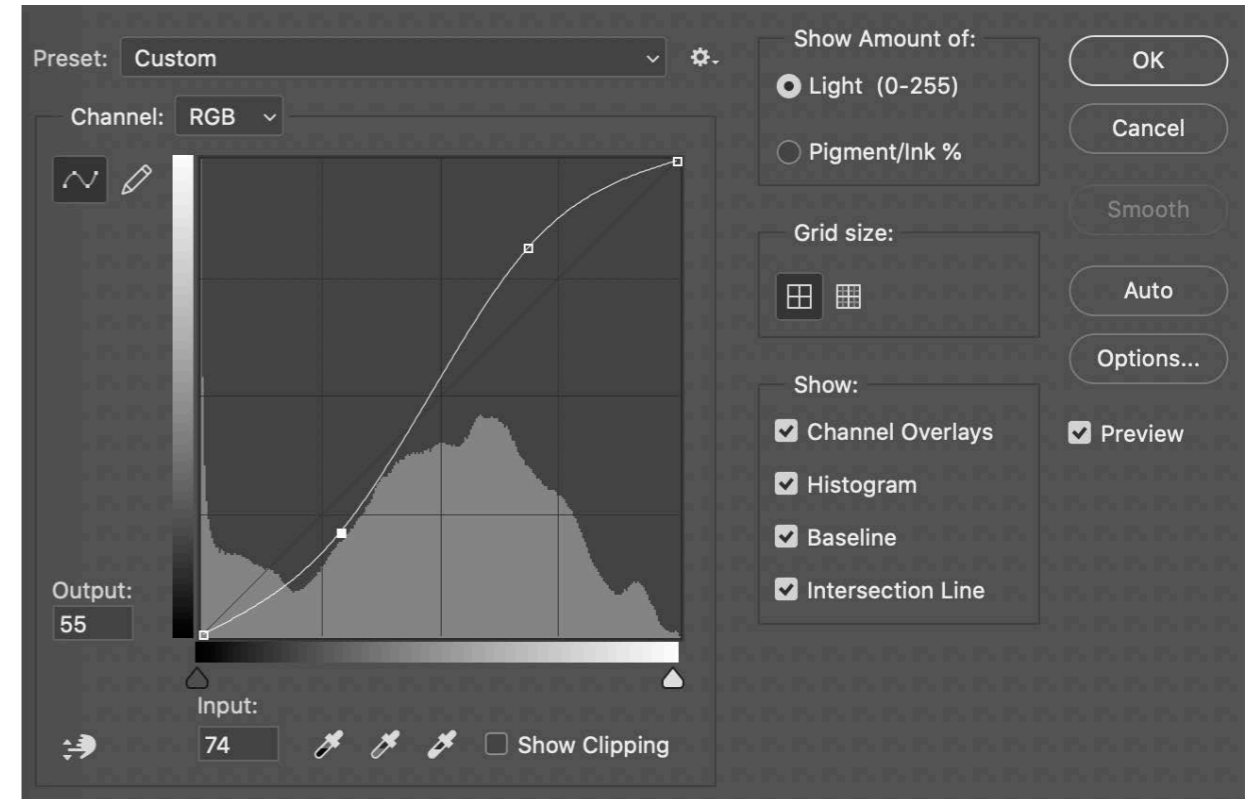
REMOVING DUST SPOTS

The bane of a digital wildlife photographer's life is dust spots on the sensor - which appear as ghastly blobs on every image. It's possible to clean them off, but it's both scary (in case you accidentally cause damage to the sensor) and time-consuming.

It's far better not to get dirt on the sensor in the first place:

- always turn your camera off when changing lens (or it'll suck in dust from miles around)
- change lens quickly and somewhere sensible (I had serious palpitations once while watching a photographer on a beach take the lens off his camera and then put the camera down on the sand while he rummaged around in his bag for another lens - and, not only that, it was windy)
- change lenses as little as possible (one reason I've taken out a second mortgage to buy three camera bodies is that each has it's own lens - and rarely do I change them)

