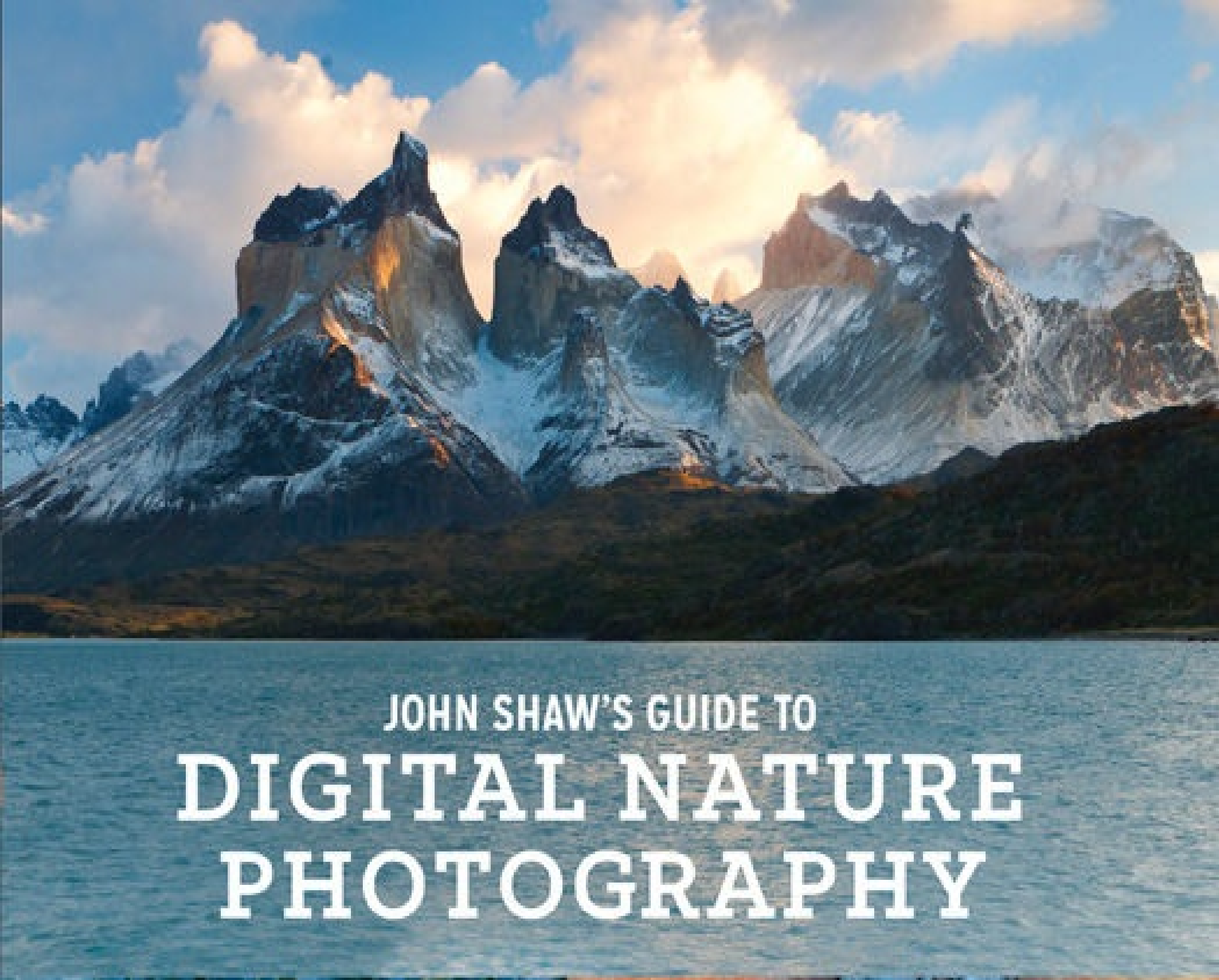
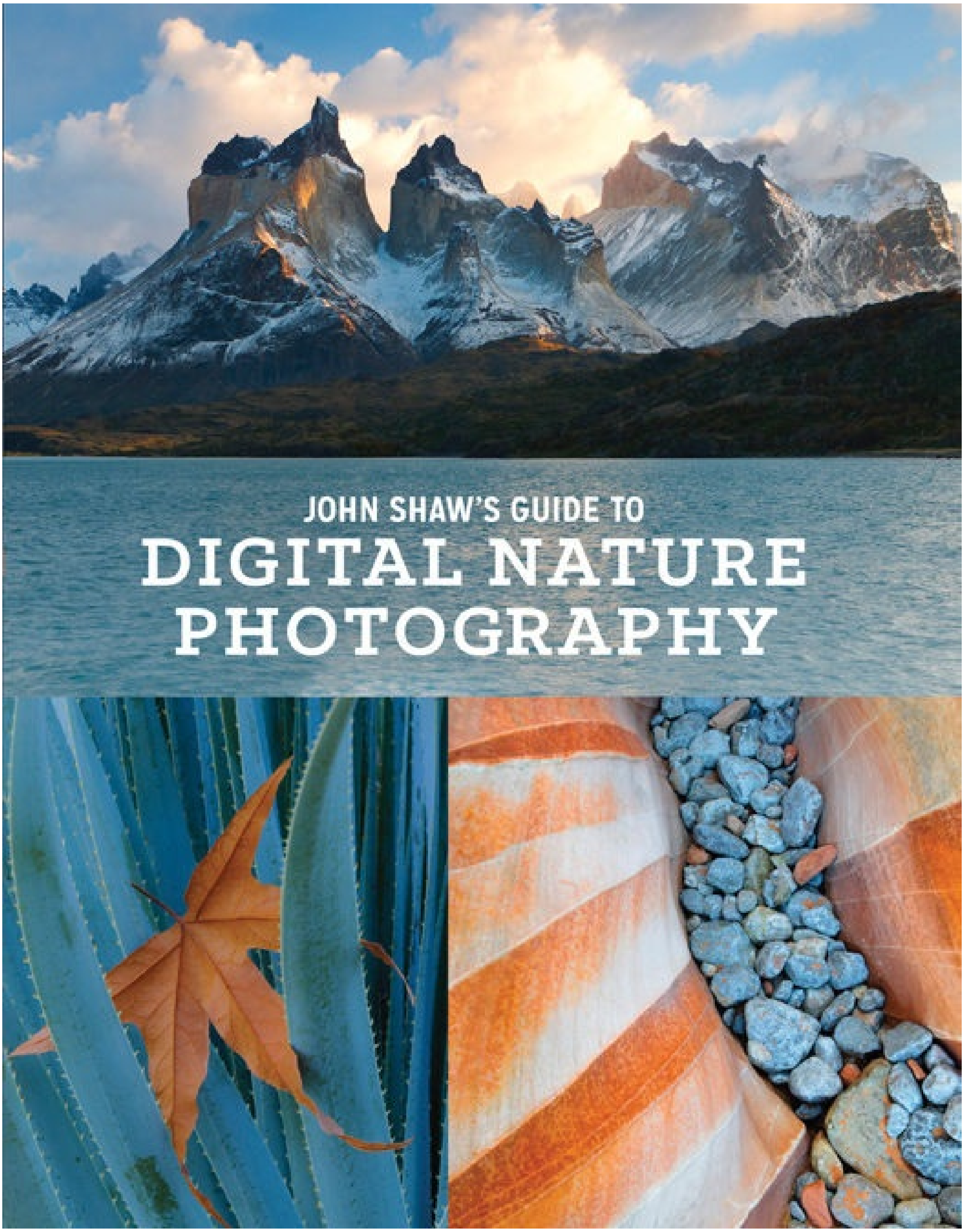


JOHN SHAW'S GUIDE TO

DIGITAL NATURE PHOTOGRAPHY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AMPHOTO BOOKS
Berkeley

Published in the United States by Amphoto Books, an imprint of the Crown Publishing Group, a division of Random House LLC, a Penguin Random House Company, New York.
www.crownpublishing.com
www.amphotobooks.com

Chapter 6 is based on Chapter 6 in *John Shaw's Nature Photography Field Guide*.

Library of Congress Cataloging-in-Publication Data
Shaw, John, 1944–
John Shaw's guide to digital nature photography / John Shaw.
pages cm
Includes index.
1. Nature photography. 2. Photography—DigitaI techniques. I. Title. II.
Title: Guide to digital nature photognaphy.
TR721.S5155 2014
778.9′3—dc23
2014009916

Trade Paperback ISBN: 978-0-77043-498-4
eBook ISBN: 978-0-7704-3499-1

Design by Margaux Keres
Composition by Happenstance Type-O-Rama

Captions for preliminary and chapter opener images:

This page: Lenticular cloud at sunset over the Alabama Hills, California. Nikon D3x, Nikon 24-70mm lens, 1 second, *f*/11, ISO 100

This page: Narrow-leaved cottonwoods in autumn, Montana. Nikon D800E, Nikon 24-70mm lens, 1/30 sec., *f*/14, ISO 100

This page: Sunset over the Salar de Uyuni salt flats, Bolivia. Nikon D800E, Nikon 24-120mm lens, 1/4 sec., *f*/16, ISO 200

This page: Autumn sugar maple, Michigan. Nikon D2x, Nikon 12-24mm lens, 1/10 sec., *f*/14, ISO 100

This page: Marble Cathedral, Lago General Carrera, Chile. Nikon D2x, Nikon 12-24mm lens, 1/30 sec., *f*/5, ISO 200

This page: Rocks and sandstone layers, Valley of Fire State Park, Nevada. Nikon D3x, Nikon 24mm T/S lens, 0.6 sec., *f*/22, ISO 100

This page: Crepuscular rays frame a tree with vultures, Masai Mara, Kenya. Nikon D2x, Nikon 70-200mm lens, 1/640 sec., *f*/8, ISO 140

This page: Sea star and barnacled rock, Oregon. Nikon D2x, Nikon 28-70mm lens, 1/3 sec., *f*/16, ISO 100

This page: Contorted tree on the shore of Lake Kussharo, Kokkaido, Japan. Nikon D3x, Nikon 200-400mm lens, 1/750 sec., *f*/6.7, ISO 100 v3.1

The *act* of photography
is the capture
of optimal data.

The *art* of photography
is the capture
of optimal vision.

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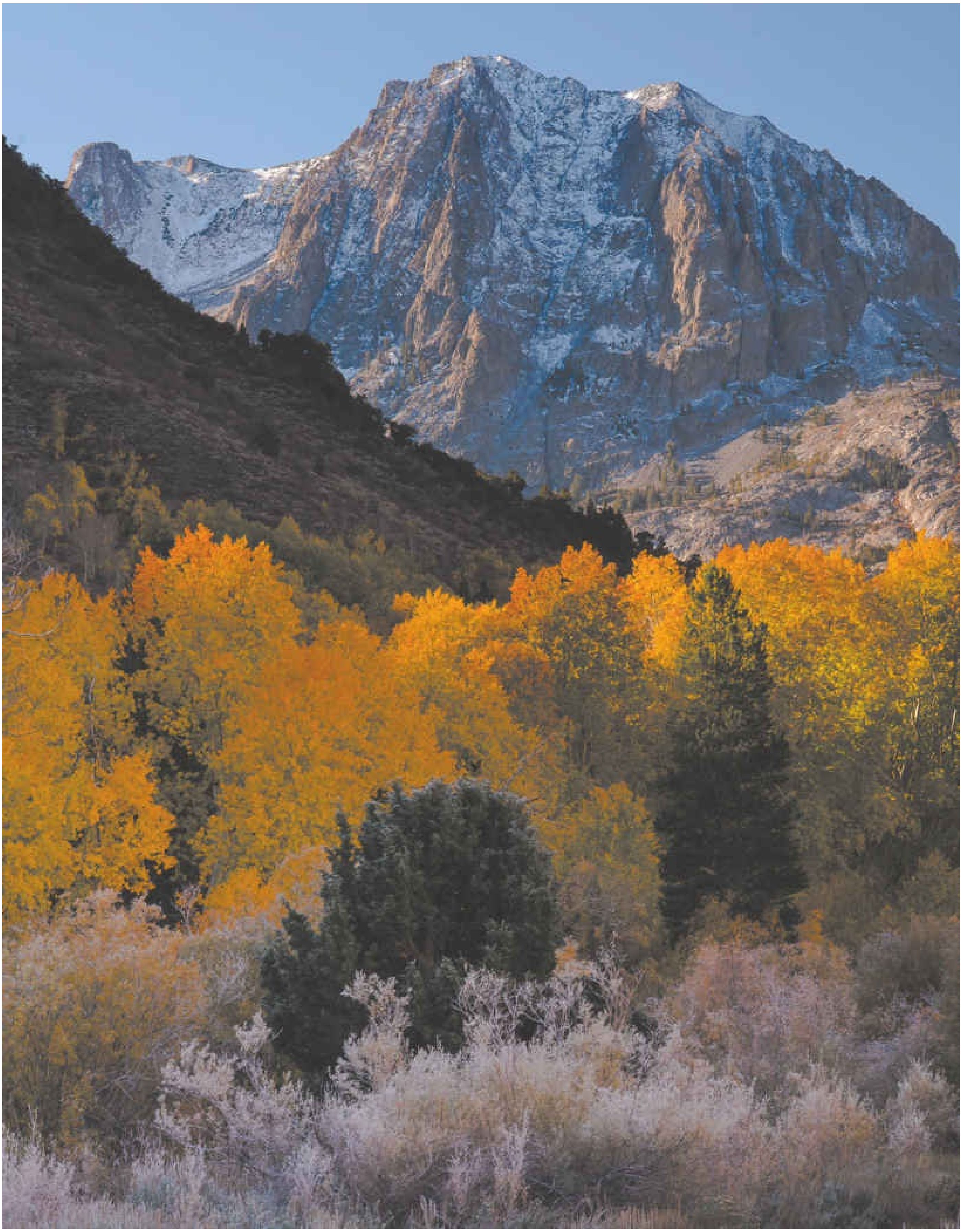


Autumn quaking aspens on a frosty morning, near June Lake, California. Nikon D2x, Nikon 28–70mm lens, 1/2 sec., *f*/16, ISO 100

Preface

I am thrilled with the digital revolution. In 1984, more than thirty years ago, Amphoto Books published my first book, *The Nature Photographer's Complete Guide to Professional Field Techniques*. At that time, Kodachrome was the film of choice. In 2001, *John Shaw's Nature Photography Field Guide* came out. The big news then was the advent of autofocus, autoexposure, and TTL (through-the-lens) flash. Most nature photographers had switched from Kodak to Fuji films. Well, things photographic have continued to change. For most photographers today, Kodak and Fuji are just historic names. Digital capture and processing is the norm: witness the fact that most young photographers have never shot a roll of film or waited days for prints to come back from a lab. Cameras now have menu choices, and "publishing" most often means uploading an image to the Web.

For me, it has been an exciting journey. I am fascinated by the digital process and amazed at what it allows me to do. When I last shot with a film camera, my "high speed" film was ISO 200; my current camera goes to ISO 204,800. With my camera, I can wirelessly control multiple flash units, customize how buttons and dials work, and view a live image direct from the sensor. Instead of waiting for film to be processed, thanks to computers and software I can have a finished image shortly after pressing the shutter button.

The process of nature photography is always changing, always evolving—new products and new techniques come along all the time. I encourage you to develop your own way of working, your own equipment choices, and, most of all, your own vision. The book you are now holding is not in any way intended as a final word on how to take pictures. Rather, it is a summation of my thoughts about camera equipment and a description of some of the methods I currently use. I hope you will consider this work a starting point for your own explorations with a camera.

As you read this book, you will notice that I frequently refer to Nikon equipment. I don't in any way mean to imply that you should buy only Nikon products, although I've been pleased with the system. I have worked with Nikon equipment all of my professional career, and I have photographed my own equipment when needed for illustration; however, quality nature photos can be taken with any currently produced photographic system. You'll also notice that I often recommend certain equipment or suppliers; I am not sponsored by any manufacturers, nor do I get subsidies or kickbacks for my recommendations.

In all of my books, I have included a statement that I will repeat here. It's as true today as it was thirty years ago:

To be a better nature photographer, be a better naturalist. The more you know about nature, the more you will see to photograph. Develop a deeper compassion for the world around us, and live by an ethic of concern for the subject matter.

What Is There to Photograph?

Each year, I travel the globe to take pictures, often leading photo tours or workshops. The people in these groups are specifically interested in photographing the natural world, yet it's on these trips that I inevitably hear the question "What is there to photograph?"

Truly this is the wrong question to ask; it leads photographers to take pictures that are empty of emotional content. Without passionate involvement, our pictures are nothing more than records. The question we should be asking is "What is there to discover?" Only after we have let our minds and eyes deal intimately with the abundance of natural marvels around us should we attempt to photograph them.

Photography should be both a process of discovery and a procedure for recording that discovery. In the process of photography, we order the chaos around us by making decisions. We decide to emphasize one aspect of the world—what we have discovered—and ignore all others. We want to represent that subject in a way that conveys how it has emotionally involved us. To do this, we must make conscious decisions about what to include within the photographic frame and how to organize the content. At this point, the procedure of photography enters. Now we must make technical choices involving the mechanics of photography: lenses, light, and exposure.

Polar bear with cub on pack ice, Spitsbergen, Norway. While I've traveled to Spitsbergen quite a few times to work polar bears, this is my favorite photo from all my trips. Nikon D4, Nikon 500mm lens, 1.4X teleconverter, 1/1600 sec., *f*/10, ISO 800

The photographic process should be deliberate and studied. Structuring our visual environment is the role of composition, but that structure doesn't just appear from nowhere. Nor is the procedure of choosing lenses and setting exposure values automatic. We must become adept in dealing with both the aesthetics and the mechanics of photography; otherwise, our results will be failures.

Photography’s dual nature has always fascinated me. In a good photograph, both aspects work in tandem, neither overwhelming the other. Form and content go hand in hand to produce a synthesis, an interesting work that engages both the viewer’s mind and emotions. To achieve this synthesis, you, the photographer, must play two simultaneous roles as well. On one hand, you must be a poet and an artist, opening yourself to the intuitive and mystical world of your inner vision. On the other hand, you must be a technician, rationally dealing with shutter speeds, *f*-stops, and focal lengths. Vision without craftsmanship is as much a failure as craftsmanship without vision. We’ve all seen photos that are intensely personal and emotional yet lack any technical competence. We dismiss these as lacking organization and think the creator cannot control the medium. We’ve all also seen photos that are technically superb but have no soul. These are aesthetically insipid, dull, and uninspiring works.

Most people have more difficulty with the technical aspect. We all see images in our mind’s eye … but how to record these? We take an interesting trip, but the resulting pictures seem to have little relationship with our experiences. Why? I’m convinced that the main factor is that most of us are only occasional photographers; consequently, we’re always starting over in the learning process. A solution many people adopt is to buy a fancy camera and then set it in autofocus/autoexposure/auto-everything mode so that they don’t have to think about what the camera is doing. However, this means that they have abdicated their photographic responsibilities; they have become camera carriers, not photographers. They are allowing a machine to make decisions for them, without learning how to control the machine.

I’m always amazed by people who say that cameras are too complex for them to learn to operate. I’ve seen people who otherwise are extremely competent become helpless when dealing with *f*-stop numbers or using a tripod. Yet these same people are doctors, lawyers, teachers, and computer programmers—people who make complex decisions every day. A camera is only a machine and no more a technical mystery than any other machine. If you can drive a car, ride a bicycle, or use a cell phone, you can operate a camera (and not just the one in your smartphone!).

Mastering the technical nature of photography frees you to concentrate on the aesthetic side; that’s why I emphasize technique so much. If you’re fumbling around with lenses and tripods, your inner vision will soon evaporate. You want to reach the point where technical mastery is second nature, where you can concentrate on the image instead of having to focus on the procedure. Control of both sides of photography, the technical and the aesthetic, is needed so that you can produce the best images possible.

Atlantic puffin and flowers, Iceland. Nikon D4, Nikon 500mm lens, fill flash, 1/500 sec., *f*/10, ISO 800

Chapter 1

GEAR

Regent bowerbird, Lamington National Park, Australia. Nikon D2x, Nikon 200–400mm lens, fill flash, 1/250 sec., *f*/5.6, ISO 200

Which Camera?

Short answer: the one you have with you. Long answer: it all depends.

This book isn't about point-and-shoot cameras or smartphone cameras. It's about digital single-lens-reflex (DSLR) photography. DSLR cameras are about the most versatile cameras on the market, as, given the right lenses, you can use them to photograph everything from mountains to mosquitoes.

BEFORE YOU BUY

Before I discuss any specific camera options, let me ask you some questions. Answer these as honestly and fully as possible.

- What do you want to photograph? *Everything … I want to photograph all subjects* is too vague an answer. Be more specific as to subject matter: landscapes, wildlife, portraits, street photography, etc.
- Where are you going to be doing this photography? Close to your car? On extended backpacking trips? On international travels that involve one or more flights? Always close to cities and support options or in remote regions of the world with no resupply? Is someone always available to help you carry the gear?
- Do you already own a Nikon, Canon, Sony, or some other brand camera?
- Do you already own some lenses? Which focal lengths do you need that you don't already have? (Notice that I said *need*, not *want*. There's a big difference.)
- If you plan on getting a new or different camera and/or lenses, what's your time frame?
- What does your current camera *not* do that a different one would?
- In what manner would a different camera make your photographs better?
- What's your budget, including any lenses you might need?
- What do you plan on doing with your photographs? Adding galleries to your website? Posting on Facebook or other social media sites? Making prints (and specifically, at what dimensions)? Publishing in books and magazines? Shooting for stock agency uses?

Fishing nets on dock, Oregon. Nikon D2x, Nikon 28–70mm lens, 1/60 sec., *f*/16, ISO 100

SOME POINTS TO CONSIDER ABOUT WEB AND PRINT

Most photographers make very few prints. (I would hazard a guess that you print less than 5 percent of the images you take—and probably less than 2 percent.) Even fewer photographers make any substantial income from selling prints. Name all of the nature photographers who make the majority of their income from print sales. I can come up with only a handful of names.

Very few photographers publish in books (discounting self-publishing places such as Blurb) or magazines. Publishing houses are downsizing and consolidating or disappearing altogether. Print outlets for nature photographers are now very limited in number. Twenty years ago, getting published in a magazine or a book was the goal of almost everyone with a camera, but now this is rarely a point of discussion.

The major use of images is on the Web. By far, that's where the vast majority of photographs are "published" today—and where the vast majority of images are seen. Just in passing, horizontal (landscape format) images are generally viewed "larger" on the Web since monitors echo that shape. Vertical shots take up a lot less real estate when viewed on-screen.

A "large" image on the Web might be 1200 pixels on the long dimension. The majority of photos on Flickr are 1024 pixels long dimension. 500px currently wants uploads at 900 pixels maximum long dimension. Consider this: a 6-megapixel camera from ten years ago had a file of roughly 3000 pixels long dimension.

Images on the Web are sRGB JPEGs. In other words, even if you have shot RAW and worked in ProPhoto RGB, what you're looking at on the Web is a compressed "lossy" file in a much smaller color space.

You will want to use good equipment, and almost all current equipment on the market today will be just that. There aren't any really terrible cameras or lenses, although obviously some are better than others. Owning good equipment means you cannot fall back on the old self-indulgent ploy of saying, *Oh, if only I had a good camera.* Purchase good equipment, treat it well, and learn to use that equipment in the best possible manner. Proper photographic technique is by far the most important factor in producing good images. The very best equipment, the top-of-the-line camera bodies and lenses, can produce photos no better than the photographer handling them. Garbage in, garbage out.

Female brown bear with cubs, Lake Clark National Park and Preserve, Alaska. Nikon D4, Nikon 200–400mm lens, 1/1000 sec., *f*/8, ISO 800

Cheetah yawning, Maasai Mara National Reserve, Kenya. Nikon D300s, Nikon 500mm lens, 1/400 sec., *f*/6.3, ISO 800

Don’t get me wrong. Equipment is definitely important. At times equipment is indeed the most important factor in getting the image, if getting the best-quality image is what you’re after. If you want to photograph grizzly bears at dawn, and you want good results, you’ll have to use a fast, long lens and a serious tripod. Trying to photograph by handholding a 70–300mm *f*5.6 lens combined with a 2X teleconverter is simply not going to produce decent results. Or, if you need an 85mm F1.4 for very-shallow-depth-of-field portraits, then the only answer is to get that lens. A shot taken with an F4 zoom lens set at 85mm is not going to look the same. Remember, I asked you specifically *what* you want to photograph.

Be careful in justifying that new equipment. Almost every photographer I know—and I count myself in this group—has a serious case of *GAS*: Gear Acquisition Syndrome. We firmly believe that if only we were to purchase another lens or a new camera body or a different tripod and head or even a new computer to process our images, our pictures would be better. Without even trying, we can justify almost any piece of equipment this way.

We also tend to be pixel peepers. We examine our images at “100 percent view” on our monitors, where one screen pixel equals one image pixel, and obsess over every little flaw. Do you view prints this way, with a powerful loupe? Consider this: The Nikon D800 offers a file that is 7360 pixels wide. Almost all monitors are roughly 100 ppi, so at 100 percent view a D800 file is equivalent to a print that’s about 73 inches long. How many prints that size do you make? And how close to such a print would you stand to look at it?

I firmly believe that just by looking at an image on the Web, it is impossible to tell what brand of camera was used. Along the same lines, I’ve even heard people argue, while they were viewing an image, whether a Mac or a PC was used for processing the shot. Folks, let's get a grip.

Again, don't get me wrong. I do think that good-quality cameras and lenses are very important. It's just that we obsess a little too much about equipment and not enough about the images we take with that equipment.

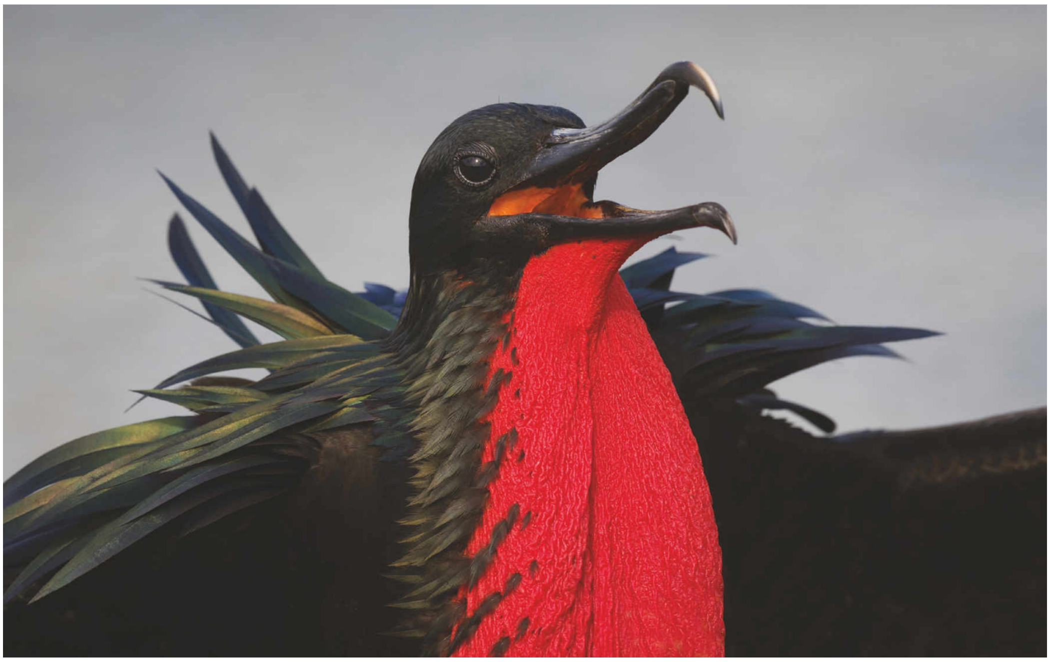
CAMERA SYSTEM OPTIONS

Having said all that, what sort of camera should you consider?

First of all, you want a camera *system*. Let me define "system" as a brand offering a choice of camera bodies, both in features and in price, and a complete system of lenses, everything from a fish-eye wide-angle to an extreme telephoto. Today this means choosing Nikon or Canon, with Sony slightly behind. Let's start with lenses.

Suppose you want a 24mm lens. Here are the possibilities from Nikon (and Canon's choices are fairly similar):

- 24mm F2.8
- 24mm F1.4
- 24mm F3.5 Tilt/Shift
- 14–24mm F2.8
- 16–35mm F4
- 17–35mm F2.8
- 18–35mm F3.5–4.5
- 24–70mm F2.8
- 24–85mm F3.5–4.5
- 24−120mm F4



Great frigatebird, Genovesa Island, Galapagos. Nikon D4, Nikon 500mm lens, 1/640 sec., *f*/10, ISO 1000

Lenticular clouds at dawn, Los Glaciares National Park, Argentina. Nikon D3, Nikon 24−70mm lens, 1/20 sec., *f*/14, ISO 200

And these are just the choices for the so-called full frame cameras. How about fast long lenses? Canon and Nikon both offer:

- 300mm F2.8
- 400mm F2.8
- 500mm F4
- 600mm F4
- 800mm F5.6

Are these choices important to you? It all depends on what you want to photograph. As to camera bodies, here's a list of what I think is essential:

- Full control of exposure settings, with a choice of exposure modes: manual, Aperture Priority, Shutter Priority, and Programmed
- Easily selectable metering patterns, including matrix (evaluative) and spot metering
- A complete range of user-selectable shutter speeds, 1/4000 sec. to 30 seconds, plus a Bulb setting
- Depth of field preview
- An electronic release (*cable release* for us old-timers). If it's a wireless remote, it must be able to be used from either the front or the rear of the camera, and it should preferably include some means of keeping that remote from being lost.
- Mirror lock-up ability

- A large LCD, with easily readable histograms (not only the composite histogram but also the individual R, G, and B channels)
- A self-cleaning sensor
- A sophisticated TTL (through-the-lens) flash system, with wireless control of off-camera flashes
- High-speed sync provision to use flash above the camera's standard sync speed. This can be an in-camera setting or a setting on the flash units.
- Diopter correction on the viewfinder
- Live view
- A My Menu feature where you can gather the menu items you tend to change
- A rear Autofocus On button or a button programmable as such
- Ergonomically friendly design (and you'll have to hold the camera to determine this for yourself)
- Low noise at high ISO settings (anything above 1600). If you never use higher ISOs, and think you never will, then this is a moot point. If you sometimes use high ISOs, this is well worth investigating. If you use high ISOs routinely, you need to do quite a bit of research and testing. But you will have to determine just what "low noise" actually means to you. How much noise is acceptable? If you're thinking of purchasing a new camera, it might behoove you to take a flash card to the camera store and make test shots at the higher ISO settings.

Some features that would be very desirable:

- An analog exposure display in the viewfinder
- A virtual horizon display in the viewfinder (indicating when the camera is level)
- Autobracketing by at least 3 stops (or more), at user-selectable intervals (third-stops, half-stops, whole-stops)
- A flash sync speed of no slower than 1⁄250 sec.
- A programmable function button
- In-camera multiple-exposure compositing
- An in-camera timer release, with user-selectable intervals (and with mirror-up at the start of the time)

Notice that I haven't mentioned megapixel count. Depending on what you want to do with your images, any camera of at least 12 megapixels will be sufficient. For the Web, that's more than enough. In terms of prints, a 12-megapixel camera will let you make a print at 12 × 18 inches with almost no upsizing of the file, if you print at 240 dpi. In my opinion, 240 dpi is about where people can no longer distinguish the "dots" from an inkjet printer, and a 12 × 18-inch print would fit nicely on 13 × 19-inch paper. You could, of course, upsize the file if you really had to print larger. Given an image that is free of noise and defects, a digital file can generally be upsized to twice the original file size before problems become easily seen at normal viewing distances. Another option would be to print on canvas, as the canvas texture hides any defects, and consequently, you can scale print size up a lot.

Of course, if you need more megapixels, you need more megapixels. Once again, define what you need, but be honest in that definition. The number-one reason I hear as to why more megapixels are necessary is “to make big prints,” but really, how often do you actually do that? You will probably end up with more megapixels when you buy a new camera, but I would be careful in using the megapixel count as the sole, or even main, criteria for purchasing one. In my opinion, other factors—lower noise, more accurate and faster autofocus, larger buffer, ease of use, weather sealing—would come before megapixels. As I said, given how quickly cameras change, a newer camera with those factors would most likely have more megapixels anyway.

Note that I didn’t list dynamic range. Back when I shot film—remember that stuff?—my standard film was Fuji Velvia 50. It had a dynamic range of about 4½ stops. You had to nail the exposure, or else dark areas blocked up or highlights burned out. Every current camera is way past this point; at base ISO, most are in the 10-stop range or more.