Removing a few dust spots is easy (though if your sensor is so dirty it looks as if you've been building sand castles on it, it's almost impossible). In Photoshop, I use three main tools for the job: the Spot Healing Brush, the Patch Tool and the Clone Stamp.
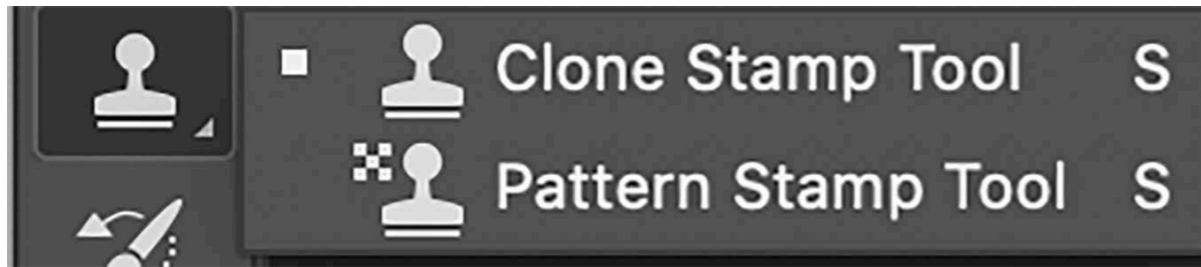
Clone Stamp Tool

Hit the Clone Stamp Tool icon and your cursor turns into a circle. You can make the circle larger or smaller by hitting the square brackets on your keyboard (it should be just big enough to cover the dust spot). Hold down the Option button (Alt on a PC) and the circle turns into a target. Keep holding down the Option button and move the target to a suitable point on the image - then click the mouse. You've just taken a sample from that part of the image that you can then paste over the dust spot. To do that, take your finger off the Option button - the circle reappears - and then move the circle over the dust spot and click the mouse again. The dust spot will magically disappear and, if you picked the right source, you won't be able to see the join.

Spot Healing Brush

This is the tool I prefer to use when removing dust spots. Hit the Spot Healing Brush icon and a circle appears. You can make the circle larger or smaller by hitting the square brackets on your keyboard (it should be just big enough to cover the dust spot). You simply paint out the dust spot (move the circle over the spot and click the mouse again - or hold the mouse and paint). With a little painting, the spot will disappear (the gap will be filled with an interpretation of the surroundings).

Patch Tool

Make sure 'Source' is live (rather than 'Destination') by hitting it in the toolbar at the top. Then hit the Patch Tool and a little patch appears next to the cursor. Draw a line around the dust spot (to make a 'patch'). Then, with the cursor over the patch, click on the mouse and drag it to another part of the image that looks similar and let go. You may need to do it several times to get a perfect blend.

CAPTIONING AND KEYWORDING

Captioning and keywording are by no means essential. But they can be useful. Captioning is a handy way to record exactly what each image shows (in a year or two's time you may forget which sub-species or species it is, exactly where it was taken, and any other salient information). It's also critical if you are going to sell any of your pictures for publication, or put them into a photo library.

If your collection grows beyond the capabilities of human memory (mine certainly has), keywording is a good way of finding specific images among thousands or even millions. If you are likely to be searching regularly for pictures of humpback whales in the Caribbean, for example, or jaguars in the Pantanal - and you've been to the Caribbean and the Pantanal multiple times - then keywording could be useful to you. You just do a search for the relevant keywords. It can also be useful when uploading to a website database (ensuring that your images appear in the correct categories).

I do my captioning and keywording in Bridge, because it's easy. You can do it one-by-one or in batches. Just highlight all

the images to be captioned and tagged with keywords (ie the ones that need the same caption and keywords). Don't open them in Photoshop - just highlight the thumbnails. Then go to 'File' - 'File Info' - and a form (shown above) will appear. Fill in 'Description' and 'Keywords' and click 'OK'. You can insert as much or as little information as you like.