What about “crop” cameras versus “full-frame” cameras? Boy, do I hate those terms. Name one camera that is not “full frame.” If a camera isn’t producing a full frame, then something is obstructing the light coming to the sensor, such as a shutter blade not working. What *crop* and *full frame* actually refer to are just different formats, different-size sensors. *Full frame* signifies a sensor 24 × 36mm (the size of a 35mm frame of film) or extremely close to these dimensions. *Crop* simply means that the sensor size is smaller (how much smaller depends on the brand of camera); the smaller sensor “sees” part of what would be on the larger sensor. *Crop factor* might be a much better term for these cameras.

However, different format sizes do affect the resulting images, and which lenses are used to take those images. It’s often stated that crop-factor cameras yield more magnification. Sorry, not true. Focal length is focal length; nothing has changed. Crop-factor cameras just have a cropped field of view, compared to a full-frame image taken from the same spot. With today’s cameras, it would be hard to tell if an image were shot with a full-frame or a crop-factor camera.

What about video? I haven’t mentioned it anywhere. Well, I can’t help you there, as I don’t shoot video. Nope, not at all; I’m just not interested in doing so.

So should you purchase a new camera and/or a new lens? Only if you can state exactly why you need that camera or lens, and in what manner your photographs would improve.

How about switching systems? I would definitely be hesitant to do this, unless you have valid answers to the question in the previous paragraph. Figure out what you want to do with your photography and find the cameras and lenses that let you do that. Of course, if you simply have money to burn, or if you just have to have the latest and greatest, or if you consider a camera as a status item … well, go right ahead.

Given that you already own a camera and some lenses, I will state that the major problem that photographers have isn't the equipment itself but their own lack of good shot discipline. Too often I see people handholding the camera—or using a flimsy tripod, not using a remote release, or not using mirror lock-up when they could—or offering my all-time favorite excuse: "I'll fix it in the computer."

Summer clouds and shadows on wheat field, Washington State. Nikon D2x, Nikon 28−70mm lens, 1/320 sec., *f*/11, ISO 100

Setting Up Your Camera

I'm of an age that remembers when cameras had only three choices to set: the shutter speed, the aperture, and the ISO of the film to be loaded. That was all. Well, how times have changed. Today we have an incredible number of settings to make, listed in the menu options of the camera, as you tailor a camera to your own exact preferences. With so many different cameras on the market, I'll have to discuss menu choices in a rather generic manner. You might have to translate the menu and/or heading names, but here are a number of options found on most cameras, the most important of which are image quality, RAW file format, and white balance.

IMAGE QUALITY

The first, and most important, choice you need to make concerns the type of file you're going to record. The options are RAW, JPEG, RAW+JPEG, or TIFF. The answer depends on the type of photography you do and the specific needs you have.

Ruddy duck displaying, British Columbia, Canada. Nikon D800E, Nikon 500mm lens, 1/1250 sec., *f*/7.1, ISO 800

RAW simply refers to all of the unprocessed data captured by your camera's sensor. Starting with as much image information as possible is a significant advantage if you need, or want, to make adjustments to the final image. The more you adjust an image, the more likely you are to lose smooth gradations of tone and color.

While I would strongly suggest shooting RAW, this does mean you will have to process the files in your computer. You're going to have to learn to use RAW-file converter software to change the RAW information into a usable file format. While this is another step in the digital process, changes made at the RAW state are far less destructive to the image than any changes made later. You can set white balance, tweak the exposure, and make other corrections during the RAW file-conversion process, all in a nondestructive manner. An analogy for film would be of selecting the type of film used in the camera not before but *after* you've taken the shot.

While you have to process RAW files using software, JPEGs are processed in the camera, with whatever parameters you've selected in the menus. By the way, name one camera that actually shoots JPEGs. The answer is none. All cameras record RAW information, the raw data from the sensor, and then software in the camera processes a JPEG file from that raw information. Once a file is processed, once it is "baked," you cannot un-bake it.

JPEGs are *lossy* files; in other words, some of the information from the sensor is tossed away. And JPEG compression tosses a lot of data, starting at about 75 percent of the total. Considering how much information is lost in the compression, and in the reduction of bit-depth, I'm staggered by the high quality of JPEG files. If you do want to shoot JPEGs, be sure to set your in-camera processing choices very carefully. You need to set image size (Small, Medium, or Large), image quality (Fine, Normal, or Basic), JPEG compression (Optimal Size or Optimal Quality), and white balance (Incandescent, Fluorescent, Daylight, Flash, Cloudy, or Shade). Lots to think about here. I once had an African-safari client comment, after a full day's shooting, about how great his new digital camera was as he had not even filled one 4GB flash card. It turned out that he had been shooting small, basic JPEGs. For the best JPEG results, you want the settings Large, Fine, and Optimal Quality.

Douglas iris, huckleberry, and salal along the Oregon coast. Nikon D100, Nikon 85mm T/S lens, 1/15 sec., *f*/16, ISO 200

The main advantages to RAW capture are the potential image quality and the option to produce an image exactly as you wish it to appear by making choices in the RAW-file converter software. The disadvantage is the added time and effort you spend at the computer. The advantages of JPEG shooting are smaller file size (more images on your card) and images that are immediately ready to use. The disadvantage is potential reduction in image quality and more limited changes possible in postprocessing. Your priorities should determine which capture mode makes the most sense for you. I will mention that I shoot RAW files 100 percent of the time.

I see no reason to record RAW+JPEG. You can easily create a JPEG from a RAW file with only a couple of clicks in software. Given that fact, if you're shooting RAW and need a JPEG, why not make it from a processed, corrected, dust-spotted, finalized master file? And, as I discuss later in the section on exposure, the best exposure for a RAW file is not the best exposure for a JPEG, and vice versa. Record both formats simultaneously and one of them will be suboptimal. RAW+JPEG just eats up space on a flash card.

I see no reason whatsoever to shoot TIFF. Yes, it's a good file storage option, but it's not a good shooting option. In a camera, TIFF is an uncompressed 8-bit file that's larger in file size than either RAW or JPEG. There is no advantage to this.

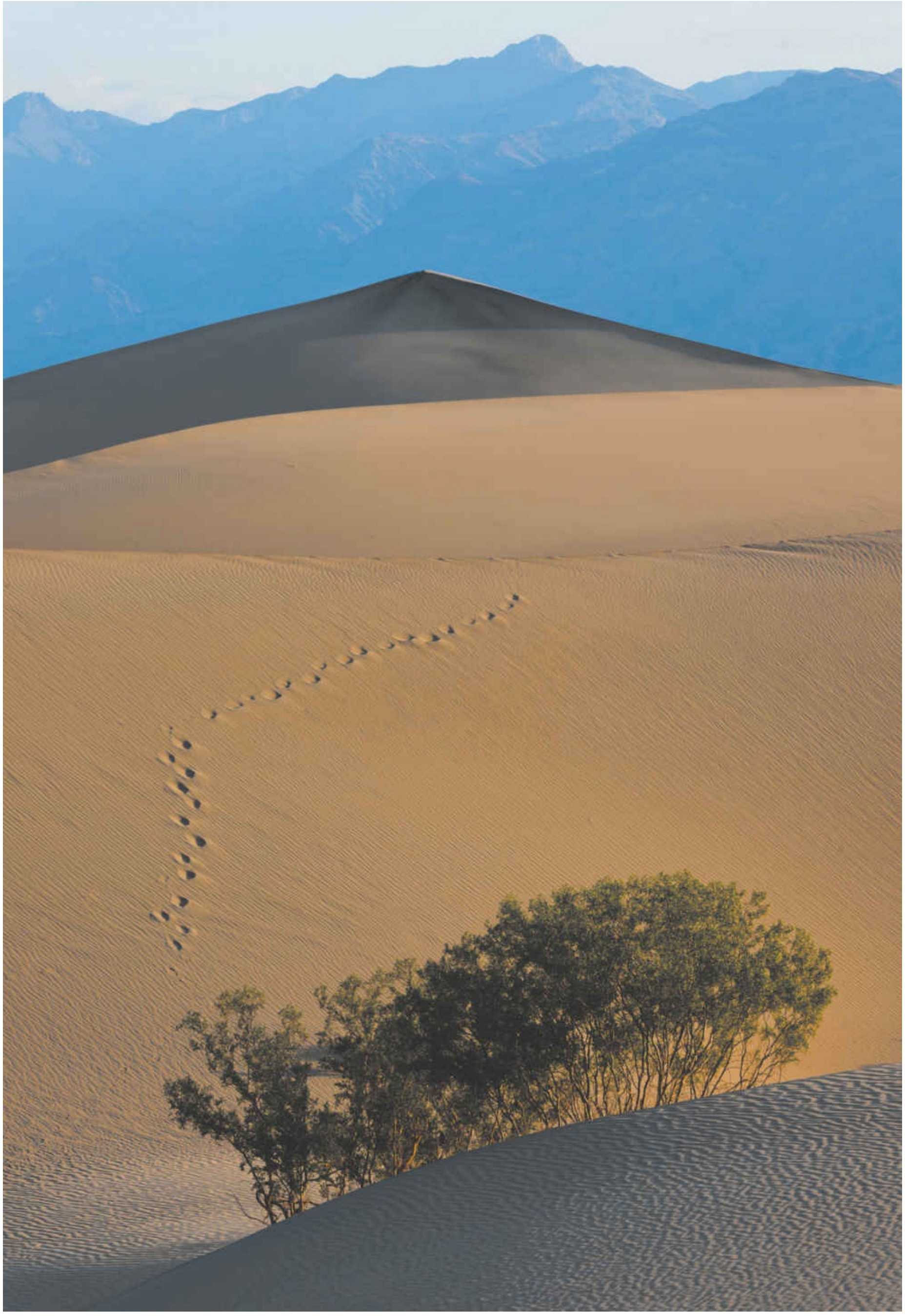
RAW RECORDING

Select 14-bit lossless compressed if you have this choice. If 14-bit slows your motor drive rate, then use 12-bit lossless compressed for action and reset to 14-bit for landscape work. Formats such as sRAW and mRAW are not exactly RAW information, as they are resampled into a lower resolution but kept artificially mosaicked and uninterpolated based on a "reference sensor." This is no longer straight data from the sensor.

WHITE BALANCE

For RAW files, setting a specific white balance doesn't matter, since if the file actually had a white balance imbedded, it wouldn't be raw information anymore. If you're shooting RAW, just leave white balance at Auto. If you're shooting JPEGs, you should set white balance as to the light. For JPEGs, Auto works most of the time. Well, it "oughta" work. (Sorry.)

When you open a RAW file in postprocessing software, it will open with whatever the default settings of the software happen to be (and the default settings can be selected by the user). Photographers often talk about how a RAW file looks right out of the camera, but that statement isn't accurate. You cannot see a RAW file. A RAW file has to be rendered in some fashion in order for it to be displayed on a monitor, and how it is first rendered depends on the default settings in the software. These are just a starting point, nothing more. A RAW file has an actual white balance only when you assign one to it—that is, only when it is changed from RAW into a real graphics file format, such as .psd or .tif or .jpeg. In other words, it has a set white balance only when it is no longer a RAW file.



Mesquite Flat Sand Dunes and the Grapevine Mountains, Death Valley National Park, California. Nikon D3x, Nikon 70−200mm lens, 1/20 sec., f/14, ISO 100

PICTURE CONTROL

This is a version of Scene mode. It affects the image on the camera's LCD, which, after all, is a thumbnail JPEG. It doesn't affect a RAW file if you use Adobe software. It might affect a RAW file if you use the camera manufacturer's software in that some of the effects might be baked into the software. My advice: You should run a test with different settings to see what happens in the software that you use.

COLOR SPACE

Again, with RAW files, it doesn't matter. If the file had an actual color space, it wouldn't be raw information. If you're shooting JPEGs, not processing your images in a computer, and posting to the Web, then sRGB is fine. Otherwise, use Adobe RGB.

LONG EXPOSURE NOISE REDUCTION

Turn this off unless you need it. The camera will take a second exposure of equal length, but without recording an image, in order to do what's called *black frame subtraction*. That 30-second exposure now lasts 1 minute. Leaving long exposure noise reduction turned on might also reduce the buffer size (the number of images the camera can hold before having to write data to the flash card).

PLAYBACK DISPLAY OPTIONS

Choose what you want the camera to display when you review images on the LCD. Definitely set the clipping display, which are the blinking highlights (or "blinkies" as they're commonly called) that indicate blown-out highlight areas. You should also have all of the histograms showing—the composite luminosity histogram along with the individual histograms for the red, green, and blue channels.

Bond Falls, Western Upper Peninsula, Michigan. Nikon D2x, Nikon 28−70mm lens, 0.4 sec., *f*/22, ISO 100

IMAGE REVIEW

Use this option to make the image appear on the LCD immediately after shooting. You can then review the histograms and the blinkies. Touch the shutter button and the LCD shuts off.

ROTATE TALL

Turn this off. This rotates vertical shots so that they appear vertical on the LCD when the camera is held horizontally. You just made the image on the LCD appear even smaller. And, if you're shooting with the camera mounted on a tripod, your vertical image will now be sideways on the LCD. Not a good idea.

MONITOR BRIGHTNESS

Most cameras allow you to change the brightness of the rear LCD. If you're working in bright sunlight, actually seeing the image on the LCD can be very difficult. It helps to crank up the brightness to the maximum setting. Remember to reset the brightness back to normal, or set it at a low number, when working in low-light conditions.

LCD LIMITATIONS

IMPORTANT: You *cannot* evaluate either the exposure or the color of your photograph based on the image on the LCD of your camera. After all, I just told you to change the brightness, which, of course, would change the apparent exposure. The "lightness/darkness" of the LCD has nothing to do with the exposure of the image file. And that LCD is definitely not a color-corrected and calibrated monitor. You *can* evaluate composition, as most cameras show 100 percent of the image on the LCD, while the viewfinder might show a lot less. You might want to compare what you see in your viewfinder to the image on the LCD.

AUTOFOCUS ACTIVATION

Given a choice, I would definitely take autofocus activation off of the shutter button. The standard method of holding focus on one area is to set the camera to one-shot AF (single servo autofocus), with Focus Priority (the usual default), and then hold the shutter release down halfway to lock focus. So long as you keep that shutter button halfway down, focus remains the same and you can recompose the image if you need to do so. This works pretty well, if you're handholding the camera and shooting static subjects; however, what happens when you're working from a tripod? You don't really want to be touching the camera during the exposure. Okay, you use a remote release. If you want to take several frames (let's assume there's a gentle breeze and only by shooting multiple frames are you assured of getting one sharp image), pushing the remote release button reactivates AF. No problem, if you haven't recomposed and your focus point is still over the same spot. Otherwise you must hold the remote release button partway down. Try that when wearing gloves.

The solution is to use back-button focusing to remove AF activation from the shutter release. Most cameras have either an AF-ON button on the back of the camera body or a button that can be reprogrammed in the custom settings. To focus, press the button with your thumb. To lock focus, raise your thumb. Autofocus won't be activated by using a remote release, or a self-timer, or an exposure-delay mode.

If you do use one-shot AF, it is normally set by default to Focus Priority. This means that you can take a picture only when the AF system locks focus. This is fine for static situations, but what if your subject starts to move?

Consider this: Elvis has returned. You've got the opportunity of a lifetime, as he's just standing there on the street corner. But just as you start to press the shutter, he starts walking. Since you've got the camera in one-shot, Focus Priority, you can't shoot until he stops again, whereupon you have to refocus again. You really need to switch quickly to continuous focus, Release Priority (which allows capture of moving subjects), before he walks away. You had better work fast.

Here's the solution: Set AF to continuous focus (on Nikon cameras, this is AF-C; with Canon, it's AI Servo) and use back-button focusing. Elvis is standing on the corner; you press your thumb down on the AF button to focus, raise your thumb to lock focus, and then change the framing any way you want. Elvis remains in focus in all of the pictures. As he starts to walk, you hold down the AF button with your thumb and continuous focus tracks him. Hold your thumb down and fire away with your index finger on the shutter button. If he stops walking again, just raise your thumb and once again focus locks. In other words, you get the best of both continuous AF and one-shot AF, and of both Focus Priority and Release Priority. I set my cameras to AF-C the day I took them out of the box and have never changed since. I use back-button AF activation almost all the time.

FOCUS POINT WRAP-AROUND

Nikon calls this feature "focus point wrap-around," while Canon calls it "continuous" in "manual AF point selection pattern." Regardless of the name, turn this on. Let's say you've selected the AF point farthest to the right. Now you want to change it to the one farthest on the left. You could use your AF point selector and do left-left-left-left-left, however many times needed. With wrap-around turned on, you would instead go to the right one more time, and the AF point "goes around the world" and comes in on the extreme left. This works top to bottom also.

FLASH SYNC SPEED

Shutters can sync with a flash only up to a certain speed. That is, to light the entire frame with flash, you're restricted to a reduced range of shutter speeds (generally 1/250 sec. or slower). Set this option to high-speed sync (Nikon calls this Auto FP) and you can use any shutter speed you want. The flash now actually emits a series of high-speed pulses, which appear as one pop to our eyes. Be aware that every shutter speed over the normal sync speed reduces the power output of the flash. You might have to set this high-speed sync option on your flash unit. Either way, turn it on and leave it on. Having high-speed sync turned on does not in any way affect using the flash at slower shutter speeds.

REVERSE INDICATORS AND CUSTOMIZABLE DIALS

Many cameras allow you to change the behavior of the dials and displays to suit your liking. For example, I like my cameras set so that all of the exposure information works in the same direction. A standard graph has positive values on the right, negative values on the left. A histogram is light on the right side, dark on the left. My meter display is set so that "+" is on the right, "-" on the left. I've set anything that changes exposure (shutter speeds, apertures, exposure compensation) turn to the right to add light and to the left to take away light. Canon owners should be aware that on some models reversing the dial direction is found under a rather cryptic heading: *Dial direction in Tv/Av*. Although the name doesn't suggest it, this custom function reverses the dial direction in manual exposure mode also.

TIME ZONE AND DATE

Reset this to the local time when you travel so that your images will match your itinerary. Which national park was that? Check the date in your itinerary and you can match date with location. Just remember to reset the time zone when you return home.

FILE NAMING

If you can give a unique identifier to a specific camera body, you might want to do so. Let's say you have two identical cameras. If there's a problem, you can quickly and easily identify which camera is at fault. Nikon, for example, lets you create a three-character code that is then included in the file name; in other words, Nikon lets you name your individual cameras. When I had two D3 cameras, one was named JSP (John Shaw Photography) and the other was NIK (Nikon … okay, not much thought here on my part). My wife mentioned I could have named the cameras Dog and Cat. I'm currently using a D4 and a D800E. I've set the unique identifiers of these cameras to D4N and D8H. I download my files using either Adobe Photoshop Lightroom or Downloader Pro. I have the software automatically add the date based on the YYMMDD format recorded by the camera at the beginning of each file name and file number generated by the camera. This process automatically organizes all of my images chronologically. Without opening a file, I know when the picture was taken and which camera was used. 130219_D4N_1234 correlates to an image shot on February 19, 2013, with my D4 camera.

AUTO IMAGE ROTATION

Turning this On records the camera orientation when the picture is taken. When you open the images on your computer, horizontal shots appear horizontal and verticals are vertical. Shoot straight up or down and you'll have to rotate the images manually.

SHOOTING MENU BANK

You can organize your menu choices into banks of preferences. Bank A might be your landscape setup, while Bank B might be for action. Be careful. The way this should work is that your choice would be "fixed in place" so that you could return to a known configuration at any time. Unfortunately, it might not work that way with your camera. If you make a temporary change, it might be recorded into the bank whether or not you wanted that change to be temporary or permanent. Run a test to determine how your camera works.

MY MENU

One of the features of the newer cameras that I really like is the option to create a personal list of the menu items that I might want to change during a shoot. The My Menu feature offers the equivalent of bookmarks in a browser, yielding a quick and easy way to find a heading rather than having to search through all of the menus over and over.

So what do I have set in My Menu on my cameras? Currently I'm using a Nikon D4 and a D800E, and I have the same choices selected and listed in the same order on each:

- Virtual horizon
- Exposure Delay mode
- Monitor brightness
- AF activation
- Multiple Exposure mode
- Long exposure noise reduction
- Clean image sensor
- AF fine-tune
- Lock mirror up for cleaning

Lenticular clouds at first light, over Cerro Torre and surrounding peaks, Los Glaciares National Park, Argentina. Nikon D3, Nikon 70−300mm lens, 6 seconds, *f*/11, ISO 400

The *virtual horizon* choice is for the LCD on the back of the camera. I have the function button on both cameras set to display the virtual horizon in the viewfinder.

Exposure-delay mode allows me to choose a 3-second delay before the shutter trips, with the camera mirror locked up at the beginning of the process.

I use *monitor brightness* to increase the LCD brightness when I'm working in direct sunlight, making it easier to view the LCD. I much prefer this over using the default Auto Brightness setting.

AF activation is there because, while I normally use the back AF-ON button, there are a few times I might want to have AF activation on the shutter button. Having that option here means I don't have to search through menus to find it.

Multiple Exposure mode and *long exposure noise reduction* are self-explanatory.

While I have my cameras set to do a sensor cleaning at startup and shutdown, the *clean image sensor* option actually runs the cleaning cycle for a longer time.

I rarely use *AF fine-tune* and *lock mirror up for cleaning*, but it's more convenient for me to have them listed here, rather than trying to find them at some other time.

A NOTE FOR NIKON USERS

I haven't used the Image Crop mode feature on my D4, and I don't see myself ever doing so. The D800E is another story, because it has such a high megapixel count and large file size. For landscape work, I want the full sensor available, but for wildlife work, cropping in-camera (especially the 1.2 crop mode) yields plenty of pixels while reducing file size slightly (which clears the buffer a bit faster). I could have added Image Area to My Menu choices, but there's an easier way. I have custom function F6 set so that the AF-L/AE-L button, when used with the command dial, cycles through the Image Crop modes. I can change the image area without looking away from the viewfinder. In fact, this custom setting allows me to choose which crop modes to include, and since I don't care about the 5:4 crop, I exclude that one. Just in passing, I also have custom function A5 (AF point illumination) set to Off, which masks the viewfinder when a crop mode is used. If A5 is On, crop lines are added to the finder image, which gets a bit confusing, as I have custom function A6 set to show the viewfinder grid display. I do wish the camera allowed me to have both the mask overlay and the AF point illumination active at the same time.

VIEWFINDER FOCUS CORRECTION

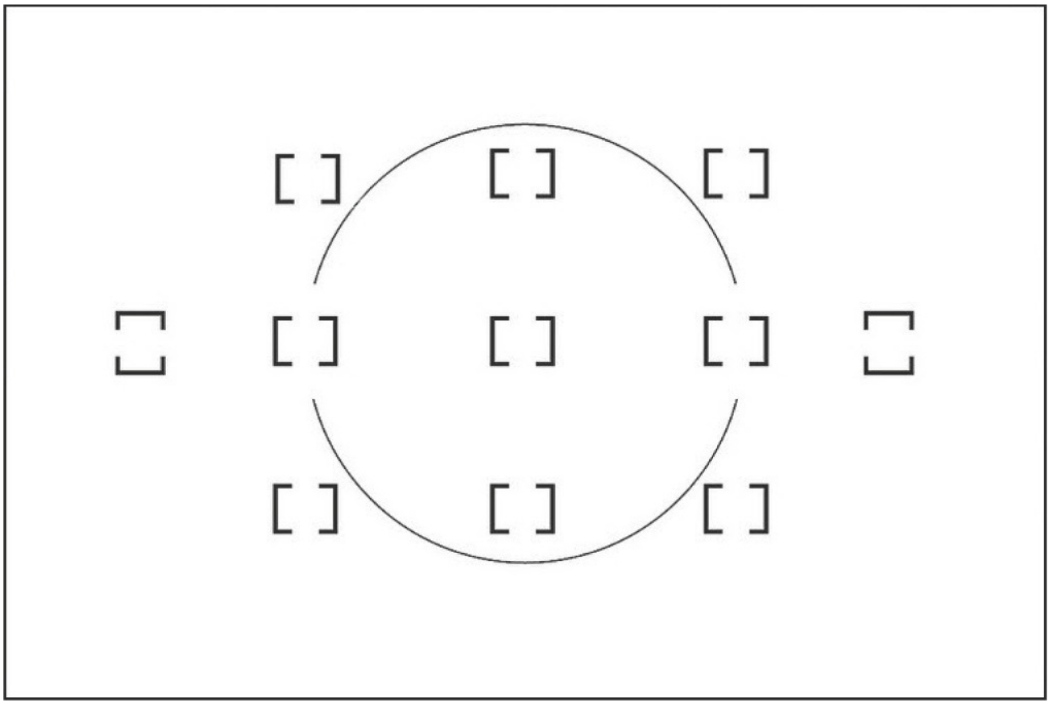
Photographers often say they are "looking through a lens." Well if the lens is attached to a camera and you have your eye to the viewfinder, then that "through the lens" statement is not true at all. The lens is projecting an image onto the focusing screen in the camera, and you're looking at the screen.

Does the image look sharp? Has the autofocus worked correctly and focused on what you wanted? If you're manually focusing a lens, can you tell when the image is in precise focus?

Almost all DSLR cameras now have a viewfinder diopter adjustment, which allows adjusting the viewfinder image to differences in vision. Generally, there is a either a small dial or a slider quite close to the viewfinder eyepiece (you might have to remove the rubber eyecup to find the adjustment slider) so that you can adjust the viewfinder to your eyesight. If your view of the focusing screen isn't correctly adjusted, the image may not appear sharp, even if the camera is focusing correctly. Here's what to do:

1. Turn the camera on and throw the image in the viewfinder grossly out of focus. Even better, just take the lens off the camera.
2. Aim the camera at a diffused light source; the sky works well (keep the sun out of the frame) or your office wall.
3. Look into the viewfinder and turn the adjustment dial until the autofocus brackets are in sharp focus.

You’re not trying to focus the image projected onto the ground glass; after all, that’s what a lens does. You’re trying to adjust your view of the focusing screen.



Turn the diopter adjustment dial until the AF brackets appear perfectly sharp. If you can see these in sharp focus, you can tell when the image projected onto the ground glass is in focus. Adjusting the viewfinder focus should be one of the first changes you make to your camera.

Tripods and Heads

If you want to improve the technical quality of your photographs, the very first thing you should do is to buy a well-made tripod—and then use it whenever possible. It's easy to take a photo that's not sharp, and at times you might indeed want to make intentional blurs. But can you record a sharp image whenever you want to do so? Every professional nature photographer shoots every frame possible with the camera firmly mounted on a tripod. A good tripod is so essential to successful field photography that I would be tempted to call is a "necessity" rather than an "accessory."

I've noticed that many photographers go through the same tripod purchasing sequence (exactly what I did many years ago). First they buy the $39.95 tripod. Two months later they get the $79.95 model. Two months more and they get the $179.95 tripod. Then they start to see that the tripod head is also important. Another two months go by and another $299.95 appears on the credit card. Two months later they buy what they should have bought in the first place: a good tripod, with a good tripod head incorporating a quick-release system, and quick-release plates for all lenses and camera bodies. Save yourself some money and frustration: go directly to the good stuff.

Unfortunately, the vast majority of tripods on the market are not well designed, nor are they members of the "quality" category. Far too many tripods are too flimsy, too short, and too difficult to use, and they don't permit photography from a low level. Most of the tripods sold at the big-box stores are not suited at all for still photography but are designed for video work (and poorly designed even for that). I have always maintained that most beginning photographers curse tripods, and consequently tend to not use them, because they have never had the opportunity to use a good one.

Saguaro cactus and the Santa Catalina Mountains, Catalina State Park, Arizona. Mounting my camera on a quality tripod let me compose precisely, placing the edges of the frame exactly where I wanted them to fall. Nikon D800E, Nikon 24−70mm lens, 1.3 seconds, *f*/16, ISO 100

I've met lots of people who claim they can easily handhold their cameras and get sharp results. Usually this statement is followed by the phrase "All my lenses have image stabilization." Okay, let's run a test: Use a 70−200mm lens at 200mm, ISO 100, and shoot a series of frames at shutter speeds from 1/500 sec. down to 1 second. Now evaluate these images at 100 percent on a monitor. Even with the latest generation of image stabilization (IS on Canon) or vibration reduction (VR on Nikon), there's a limit for handholding if you want sharp images. The point is, can you produce a sharp image whenever you want a sharp image? It's not that a lack of sharpness is necessarily bad; perhaps you want a soft-focus, ethereal photo. Fine. But I doubt that you always want such images.

The old rule of thumb says that to obtain sharp photos with any consistency when handholding a camera, you need a shutter speed equal to the focal length of the lens in use. For example, with a 100mm lens, you would need at least 1/100 sec. or faster for sharp results; with a 500mm lens, you would need 1/500 sec. or faster. For today's high-megapixel cameras, and with the advances in IS/VR, we need to modify this rule. I would suggest that with IS/VR *off*, and a 20+ megapixel camera, the focal-length number should be doubled. With IS/VR *on* … well, there are too many lenses on the market with different versions of IS/VR for me to generalize. Again, testing your equipment is the only answer. With any given length lens, what's the slowest shutter speed that yields results acceptable to you?

Given that you really need a tripod, what features should you consider when looking for one? And what about tripod heads?

TRIPODS

The sturdiest tripods, made of whatever material, have the fewest leg sections. Every joint in a tripod is potentially a weak spot, a possible problem area when you're far afield. Choose between three-section legs (two locking joints per leg) or four-section legs (three locking joints per leg) if you need a taller tripod. The fewer leg sections you have, the faster you can set up and take down the tripod. Look at the smallest leg section. If it's smaller than $^{5}/_{8}$ inch in diameter, consider a different tripod. A tripod with a larger bottom leg diameter would be sturdier.

Here's a quick tripod-use tip: Whenever you're working in sand or mud, always keep the bottom leg extended out a little bit, even if just a few inches. Keep the leg locking mechanisms out of the dirt. I've had clients on my Antarctica trips plunk down their tripods on damp sand beaches without extending the legs at all, and after a week you can actually hear the leg locks grinding apart from internal grit. Not a good sound, considering the remote location.

To check for tripod sturdiness, tape a laser pointer to the tripod head and then lightly tap the tripod legs. See if that red spot jumps around. Run this same test with the center post fully extended. You'll find that, in general, the more you extend the center post, the less sturdy the tripod becomes. Tripods are at their best with no center post extension whatsoever. If at all possible, I would avoid extending the center post more than a few inches, except when photographing with short lenses. If you crank up that center post to full extension, you no longer have a tripod. You have a monopod with a three-legged base attached. My most-used tripods actually have no center posts at all.

Make sure your tripod is tall enough. With its legs fully extended, the camera should be slightly higher than your eye level. Working all day with a short tripod, where you must constantly stoop over, is no fun at all. A tripod that seems fine when set up on a flat surface will shrink once you're working out in the field. For example, if you're working on the side of a hill, one leg of the tripod must be below your body position. In effect, the tripod has just gotten shorter. While it's easy to make a tall tripod shorter, there is no good way to make a short tripod taller.

Having a tripod go low to the ground is another story. More and more models now offer this capability, a feature you definitely want, but you still hear suggestions about inverting the center post. Let's abolish that idea forever. The camera is upside down, the controls are upside down, your head and shoulders are jammed in between the legs, and the lens is pointed at the leg directly opposite. I have noticed that tripod makers who tout inverting the center post never actually show a picture of a photographer working this way.

The focal lengths you plan on using will also affect tripod choices. The tripod you buy to support the lenses you own right now may not be the best tripod for the lenses you'll own in the future. What's the longest and heaviest lens you think you'll ever have? Which of the following three statements applies to you?

1. I never use anything longer than a 135mm F2.8 lens.
2. I never use anything longer or heavier than a 300mm F4 lens.
3. I have, or want to have, a 400mm, 500mm, or 600mm lens.

Rice terrace design, Bhutan. These rice terraces glowed in the early-morning light. Nikon D3x, Nikon 70−300mm lens, 1/8 sec., *f*/14, ISO 100

Here's a question for those of you in group 1. Really? Never longer than 135mm? If you are indeed a nature photographer, then you have highly limited your possible subjects. To group 2: Are you absolutely 100 percent positive you will never be in group 3? I think most people photographing nature would almost automatically fall into group 3. In my opinion, consequently, it makes a lot more sense to "futureproof" a tripod purchase. Better to be "over-tripoded" rather than "under-tripoded," especially when faced with that once-in-a-lifetime shot.

Of course, you have to be willing to carry the tripod with you. Any piece of equipment that you won't take with you out in the field is, for practical purposes, just an expensive paperweight.

Here's a short list of the features you want in a tripod:

- Sturdy
- Easy to set up and take down
- Tall enough
- Goes low to the ground
- Has leg locks that you find easy to use (whether twist lock or lever style) and that stay securely locked
- Made from carbon fiber (most tripod manufacturers have gone to carbon fiber, as it's lighter and less prone to vibration than aluminum)

A Really Right Stuff BH-55 ball head mounted on a leveling base and connected to a Really Right Stuff TVC-33 Versa tripod. I've intentionally tilted the tripod legs to illustrate how a leveling base can be used.