STORING YOUR PICTURES

I store my finished images as 8-bit tiffs (and sRGB - as set when exporting them from Lightroom). Then I prepare jpegs of different sizes whenever I use them (eg for publication, to send to a friend, or for a lecture).
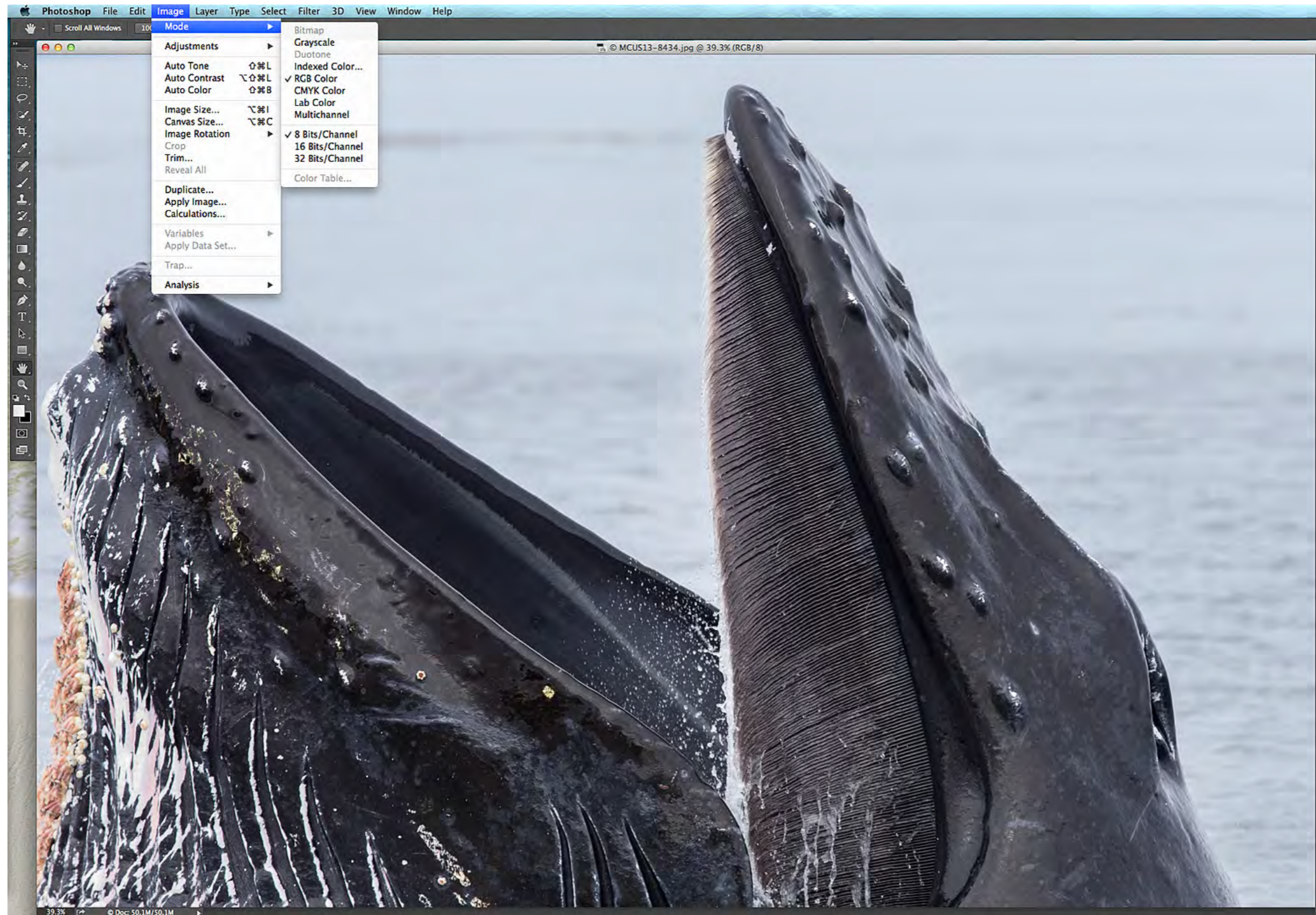
BACKING UP

Several years ago, in the Pantanal, I took a series of fabulous pictures of a jaguar pouncing onto a capybara. I downloaded them onto my laptop and re-formatted the card. Then someone sat on my laptop. The pictures were irretrievable - lost forever.

It was a valuable lesson. Accidents happen, cards corrupt, hard drives get lost. So now I back everything up twice. In the field, that means once on the laptop and once on a separate hard drive. And only then do I re-format the SD or CF card. At home, it means identical back-ups on two separate hard drives (kept in two different places). I may be paranoid - but I'm determined not to lose any prize-winning pictures again.

So we'll finish with three golden rules: back-up, back-up, and back-up. And that's it.

For more wildlife photography tips and tricks - and for some fabulous wildlife photography holidays and workshops - please visit:

www.markcarwardine.com

MARK CARWARDINE

Zoologist Mark Carwardine is a widely published wildlife photographer, an award-winning writer, a TV and radio presenter, a best-selling author, a wildlife tour operator and leader, a BBC Wildlife magazine columnist and an outspoken conservationist.

He was Chair of the Judging Panel of the prestigious 'Wildlife Photographer of the Year' competition for seven years (2005-2011). He was selected one of 'The World's 40 Most Influential Nature Photographers' in Outdoor Photography magazine and was one of 58 European nature photographers chosen to contribute to 'Wild Wonders of Europe'. He also wrote the monthly four-page 'Photo Masterclass' in BBC Wildlife magazine, which ran for two years. His own extensive collection of wildlife images are sold through Getty, Minden Pictures and Nature Picture Library.