As to makes and models, here goes: Hands down, I would look at Gitzo and Really Right Stuff tripods as the best brands available. No two ways about it, they are expensive … but they will last and last. The two tripods I recommend for the widest overall usage, to support any lens to photograph any subject matter, are Gitzo GT3532LS and Really Right Stuff TVC-24L Versa. The runner up, for 400mm maximum focal length, are Gitzo 2 series tripods. For slightly heavier tripods, for those who use really big glass most of the time, I recommend Gitzo GT5532LS and Really Right Stuff TVC-33 Versa.

There are quite a number of carbon-fiber tripods on the market that are pretty much Gitzo knockoffs, marketed under a number of brand names. I haven't used any of these, but I see them on the photo tours I lead. My experience is that there is some inconsistency in these brands, not in any one particular model or any one particular brand, but from individual tripod to tripod of the same model and manufacturer. One tripod will work fine, one won't. Induro, Sirui, and Feisol seem, in my experience, to be the better choices.

TRIPOD HEADS

As to a tripod head for fieldwork, today I would recommend a ball head and suggest you forget about anything else. The best (by a huge margin) is Really Right Stuff BH-55. Runner up models: Kirk Enterprises BH-1 and Markins Q-Ball Q-20. And for 300mm F4 lenses maximum: Really Right Stuff BH-40, Kirk Enterprises BH-3, and Acratech GP.

Personally, I would not consider other brands of tripod heads, nor would I recommend any pan/tilt head for general nature photography fieldwork. Pan/tilt heads, with a separate locking arm for each axis of movement, work fine for studied landscape photography but are too complex for any sort of action work. Avoid like the plague the “action grip” or “pistol grip” heads, the ones that look like a small ball head with a grip handle sticking out to one side. These are not particularly stable, are very prone to vibration problems since they use a tiny little ball, don’t work with big lenses, and are about hopeless for taking sharp verticals. Don’t waste your money.

Whatever head you get, make sure it takes a quick-release system. The Arca-Swiss design, with dovetailed plates that drop into an open-ended clamp, is the only quick-release system I would consider. This design has become the professional standard. You’ll need a separate quick-release plate for each camera or tripod-collared lens, and a clamp on the tripod head (all the ball heads I recommend have an Arca-style clamp). The best plates are designed to incorporate an anti-rotation lip, or even have two attachment screws in the case of plates for larger lenses. The plates attach to a camera or lens with direct metal-to-metal contact, while the clamp is strong and rigid, better than any other style of quick release.

Really Right Stuff and Kirk Enterprises offer custom machined plates and clamps for almost all cameras and lenses. Wimberley has slightly fewer options available. I highly recommend all three companies.

Yes, having a quick-release system—and purchasing all these camera and lens plates—is indeed an added expense, but doing so is well worth the money. Don’t try to scrimp by purchasing generic Arca-style plates, especially the “one-size-fits-all” variety. A word of warning: You would think that all Arca-style plates and clamps would be the exact same dimensions. Not true. Clamps are designed with either a lever to operate opening and closing the clamp, or with a screw knob. In my experience, screw clamps are compatible with any brand of plate, but the lever-style clamps are not. If you purchase a lever clamp, buy the plates from the same manufacturer. Note: Manfrotto and Gitzo both have their own proprietary quick-release systems that appear to be Arca-Swiss compatible, but they’re not. Only Manfrotto plates work with Manfrotto clamps, and only Gitzo plates work with Gitzo clamps. My advice is to stick with Really Right Stuff, Kirk, or Wimberley.

A specialized camera plate is the “L” bracket. As the name suggests, the plate is shaped like the letter *L* and has the Arca dovetail groves on both sides of the L. In essence, the L bracket is two plates in one.

Here’s my Nikon D4 with a Really Right Stuff L bracket. Notice that I don’t have to flop the head to one side for a vertical composition.

Consider what happens when you shoot a vertical with your camera mounted on a tripod. As you flop the camera over on its side, you’re actually changing the location of the optical position of the lens. You have lowered the lens and moved it to one side. Your tall tripod just shrunk in height. In addition, all of the weight of the camera and lens is now hanging off to one side.

Of course, if the lens has a tripod collar, you should always use it (with appropriate quick-release plate attached). Mount the collar onto the tripod head and then rotate the camera using the collar, without flopping the head over. But almost all shorter-focal-length lenses, and even zooms such as most 70−300mm ones, lack tripod collars, so you have no choice. And this is where the L bracket comes into play. When taking a horizontal composition, you attach the camera to the head as you normally would. For a vertical photo, you loosen the quick-release clamp, pull the camera out, and then replace it in a vertical orientation back into the Arca clamp. The optical axis of the lens ends up in almost the exact same location, the tripod maintains its height, the camera and lens weight are well centered over the tripod for optimum stability, and all is well.

There’s actually another use of the L bracket that I’ve had to resort to only once or twice, but still it’s worth mentioning. What if you want to make a horizontal photograph with your camera positioned as low to the ground as possible? Even if you’re using a low-level tripod, there’s still the height of the tripod head to contend with, several inches at least. Mount the camera as a vertical using the L bracket and then flop the head over (you’ll have to rotate the head using the pan movement so that the camera hangs off the right-hand side of the head). Your camera is now positioned very low. By loosening the quick-release clamp, the camera’s L bracket can be slid down the clamp another inch or two. Do this also and you’ll end up with the bottom of the camera, the bottom of the L bracket, touching the ground. That's definitely a low-level photograph!

There's one final style of tripod head to consider: the gimbal head. These heads are designed for one type of photography and one type only: action work with long lenses that have tripod collars, allowing for camera rotation from horizontal to vertical. If the head is set up correctly, one finger is all it takes to move the camera and lens in any direction. Let go of the camera, and the lens does not move; it remains in the same position as before. For big-glass action photography, no other style of tripod head comes close to a gimbal's ease of use.

But, as always, there's a catch. As I said, gimbal heads are for long lenses only. If you want to take a landscape photo, using a short lens from a gimbal head is almost impossible, since there's no way to tilt the camera left/right. You'll have to carry a second tripod head.

Gimbal heads are also fairly heavy, generally running about 3½ pounds. You don't want to mount one on a lightweight tripod. Add the weight of that big lens and camera, and a small tripod quickly becomes top-heavy. If you travel a lot by air, the sheer size and bulk of most gimbals start to add up fast.

Redhead duck, British Columbia, Canada. I was working in the water, so after every photo session I would literally pour water out of the tripod legs. If you shoot with your tripod mostly submerged, be sure to later disassemble it and let it dry out. Nikon D800E, Nikon 500mm lens, 1.4X teleconverter, 1/800 sec., *f*/8, ISO 800

Good gimbal heads are rather pricey, in the $400 to $600 range, so be sure you really need one. On the other hand, once you actually purchase that 600mm F4 lens (currently both the Nikon and Canon versions are over $10,000), what's another $600? I say that in all seriousness. If you're buying a lens primarily for action photography, and you want to use it to its best advantage, you should also buy a gimbal head.

The gimbal heads I would recommend are the Wimberley WH-200 Version II; the Jobu

Design Jr. 3 BWG-J3K, with swing arm, or the Jobu Design Heavy Duty MK III; and the 4th Generation Designs M-3.6 Mongoose. I’ve used all of these (I certainly don’t own all of them but have borrowed ones from friends), and all are quality products.

Gimbal heads have become popular, and consequently, there are quite a number on the market. Do a Google search and you’ll discover dozens of designs. Most are knockoffs of the basic Wimberley/Jobu design, and reading the reviews of the knockoffs, the quality is all over the place. I have no recommendations either pro or con on these knockoff gimbal heads; I’ve never seen most of these, let alone used them, and as they say, your mileage may vary.

The Wimberley WH-200 Version II gimbal head.

Winter pool and ice, Vermilion Lakes, Banff National Park, Alberta, Canada. A good tripod should be easy to use, regardless of the weather. Nikon D3x, Nikon 45mm T/S lens, 1/4 sec., *f*/22, ISO 100

LEVELING BASE

If you plan on taking a series of images to stitch into a panoramic, it's helpful to have a leveling base, a device that goes between the tripod and the tripod head. It allows you to level the rotational movement of the head, regardless of how the tripod's legs are spread. Leveling bases are designed for video and film work, since these formats pan along with any action and the image framing must remain level during the entire pan. Gitzo, Really Right Stuff, and Acratech all offer well-made versions of leveling heads. If you're interested in learning more about panoramic photography, my e-book *Panorama* would be a helpful resource.

REMOTE RELEASES

When you are working from a tripod, you want to use a remote shutter release as often as possible. Once called cable releases, today the remote shutter release is either a wireless devices or an electrical switch cord connecting into a special socket on the camera body. Either way, the purpose is the same: to trip the shutter without having your hand on the shutter release button. Some cameras have a timer release also, which fires the shutter after a 2- or 3-second delay. On a windless day, the timer works well, but there seems to be a direct correlation between wind speed and when the timer trips the shutter. With a remote release in hand, you can wait for the exact moment a lull in the wind happens. Remote releases are for tripod-mounted camera use only. I've seen people try to use a release while handholding the camera. Don't do that.

Both wind and flowing water will cause a tripod-mounted camera to vibrate, and using a remote release will not solve the problem. In this case, hang on to the camera with one hand while pressing down on the top of the lens, directly above the tripod head, with the other. You might also try pressing up from the bottom of the lens. Shoot a few test frames at home to see which is easiest for you to do and which yields more sharp images. You can greatly reduce camera movement by doing this. Even so, I would strongly suggest favoring faster shutter speeds, even if this means raising the ISO. I don't worry much about high ISO noise; better a sharp noisy photo than a blurry noiseless one.

If your camera has a mirror lock-up feature, use it whenever possible. Inside every DSLR camera is a mirror that must swing up out of the way for each exposure. "Swing" is really an understatement. The mirror snaps up instantly every time the shutter is tripped. This movement, the slap as the mirror hits the camera's pentaprism finder, creates vibrations that in turn can lead to photographs that aren't sharp.

A mirror lock-up provision is a means of avoiding this. It allows you to raise the mirror out of the light path once you've composed the image. It should be fairly obvious that you won't use mirror lock-up when handholding the camera, since once the mirror is up you cannot see through the viewfinder.

The most vibration-prone shutter speeds on all cameras are 1/8 sec. to 1/15 sec. Using a longer-than-normal lens magnifies both the image and the vibration problems. When possible, lock up the mirror with long lenses, at any shutter speed. Of course, there will be many times when you cannot. In those cases, follow the advice I gave previously for wind and water problems.

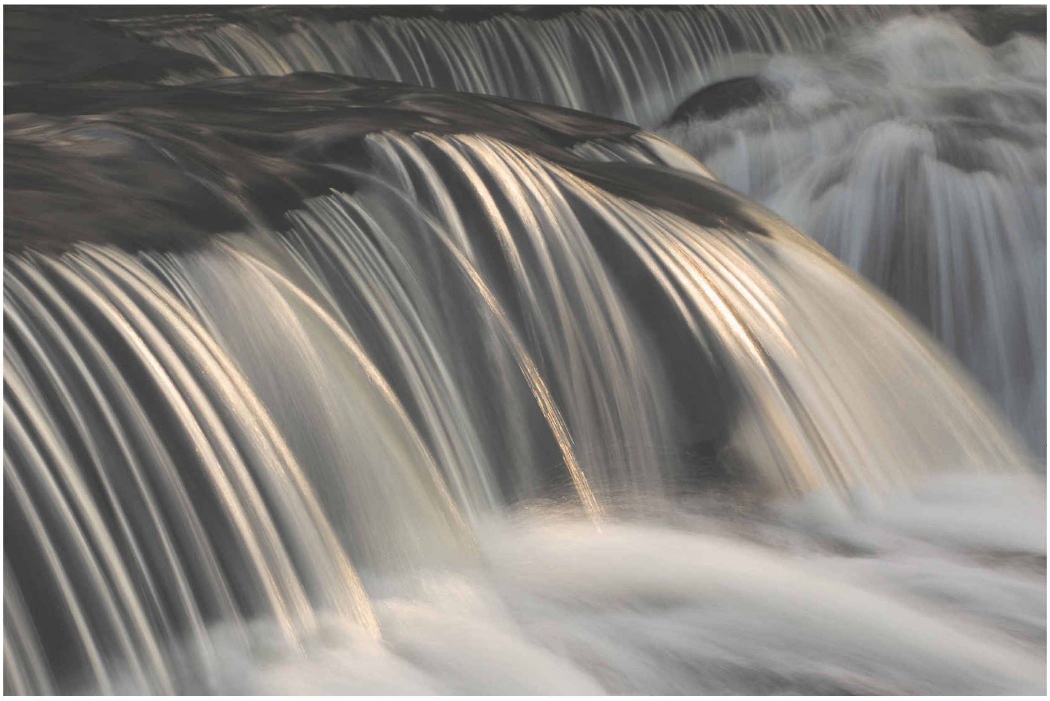
For action photography of any kind, don't use a release. Keep your right hand glued to both the camera's shutter release and the AF-ON button and use your left hand to guide the lens or tighten the head controls.

Filters

The need to carry filters has changed greatly since the film days. There are still what seems like a million varieties of filters available—cross star filters, rainbow filters, multi-image filters, color-enhancing filters, soft-focus filters—but now most of these effects are created by using software rather than by using a filter on a lens.

I still see many photographers who always leave a skylight or UV filter mounted on their lenses as “protection.” I’ve never understood this concept. From what are they protecting the lens? Dirt and fingerprints? If so, then they must remove the filter for every shot, otherwise they’re shooting through a dirty, fingerprinted filter. Salt spray? Yes, that might be a valid answer, but how often are they working in salt spray? I live about 100 miles from the ocean, and on the other side of a mountain range, and if there is salt spray all the way over here, protecting my lens will be the least of my worries.

Use a filter only when one is needed. If you cannot state out loud why you’re using a filter, if it’s not a conscious decision on your part to use a filter, then in my opinion no filter should be on your lens. If you still want to use a UV filter as protection, be aware that adding a second filter to the lens, such as a polarizer, most likely will cause vignetting problems due to the added thickness of the filters. Adding any filter to a zoom lens is an invitation to flare and ghost image problems, unless you consistently use a lens hood also. Zoom lenses are optically complex designs, with many glass elements, and even the best zooms tend to be a bit flare prone. Add a filter, a flat piece of glass, in the direct sunlight on the front of a zoom and you just create more potential problems.

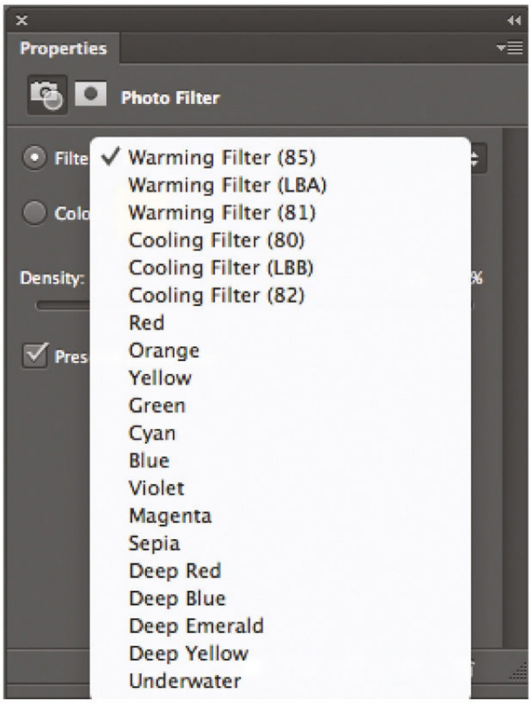


Tannin-stained water at Bond Falls, in Michigan's Upper Peninsula. I almost always add a polarizer when photographing streams and waterfalls. Nikon D2x, Nikon 70−200mm lens, 1/4 sec., *f*/14, ISO 100

My advice: Instead of a filter, use lens caps to protect the lens from dirt and grime. I'm staggered by how many photographers I see who have lenses in their packs with neither front nor rear caps on them. Use a lens hood as additional protection, since a hood keeps greasy fingers and raindrops away from the front element. Lens hoods also cut down on flare problems while increasing the microcontrast of an image.

While I'm suggesting that a "protective" filter isn't necessary, I'm certainly not suggesting you should never use a filter on an image. However, most filters today are not physical pieces of glass but effects created with software. Let's consider Photoshop for a moment. For the least-destructive editing, working with Adjustment Layers is the way to go, and sure enough, there is a Photo Filter adjustment layer.

With the Filter button checked in Photoshop, the preset options will look like below. The Density slider allows adjusting the density of the filter from 1 percent to 100 percent. Of course, the opacity of the layer itself can be set, from 0 percent to 100 percent.



But wait, there's more. Click the Color button and you get the Color Picker, where you can select any color you want. You can create any colored filter you want, of any density you want, and apply it at any opacity you want. If you want to add another filter, you simply make another photo-filter adjustment layer, and thanks to masking (in my opinion the major reason to use Photoshop), you can apply each filter to a discrete part of the image. How many adjustment layers can you have for any one image? I believe the number is 999, but why anyone would ever need that many I have no idea. This certainly does seem like a bit of overkill.

The most popular "special effects" filters are those from Nik (www.niksoftware.com) and Topaz (www.topazlabs.com). Free trial versions are available for download, for both Mac and PC.

A word of caution about software filtration: Be judicious. I see far too many photos that seem to have been taken on a different planet from the one where I live. It's very easy to overdo an effect, so err of the side of understatement. In particular, too many photographers have an inordinate fondness for the saturation slider.

There are a few actual physical filters you might want, as their effects cannot be duplicated in software. And just to be sure we're all on the same page, round, screw-in-type filters come in various millimeter diameters. What size fits a particular lens is noted in the info that came with the lens, or it's on the manufacturer's website. You could get a filter with an extra-large diameter and use step-down rings for all of your smaller-diameter lenses, but I would strongly advise against this. Trying to unscrew small metal rings when outdoors in bad weather is a quick lesson in total frustration. You'll say words that your mother would not want to hear.

Autumn *Nothofagus* beech trees, Los Glaciares National Park, Argentina. Using a polarizer removed the glare from the autumn leaves, saturating the colors. Nikon D3, Nikon 24−70mm lens, 1/40 sec., *f*/14, ISO 400

POLARIZING FILTER

No matter what subject matter you photograph—nature, travel, cityscapes, architecture, pets—the one filter you should have is a polarizing filter. Buy a good-quality glass polarizer. Cheap polarizing filters tend to have an undesirable color cast and can often create autofocus problems. Under many lighting conditions, polarizers increase color saturation, yielding richer and more intense hues. You get greener greens, richer reds, and brighter yellows. Many subjects reflect a certain amount of natural glare from their surfaces; along with atmospheric haze, this glare tends to diffuse the way we see colors. Polarizers can reduce, or even eliminate, some of the diffusing problems and, consequently, can produce richer colors. There is no software that will remove glare; only an actual polarizing filter will do that.

A polarizer is by far my most-used filter. Most of my lenses are 77mm filter size, so I carry two identical 77mm polarizers. I don't have to keep switching filters if I'm working with two lenses, and I've got a backup filter just in case. Several years ago, I fumbled a polarizer while I was shooting from a Grand Canyon overlook and watched it bounce across some rocks and into space. If you should find it somewhere down in the canyon, it's yours to keep.

I use the thin Nikon polarizers and would highly recommend them. They are neutral in color (which is exactly what a polarizing filter should be, since you can add "warmth" at any time in postprocessing), don't vignette even on a 16mm lens, and have front filter threads, so a lens cap can be used on the filter. It doesn't matter if you don't own a Nikon; any brand of filter can be used on any brand of lens.

To use a polarizer, screw it onto the front of your lens, and then turn its rotating mount until you like what you see. Rotate it slowly, very slowly, as sometimes the effect is difficult to determine. To be honest, my usual procedure for deciding if I want to use a polarizer is to hold it and rotate it while I look through it. I don't even bother mounting the filter on a lens. Be aware that the polarizers to be used with current cameras are all one-directional; there's a correct direction to look through the filter and an incorrect direction. One way (the way a lens would view through the filter) shows the polarization effect, while the other does not. If you're like me—just holding up the filter to view through it—make sure the filter threads are facing you.

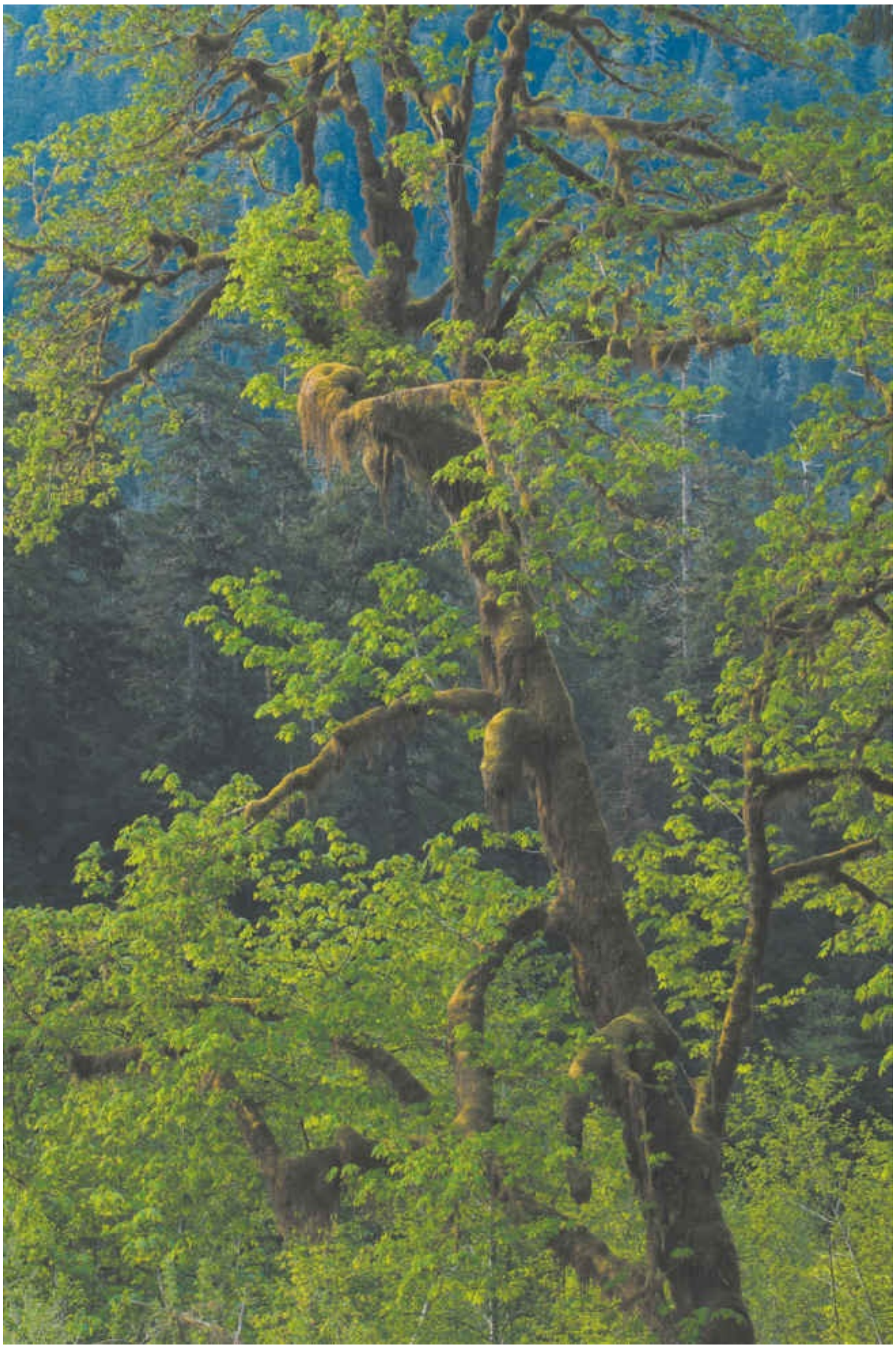
Polarizers are often used to darken the blue sky, but doing so should not be a major concern. Using Photoshop or Lightroom or other software, it's easy to tone down the sky. You don't want the sky to appear midnight blue, unless you're illustrating Toto leaving Kansas. How much a polarizer actually darkens the sky depends on the type of sky and your shooting angle in relation to it. Seen through a polarizer, a clear blue sky will darken appreciably at right angles to the direction of the sun, while an overcast sky will show hardly any effect at all. Polarizers cannot turn the gray sky blue.

There's an easy way to determine which area of the sky will be most affected by a polarizer: Point your index finger at the sun and then extend your thumb at a 90-degree angle to your finger, like a child's imitation play pistol. If you keep your index finger pointed at the sun and rotate your wrist, your thumb will traverse a plane across the sky which is 90 degrees to the axis of the sun. This plane, at a right angle from the axis of the sun, is the plane of maximum polarization. At high noon, with the sun directly overhead, the plane of maximum polarization is near the horizon, while at sunset it passes overhead.

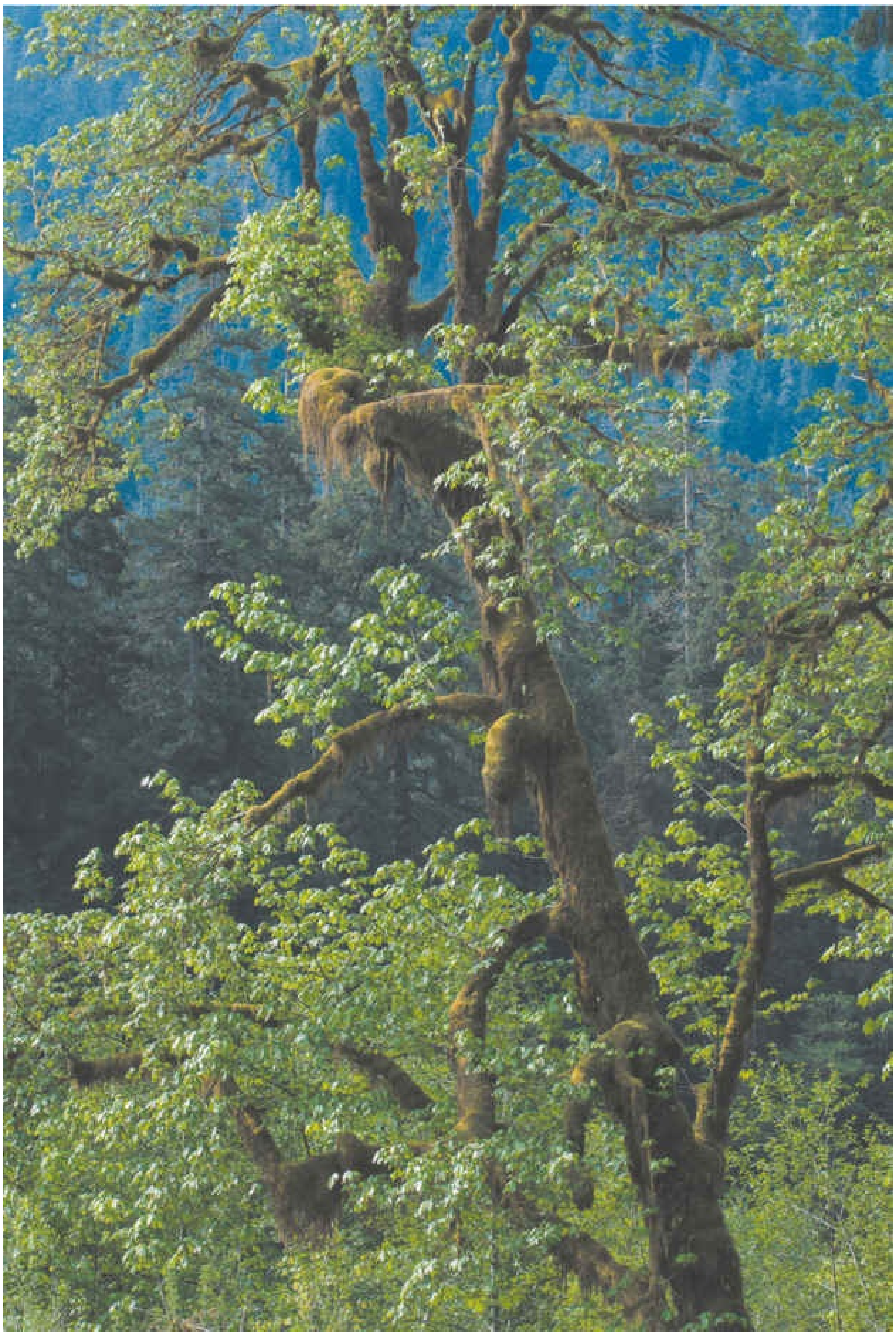
A wide-angle lens often accentuates this plane of maximum polarization. If you take a photo of the sky with a wide-angle lens, you'll notice unevenness in sky tonality, even without a polarizer, since the lens sees such a large angle of view. If you add a polarizer, the effect is heightened even more. For example, a 24mm lens has a picture angle of 84 degrees. One side of the frame will be relatively close to the axis of the sun and, consequently, show little polarization effect. The other side is relatively close to 90 degrees off the sun's axis and thus shows a great polarization effect. The end result is an unevenly polarized sky. This is not the fault of your polarizer; it's just an effect that is inescapable with a wide-angle lens's coverage of view. If the graduated tone in the sky bothers you, there are several partial remedies. You could reframe the composition to encompass the least sky possible. Shooting a vertical would also help, as it narrows the angle of coverage across the top of the frame. Try backing off the amount of polarization; there's no reason to always use the maximum effect. Using a longer focal length would totally solve the problem, but of course, it would also radically alter the image.

Watch for vignetting when you use a polarizer on a short-focal-length lens. Some polarizers are fairly thick and cut off the corners of the frame, an effect worsened by stacking filters, or adding a hood that screws directly into the filter. Since you're generally viewing with the lens wide open, this vignetting may not be obvious. Mount the filter, point your lens at the sky, and shoot a test frame at the smallest aperture.

I mainly use polarizers to remove glare from vegetation or rocks or the surface of water. Photographing in light rain is a great time to use a polarizer to saturate the colors of those wet, shiny leaves. The problem here is that polarizers cut the amount of light passing through the lens, necessitating a slower shutter speed for any given *f*-stop. Inevitably, the slower the shutter speed, the more likely an increase in wind speed.



Moss-covered big-tooth maple in the Hoh Valley, Olympic National Park, Washington. Photo taken with a polarizer.
Nikon D2x, Nikon 70−200mm lens, 1/15 sec., *f*/11, ISO 200



Moss-covered big-tooth maple in the Hoh Valley, Olympic National Park, Washington. Photo taken without a polarizer. Nikon D2x, Nikon 70−200mm lens, 1/60 sec., *f*/11, ISO 200

Polarizers cost you between 1 and 2 stops of light. Of course, the camera's TTL meter takes this into account. If you rotate the polarizer on your lens and see no visual change, you have in effect added a 1-stop neutral-density filter. Getting a slower shutter speed, to blur moving water for example, is one reason to add a polarizer even if it doesn't seem to change the image visually. At maximum polarization, where you see a major difference as you rotate the filter, it is roughly a 2-stop change. Be aware of what this is doing to your exposure values, particularly the shutter speed. You might have to increase ISO in order to fight the wind.

NEUTRAL-DENSITY FILTERS

A neutral-density (ND) filter is a really basic filter: it simply reduces the amount of light entering a camera and thus opens up two opportunities:

1. Photographing at a longer exposure time than otherwise possible.
2. Photographing at a wider aperture than otherwise possible, allowing shallower depth of field.

For nature photographers, increasing the exposure time is by far the more important point.

Theoretically, ND filters are, as the name suggests, neutral in color. Unfortunately, this is not always the case. If you're a RAW shooter, a color cast isn't really a big deal, since this can usually be corrected in postprocessing by adjusting the white balance; however, if you're a confirmed JPEG shooter who does no postprocessing at all, you will have to run some tests to determine what white balance to set in-camera when the filter is used. Be aware that some of the inexpensive filters sold as "gray" are not remotely neutral and often have a color cast that is impossible to correct.

Lichen-covered granite at the Remarkable Rocks, Flinders Chase National Park, Kangaroo Island, Australia. I believe this is the first image I ever shot using the Kenko ND400 filter. I do remember timing the exposure using my watch, trying not to get distracted by some friends who insisted on talking to me. Nikon D2x, Nikon 12−24mm lens, 2 minutes, *f*/16, ISO 100

ND filters are available in different strengths, usually marked in stop values in one of several ways, depending on the filter manufacturer. For example:

- .3 or 2X or ND2 = 1 stop
- .6 or 4X or ND4 = 2 stops
- .9 or 8X or ND8 = 3 stops

ND filters come as screw-in versions in standard filter sizes or as square or rectangular versions that require a filter holder for use. I think the most useful strengths are between 5 and 10 stops of density.

The brands I would recommend are Hoya or Kenko (the same, just different marketing names), Lee, Tiffen, B+W, and Singh-Ray. I happen to own four ND filters: a Kenko ND8 (which I rarely use); a Singh-Ray 5-stop, a 7-stop Tiffen IRND 2.1, and a Kenko ND400. Hey, how many stops is that last one? Remember that a stop is a doubling, so let's count doubles: 2, 4, 8, 16, 32, 64, 128, 256, plus some more. So that's about 8 1/2 stops. I can easily make sure of the exact amount by setting my camera on manual exposure, zeroing the meter, and then adding the filter and counting how many stops are needed to get the meter back to zero. In this case it's 9 stops, so this particular filter which I own should really be marked as an ND500 (Okay, an ND512 to be precise). Do this test with any ND filter you buy in order to check the actual density amount.

By the way, there's nothing special about the ND filters I own. These just happen to be the ones I could easily obtain.

There are a number of companies offering variable ND filters, which allow you to dial in a varying amount of ND (although few of these variable filters show in *f*-stop increments the amount of ND being changed). Since I already own ND filters, I see no reason for me to purchase one of the variable type. I've heard good reports about the ones from Singh-Ray (the thin model), Tiffen, and Heliopan. All of these are available only as screw-in filters. Variable NDs tend to be rather thick, so watch out for vignetting on lenses wider than 28mm. Vignetting and price are the major drawbacks with this style of ND.

Good ND filters, while seemingly simple in design, are not cheap. The Tiffen IRND in 77mm size is currently about $90 retail; the Lee 10-stop "Big Stopper" is about $180 and needs an additional filter holder to use, and the Singh-Ray thin-mount variable ND in 77mm size is roughly $400.

How to Use an ND Filter

It goes without saying that if you're working a really long exposure, the camera will be mounted on a solid tripod. When you use a heavy ND filter to obtain a really long exposure, anything that moves will be blurred, whether that be clouds, flowing water, or vegetation. Generally speaking, it's often more powerful to contrast the blurred subject with a sharply focused nonmoving object.

The two major problems when using an ND filter are focusing and obtaining correct exposure. In some light, my Nikons will actually autofocus with my Kenko ND400 in place on the lens, but at lower light levels, this is just impossible. The answer is to compose and focus without the filter in place and then *carefully—very, very carefully—* add the filter, making sure you do not change the focus, or change the focal length on a zoom lens.

Up to a 30-second exposure time, the odds are that your camera meter and/or autoexposure will work. If you're using autoexposure with an ND filter, make sure you cover the viewfinder eyepiece before you shoot, as light entering from the back of the camera will most likely affect the meter.

Past a 30-second exposure time, you'll need to count stops. Take a meter reading without the filter in place and then add the number of stops needed for that filter (earlier I told you to run a test to determine the actual amount of ND of a filter). For example, suppose I'm going to use my 9-stop ND Kenko, and a metered exposure without the filter is 1/4 sec. at *f*/11. I need to add 9 more stops of light, so doubling the shutter speed yields: 1/2 sec., 1 second, 2 seconds, 4 seconds, 8 seconds, 16 seconds, 32 seconds, 1 minute, 2 minutes. I can easily count this on my fingers, doubling the time for each stop.

Turn off autofocus if it's on the shutter button. Turn off image stabilization/vibration reduction. Set the camera on manual exposure mode and the Bulb setting. You obviously don't want to touch the camera during the exposure, so use a locking remote release and keep the shutter open for the long exposure time you determined. You could use a remote release and time the exposure with a watch, but far easier is to use a programmable-timer release such as the Nikon MC-36A or Canon TC-80N3. Don't worry about mirror lock-up for such a long exposure.

Now the question is whether or not to use the in-camera Long Exposure Noise Reduction (LENR). When LENR is turned on, the camera immediately makes another exposure of the same length, a dark frame, and compares the two. The camera then subtracts the noise and any hot pixels before it writes an image to the card. While this works well, doubling the exposure time for every shot is a high penalty. A 5-minute exposure becomes a 10-minute one. And, of course, you're draining your camera battery. You do have a second battery with you, right?

I would strongly suggest that you run a test to see if the benefit of LENR is worth it. Take several very long exposures, with and without LENR turned on, and evaluate the results. Just in passing let me remind you that underexposing digital files is a major source of noise in images. Please read the section on exposure.

GRADUATED NEUTRAL-DENSITY FILTERS

Graduated ND filters are, as the name says, graduated. That is, they are partly dark neutral density and partly clear. One side of a graduated ND filter has the dark density, which then tapers to the totally clear area on the other side of the filter. The graduation itself can occur abruptly, a "hard" graduation, or it can shift over some distance, a "soft" graduation.

By adding a graduated ND filter over your lens, you can reduce the light on one portion of the image, effectively compressing the tonal range of a scene. Exactly where this occurs within the photo depends on how you orient the dark area of the filter. However, these filters are not a miracle cure. If there is no data to be recorded in part of the scene, an absolutely blank white sky for example, a graduated ND filter is only going to make that area darker in tone, nothing more.

Graduated ND filters are available as round screw-in filters and as rectangular filters that must be used in a slotted filter holder. Don't bother with buying a round screw-in version, as it's a waste of money; the graduation is right across the middle of the frame, and there is no way to reposition where it falls. A filter holder for the rectangular filters allows you to slide a filter up or down, repositioning the ND part of the filter. The holder can also be rotated at any angle, which gives the photographer even more control over the filter placement.

You could dispense with the holder and just hold the filter up to the front of the lens during the exposure. This works okay once in a while, but it's pretty easy to bump the camera during the exposure. Depending of the orientation of the filter, having your fingertips creep into the frame is another problem (speaking from my own experience, at least), and while in cold weather, the filter can be fogged from the heat of your hands. All in all, having a filter holder is a good idea if you use graduated ND filters more than just a few times a year. FYI, the extra thickness of the filter holder itself can create vignetting problems with short focal lengths, so one solution is to get a larger-than-normal filter holder and filters. Most rectangular graduated filters are 82mm by 120mm, which fit the readily available Cokin P size filter holder. The next size up—at just over double the cost—are 100mm by 150mm filters, which fit either the Lee holder or the Cokin Z-Pro holder.

Sea stacks at low tide, Bandon, Oregon. I was concerned about two potential problems: my tripod slowly sinking as the waves washed the sand beach, and any movement of the gulls in the middle-ground area. While the tripod held firm, the gulls did move a bit, but they are small enough in the frame that I'm not really concerned. Nikon D800E, Nikon 45mm T/S lens, 30 seconds, *f*/7.1, ISO 100

Graduated ND filters really work well only with normal to short focal lengths. The longer the focal length used, the less obvious the graduation; use a telephoto lens, and a graduated filter has little effect at all.

Just as with solid ND filters, graduated NDs are available in different ND strengths, almost always 1-stop, 2-stop, and 3-stop densities in both soft and hard graduations. I've used, and would recommend, those made by Singh-Ray. Note that these are made of acrylic resin, so they can scratch fairly easily if mishandled, plus they tend to hold a static charge and attract dust. The best feature about them is that the neutral section is indeed neutral, adding no unwanted color cast.

You can also find "color grad" filters—with one side clear, one side colored—with names such as Sunset, Tobacco, Coral, and Tropical Blue. Don't go there. When did you last see a tobacco-colored sky?

Storm waves batter the rocky shore of Sea Lion Island, Falkland Islands. I only had a 3-stop ND filter with me, so I did everything I could to lengthen the exposure time: ND filter, lowest ISO possible on my camera, and the smallest aperture on my lens. Nikon D4, Nikon 24−120mm lens, 20 seconds, *f*/22, ISO 50

How to Use Graduated ND Filters

The most difficult aspect of using a graduated ND filter is positioning the graduation. You cannot position the filter by looking at where the graduation occurs in front of your lens. How much density covers the front element does not directly equate with how much of the final image is affected. The more you work at the small apertures, the greater the effect of the filter; shoot with the lens wide open and there is little effect at all.

You want the graduation to fall along the transition between the light and dark areas of your subject. A filter with a "hard" graduation is most useful where there is a distinct and relatively abrupt shift in tonality. A "soft" filter works better where the transition is more indistinct. For precise positioning of the graduation, do one of the following:

1. While looking through the viewfinder, use the depth-of-field preview function to stop down the lens to your selected shooting aperture. The viewfinder image will get darker, so wait a bit for your eyes to adjust to the lowered light level. Now slightly wiggle the filter. The movement of the filter allows you to see exactly where the graduation occurs so that you can precisely align the filter as you desire.
2. If your camera has Live View, and most current models do have this feature, use it to position the filter. Again, you'll want to view at the shooting aperture. You will have to read your camera manual in order to determine the steps necessary for your particular camera. Neither Nikon nor Canon has totally consistent Live View

procedures for all their different camera models. Read the manual, then reread it again, as I guarantee that the directions will be confusing (and probably conflicting). When in doubt, run some tests and google how to use Live View with your camera model.

Determining exposure is easy. Take a meter reading with the filter in place and shoot a frame. Check the histograms of the resulting image and adjust the exposure as needed. Take a shot, take a look. Please refer to the section on exposure for a thorough explanation.

A problem you'll discover with using any graduated filter is caused by the simple fact that the graduation is in a straight line across the filter. Any object that falls directly in the transition zone of the filter will be darker on one side and lighter on the other. One classic example is a tree near the horizon. Add a filter to darken the sky, and the tree changes tonality part of the way up its trunk. Or, use a graduated filter on a mountain scene, and the top of the mountain ends up darker than the lower section. I've seen portraits of people taken this way, where the upper half of their faces are 2 or 3 stops darker than the lower half. (Aliens from another planet? Should we contact *Men in Black*?)

To be honest, with the newest cameras I see far less need to use graduated filters in the field. Why? The widening dynamic range of the latest cameras, combined with the most recent RAW file conversion software. My Nikon D800E has at least 11 stops of dynamic range at ISO 100, and I tend to think it's probably a stop or so more than that. This is roughly three times what I had in the film days when I used Velvia 50. I can get usable data in both the shadows and highlights without any filtration done in the field.

Combine this with the latest software. I use Lightroom as my RAW file converter, and it offers both a graduated filter and an adjustment brush. Its graduated filter can be adjusted incrementally in $^{1}/_{100}$ of an *f*-stop. Need a .73 stop filter? It's now available, along with a 1.41 stop grad, a 2.59 stop grad, etc. Using a Lightroom graduated filter allows me to affect a number of other adjustments (such as Clarity and Contrast) along with exposure, if I want to do so. For practical purposes, I can have as many graduated filters on any one image as I want, in any sort of graduation (from extremely hard-edged to as soft-edged as possible). Plus, Lightroom has an adjustment brush, which lets me brush in a lightening or darkening effect in combination with other adjustments, once again in increments of $^{1}/_{100}$ of an *f*-stop. I'm no longer restricted to that straight-line graduation across a physical filter. I can paint around the tree that's on the horizon.

If I really need to extend the dynamic range even more, I'll take two images in the field, one exposed for the highlights and one exposed for the shadows, and combine the two in Photoshop using masks. I still own several graduated ND filters—2-stop and 3-stop soft and hard graduations—but now I rarely use them.

Sea stacks on the Oregon coast. A combination of low light, a polarizer, and a 5-stop ND filter gave me the effect I wanted. Nikon D2x, Nikon 28−70mm lens, 1 minute, *f*/8, ISO 100

Flash

All current cameras support through-the-lens (TTL) flash metering, using either a small built-in flash that pops up or a larger external flash. Both kinds offer two modes—manual and TTL—while some of the external flashes have a third “auto” mode, which makes the flash usable with only two or three apertures. If your flash has this “auto” choice, don’t bother using it.

The amount of light falling on a subject depends on how far away the light source is located. Back in middle-school science we learned that light falls off at the square of the distance. Move away from a reading light, and it quickly gets a lot dimmer. But we’ve all seen concerts where hundreds of flashes are firing, from point-and-shoot cameras or smartphones, held by people far from the stage. Well, they’re not going to illuminate much with that little pop of light. It’s not because the people are too far away but because the flash-to-subject distance is too great for the amount of light put out by the little flash. While we tend to think of flash-to-subject distance as the same as camera-to-subject distance, these need not necessarily be the same. Of course, with a built-in flash you have no choice.

Young Japanese macaque monkey being held by its mother, Japan. Nikon D3, Nikon 70−200mm lens, fill flash, 1/750 sec., *f*/8, ISO 560

MANUAL FLASH

The standard method of determining flash exposure in manual mode is by using a guide number (GN) formula:

$$\text{GN} = \text{aperture} \times \text{flash-to-subject distance}$$

Guide numbers are supplied by the manufacturer and are generally given for ISO 100. Of course, if you work in stops, it's very easy to determine GNs for other ISOs. Suppose the GN is 28 for a given ISO. One-stop faster ISO would be GN 40; one-stop faster ISO than that would be GN 56. (How did I get these numbers? Did you recognize it's the *f*-stop sequence: 2.8, 4, 5.6?)

Don't bother about GNs when using a built-in flash. In all honesty, even though these have a manual setting and generally allow for reducing the manual output, these flashes are meant to be used in the TTL mode.

With modern external flash units, you shouldn't have to worry about GNs either. Almost all have a built-in calculator that coordinates the flash output power, with the aperture you set and the flash-to-subject distance to use. You'll need to put the flash in the camera's hot shoe for the calculator to work, since a chip in the flash reads information from the camera. For example, I have a Nikon SB-700 flash, a very popular unit. I mount the flash in the hot shoe and set my lens to *f*/11, and using ISO 400, the flash tells me it needs to be 16 feet from the subject, if I use the flash at full power output. However, if I dial down the power to 1/8, the flash then tells me to be 6 feet from the subject. The flash unit fudged the answer a bit, since full power to 1/8 power is 3 stops—1/2, 1/4, 1/8—and three *f*-stop numbers from 16 would be 5.6. There are many applications of the *f*-stop sequence, which work in whatever units of measurement you want to use: feet, meters, wine-bottle lengths, etc.—it doesn't matter so long as you are consistent).

Why would I ever do this, when the flash has a TTL mode? If you take the flash off-camera, the camera might no longer communicate with the flash; consequently, no TTL. Let's say I'm shooting at twilight and want to add some light to a certain area. I can use the timer to trip the shutter while I hold the flash in position, given that I'm using a long enough shutter speed so that I can fire the flash while the shutter is open. What if I want to weaken the flash a bit? In the example above, I ended up with the flash at 5.6 feet from the subject. If I move back and hold the flash at 8 feet, I've weakened the light by 1 stop. Or I could have remained with the flash at 5.6 feet and cut the flash output power from 1/8 down to 1/16.

If you think in stop increments, lighting becomes a bit easier to understand. Suppose your flash is on full power but you still need 1 more stop of light in order to get the aperture you need for depth of field. You could add a second identical flash, at the full power setting, at the same location at the first unit. Or you could increase the ISO 1 stop. Or you could move the original single flash closer to the subject, determining flash-to-subject distance using the *f*-stop sequence. Any of these would give you 1 stop of additional light. Double the amount of light = 1 stop.

Just to make sure you understand, let me give you a test. You're shooting a photo of your pet (who is lying on the couch, even though it knows better). The light source is one 100-watt lightbulb, but you need another stop of light. What do you do? A stop is a doubling of the amount, so you need a second 100-watt lightbulb. Okay, but then you need another stop of light. This time you need four 100-watt lightbulbs (double the two bulbs you were using). Eight 100-watt lightbulbs would be 1 more stop additional light, and sixteen bulbs, another.

TTL FLASH

One of the few times you might use your flash in manual mode is when you need extremely short flash duration times. Dropping the power output down significantly, to

1/32 power or less, gives extremely short bursts of light but of course also means that the flash has to be pretty close to the subject. For the vast majority of uses, you'll have your flash in TTL (through-the-lens) mode.

In TTL, a meter in the camera (a separate meter for the flash, not the ambient-light meter) reads the light coming through the lens and adjusts the flash's output accordingly. The meter turns the flash off once it has put out the correct amount of light needed for the selected aperture, provided that the flash has enough light output for that aperture. Just to make sure all of the electronic connections work correctly, and that flash and camera talk to each other, I would suggest purchasing a flash made by your camera manufacturer. Nikon owners, get a Nikon flash, and Canon owners, get a Canon flash, etc. If you want to use the flash off-camera, you'll need a TTL flash cord; again, I would get the brand name one, as many of the eBay knockoffs don't work correctly.

Okay, you've gotten a TTL flash, but now what? There are two ways to use any flash: you can light your subject entirely with the flash, what I call *total flash*, or you can add light to a normal natural-light exposure, what is called *fill flash*. These are two distinctly different concepts.

TTL Total Flash

In TTL total flash, all of the light hitting the subject is from the flash. There is no available-light exposure being recorded. This is the old "use a flash indoors since there's not much light" type of photo. You will rarely find yourself doing this in nature photography except for studio setups, and close-up work, especially of small, animate creatures (see this section on close-up flash).

To use TTL total flash, set the camera exposure mode to manual and the shutter speed to sync speed or slower. You don't want the camera to try to take a really long ambient exposure. Connect the flash, make sure it's in TTL mode, and trip the shutter. The flash will put out the correct amount of light for the *f*-stop you're using. With an available light exposure, shutter speed and aperture control the amount of light hitting the sensor, but with TTL total flash, the flash output is the only control. To lighten or darken an image, use the compensation setting on the flash, which works in stop increments. Dial in +1 to lighten the image by 1 stop, or +2 for 2 stops, and so on. Some camera/flash combinations allow for adjusting the flash output using the autoexposure compensation on the camera, in addition to the compensation on the flash. A quick test will tell if your camera does so. Take a flash photo with no camera compensation, then a second frame at a−2 stop compensation on the camera, and see if there is a difference in the images. To tell if the exposure is correct, check the histogram. Raw shooters will want it weighted to the right; JPEG users will want it to reflect the tonal values of the subject. The exposure process has not changed; you're just using a flash to get there. The histogram is your friend.

TTL Fill Flash

When a subject is lit entirely by ambient light and you add flash, you are using fill flash. The flash doesn't light the subject, as in total flash, but only adds some light to the dark, shadowed areas. You’re just taking a normal available-light photograph and adding some flash to it. The flash supplements, but does not supplant, the natural light. Flash units in the TTL setting are by default always in the fill-flash mode. When there is no available light, they are just “filling” all the light needed for a photo.

I’m going to have to generalize a bit now, as every flash system on the market works slightly differently. There’s no way around it … you’re going to have to do a bit of testing with your equipment. Canon and Nikon flashes work slightly differently in terms of flash compensation. And, to make matters more confusing, not all the flashes of the same brand have the same features or the same controls. Read your flash instruction manual carefully, and then reread it, as I promise the instructions will be confusing (seemingly written by someone who speaks no language known on this planet).

Whatever system you have, you’ll want to enable your camera to use shutter speeds higher than the normal flash-sync speed. Canon calls this *high-speed sync*, while Nikon uses *auto FP*. At higher shutter speeds, the flash fires a series of pulses, rather than one big pop of light. You basically lose 1 stop of power for every stop of shutter speed above the normal sync speed (1/250 sec. on most cameras). In terms of using slow shutter speeds, most cameras will not drop below 1/60 sec. with flash, when the camera is in either the Aperture Priority or Program exposure mode. You can change this minimum speed in the Custom Settings menu, or set the flash to *slow-speed sync*.

As I said earlier, with fill flash you’re just taking a normal available-light exposure and then adding flash to open the shadows. How much flash you add is up to you. In my opinion, at their base “zero-compensation” setting, most flashes put out far too much light. I find these pictures to be overlit. You don’t want to eliminate all the shadows but just to lighten them a bit. In general, you’ll want to set the compensation on the flash somewhere in the range of −1 to −2 stops. Take a test shot, evaluate the image on the camera’s LCD, and change the compensation if needed.

Telephoto TTL Fill Flash

You can increase the effective power of your flash by concentrating the light. When a flash is fired, the light spreads out at a fairly wide angle, but often you don’t want that coverage, especially when you’re using a telephoto lens. By narrowing the beam of light, you direct more light onto your subject. Indeed, most current flashes do this to some extent, as the flash head automatically zooms a bit as you change focal length, yielding at most about a 1-stop gain in light.

The Better Beamer flash extender mounted on a Nikon SB-800 flash. In use, the flash would either be in the camera’s hot shoe or connected to the camera with a TTL flash cord.

The Harbor Digital Designs flash extender mounted on a Nikon SB-800 flash. As with the Better Beamer, in use, the flash would either be in the camera’s hot shoe or connected to the camera with a TTL flash cord.

Whimbrel, California. Nikon D3, Nikon 600mm lens, fill flash, 1/1500 sec., *f*/5.6, ISO 1000

If you need to throw the light much farther, the answer is a flash extender, basically a plastic Fresnel lens held in front of the flash. There are two flash extenders on the market that I would recommend: the Better Beamer (also sold as the Flash X-Tender) made by Visual Echoes and the Harbor Digital Design Flash Extender. Both brands will effectively increase the power of your flash by about 2 or 3 stops. The Better Beamer is widely available, is inexpensive, and folds flat for storage. Heavy plastic nontwist wings attach to your flash with a wide strap, and the Fresnel Velcros on to the end of these sides. The Harbor Digital Design extender is a bit more expensive, with fitted adapters for specific flash units, and consequently quite a bit more stable. While I do prefer the Harbor Digital model, it is a rigid unit, so it's more awkward to pack. With either brand, use a 300mm or longer lens and make sure there is a clear sight path from flash to subject.

Determining the amount of fill to use is exactly the same as if you didn't have a flash extender mounted on the flash unit. You're just throwing the light out a greater distance. Between −1 stop and −2 stops of flash compensation is still a good starting point.

You'll use a flash extender to add fill light on birds or mammals out to a subject distance of about 100 feet maximum, although generally you'll be much closer. After all, to get a decent shot of a mallard duck, you've got to be fairly close, within about 40 feet with a 500mm lens. It's also a good idea to set the flash to *rear-curtain sync*. A flash normally fires at the moment the shutter opens, at the start of the natural-light exposure. Occasionally, a subject will flinch a from the flash's burst of light. With rear-curtain sync, the flash fires at the exact moment the shutter starts to close, and any subject movement occurs after the exposure has been made.

A word of caution: a Fresnel lens acts as a magnifying glass in that it concentrates light. This applies to both directions: light going out or light coming in. If you leave a Better Beamer-equipped flash inadvertently aimed at the sun, the concentrated sun rays will burn a hole into your flash, even if the sunlight path is at an angle. I have a Nikon SB-800 flash with burn marks all over the black plastic body of the flash just from my extended use of the Beamer in the field.

And a final note about flash: more and more cameras now allow wireless control of off-camera flashes, so long as the flashes are the same brand as the camera. This might be via the built-in pop-up flash, or through an external flash mounted in the camera's hot shoe. I'll use Nikon as an example, just because I'm most familiar with the system. With the right flash units, one on-camera flash can wirelessly communicate to three other groups of flashes, with basically an unlimited number of flash units in each group. The power output of each individual group can be adjusted up or down by simple menu selections set on the camera, while maintaining complete flash TTL metering. In practical terms, you're limited only by how many flashes you want to carry. Having a wireless option available might be something to consider when purchasing flashes.

Patagonia gray fox, Torres del Paine National Park, Chile. Nikon D2x, Nikon 200−400mm lens, fill flash, 1/320 sec., *f*/5.6, ISO 400

Chapter 2

GETTING STARTED

Working in Stops

During the past few years, I've encountered a serious trend at the workshops and seminars I conduct: given the sophistication of current digital cameras, users have not bothered to learn basic underlying photographic concepts, relying instead on their cameras to make all the "correct" decisions. This, to me, is not a wise decision. I want to be in direct control of the entire photographic process, from start to finish.

Let me review what I consider to be the most essential photographic knowledge: the concept of *f*-stops. In photographic terms, a 1-stop change is defined as a doubling or halving of any value whatsoever. It's always relative, since you can have twice as much or half as much of any given value. The more you can think and work in stop increments, the easier camera control will become.

There are three functions on a camera that are interrelated: shutter speed, lens aperture, and ISO. These three functions control how the camera deals with light. *Shutter speed* is a time value, expressed as the length of time the camera's shutter blades are open, allowing light to fall on the sensor. Shutter speed measures the duration of time that light enters the camera and is measured in seconds and fractions of seconds. *Aperture* is a measurement of the size of the lens opening, the hole through which light passes to fall on the sensor when the shutter is open. Aperture settings control the light intensity, allowing more or less light to pass through the lens. Aperture settings are normally expressed as a series of *f*-stop numbers. *ISO* is a measurement of how the sensor reacts to light. In a digital camera, this is basically the equivalent to the volume control on TV or radio. ISO is expressed in ISO numbers, typically ranging from 100 to 6400. Crank up the volume and you get more signal (and more static).

The Beehive, a weathered sandstone formation in Valley of Fire State Park, Nevada. Nikon D3x, Nikon 45mm T/S lens, 1/60 sec., *f*/14, ISO 100

Let me discuss these three variables one by one and then show their interdependence.

_F_-Stop Numbers Explained

Ever wonder why the *f*-stop numbers are such a weird progression? You might notice that each number is 1.4 times the preceding. Okay, let's do some middle-school math. Apertures are holes and are basically circular in shape. Let's write a formula so that one circle is twice the area of another circle. The formula for the area of a circle is Area=πr^2 where r is the radius of the circle. To find a circle with twice the area we have $2\pi r^2 = \pi \times 2$. Solve for × and you get the square root of 2 (1.4, that is) times the radius. If r = 1, a circle twice as large in area has a radius of 1.4; if r = 1.4, × = 2; if r = 2, × = 2.8; if r = 2.8, × = 4; r = 4, × = 5.6. Wow, it's the *f*-stop sequence of numbers!

SHUTTER SPEED

As you change shutter speeds, you change the way in which motion is recorded. The faster the speed—going from 1/250 sec. to 1/500 sec. to 1/1000 sec., for example—the more an image will be a recording of a moment frozen in time. Conversely, going to ever-slower speeds—from 1/15 sec. to 1/8 sec. to 1/4 sec.—will record any motion as blurred; the slower the speed, the longer the time the shutter is open and the more blurred the motion.

Shutter speeds are indicated in seconds and fractions of seconds in a progression of times. Different camera bodies from different manufacturers have various starting and ending points on this scale, but the scale itself is what's important. All DSLR cameras will have at least the following sequence (and probably a lot more): 1 second, 1/2 sec., 1/4 sec., 1/8 sec., 1/15 sec., 1/30 sec., 1/60 sec., 1/125 sec., 1/250 sec., 1/500 sec., and 1/1000 sec. No camera that I know of displays the fractions of seconds as written; instead these shutter speeds are abbreviated, displaying 1/30 sec., for example, as just 30. To differentiate between full seconds and fractional speeds, speeds of 1 second and above are normally shown with a “mark. Thus 2” means 2 seconds, not 1/2 sec.

If you look at the shutter speed sequence in the previous paragraph, you’ll see that each time value is either half the preceding number or double the following number, depending on which way you’re looking at this progression of numbers. For example, 1/30 sec. is half the time of 1/15 sec. but double the time of 1/60 sec. Each of these is a 1-stop change, since a stop is defined as a doubling or halving of any value. Going from 1/125 sec. to 1/250 sec. is a 1-stop shift (one halving), to 1/500 sec. another stop change (another halving of time), to 1/1000 sec. another one. Changing from 1 second to 2 seconds is a 1-stop change (one doubling of time).

Monte Fitz Roy reflected in Lago Capri, Los Glaciares National Park, Argentina. Nikon D3, Nikon 24−70mm lens, 1/6 sec., *f*/16, ISO 200

So pop quiz time: How many stops are there from 1/30 sec. to 1/1000 sec.? And, going the other way, how many stops from 1/30 sec. to 1 second? Did you get it right? It's a 5-stop change, either direction.

In their Custom Settings menu, most cameras allow you to program how you want the camera to function. For example, my Nikons let me choose between 1/3-stop increments, 1/2-stop increments, or full-stop increments. My advice: select 1/3-stop increments for more precise control. When I select that, my camera includes and displays all the intermediate shutter speeds: 1/8, 1/10, 1/13, 1/15, 1/20, 1/25, 1/30, 1/40, 1/50, 1/60, etc. But the concept of doubles and halves still applies. From 1/30 sec. to 1/60 sec. is a 1-stop shift, as is from 1/20 sec to 1/40 sec. or 1/13 sec. to 1/25 sec.

APERTURE

The apertures of a lens, marked in the *f*-stop numbers, also work in stop values. Although they represent a progression of doubles and halves, the numbers themselves are not numerically doubles and halves. A typical *f*-stop series would include *f*/1.4, *f*/2, *f*/2.8, *f*/4, *f*/5.6, *f*/8, *f*/11, *f*/16, and *f*/22 (although the camera will display only the number itself, not the "*f*/" part). Not all lenses will have all these numbers, while some will have additional ones. The important thing to remember is that this sequence represents the varying hole size in a lens—the aperture—though which light passes. The *f*-stop numbers just listed are in full-stop increments. Each opening, each aperture, allows twice as much light or half as much light to pass through the hole as the preceding or following aperture. Memorize this series of numbers; instead of singing in the shower, count off the *f*-stop numbers both forward and backward. *F*-stop numbers are actually fractions, although they aren't regularly written as such. Thinking of them as fractions will help you realize that the larger the number, the smaller the hole actually is, thus allowing less light to pass through the lens. For example, *f*/2 represents a fairly large hole that admits a lot of light, while *f*/22 is quite a small opening, admitting only a small amount of light. Think of these as fractions: ½ is a lot larger than $^{1}/_{22}$.

As I mentioned, digital cameras can be programmed to display 1/3 -stop, 1/2 -stop, or 1-stop increments. When you select 1/3-stops, as I suggested, it will affect the aperture settings and the digital display readout on your camera. Now an aperture progression might show as 4, 4.5, 5, 5.6, 6.3, 7.1, 8, 9, 10, and 11. Just remember that a 1-stop change is a 1-stop change, regardless of where you start. Going from *f*/4 to *f*/5.6 is a 1-stop shift, as is changing from *f*/11 to *f*/8. But so is switching from *f*/5 (1/3-stop before *f*/5.6) to *f*/7.1 (1/3-stop before *f*/8). The doubles and halves concept still applies, just not in a linear numerical fashion.

By the way, if you have an old lens that has an aperture setting ring, you can set this ring at any position, even if it has click-stop detents. The "click-stops" are there only for convenience so that you could count the *f*-stops as you moved the aperture setting ring. The "clicks" have no other meaning whatsoever. Yes, I remember lenses like this, and yes, I'm really happy not to have to do this anymore. Digital control with command wheels and viewfinder readouts is a lot easier.

Two terms are traditionally used in respect to making a change in aperture. *Opening up* means going to a larger aperture, to a wider hole in the lens, allowing more light to pass to the sensor. *Stopping down* is the reverse procedure. It means going to a smaller aperture, reducing the amount of light. Thus you would open up from *f*/8 to *f*/4 but stop down from *f*/4 to *f*/8.

RECIPROCITY OF SHUTTER SPEED AND APERTURE

Shutter speeds and apertures work together to control the amount of light hitting the sensor. They must be thought of as a pair. They both work in stop values, in a progression of doubles and halves, and are related to each other by what is called *reciprocity*. Once you know the amount of light needed for an exposure, then either the shutter speed or the aperture can be adjusted, so long as the other value in the pair is changed reciprocally. A 1-stop change in the shutter speed equals a 1-stop change in the aperture in the other direction, in terms of the actual amount of light. Double the amount in one scale and halve the amount in the other scale, and you end up in the exact same place in terms of the total amount of light.

Reciprocity is an important concept, so be sure you understand it. Doubling the duration of the shutter speed while halving the intensity of light passing through the aperture is exactly the same, in terms of the amount of light, as halving the time the shutter is open while doubling the aperture's size. Let me give you a nonphotographic example. Suppose you want to draw a gallon of water. You could turn the tap on very hard for a short period of time, or you could have just a trickle of water for a long period of time. It makes no difference, as either way you end up with a gallon of water. That's reciprocity.

In photographic terms, you would use a slow shutter speed and a small aperture, or a fast shutter speed and a large aperture. Either way, the total amount of light going to the sensor is the same. In terms of the amount of light, 1/15 sec. at *f*/11 is exactly the same as 1/8 sec. at *f*/16 or 1/4 sec. at *f*/22 or 1/30 sec. at *f*/8 or 1/60 sec. at *f*/5.6 and so on.

However, and this is a big however, the resulting images will not look the same, due to differences in the depth of field and the control of subject motion. The amount of light is the same but not the recorded image, and that's where you, the photographer, have to start making some choices as to how you want your photograph to appear.

Understanding the concept of stop increments, this doubling and halving of values, is a basic tenet of photography. If you're not comfortable with this idea, please take the time to read this section multiple times. An understanding of the fundamentals will definitely help you work toward becoming a better photographer.

Weathered iceberg, Paradise Bay, Antarctic Peninsula. Nikon D3x, Nikon 24−120mm lens, 1/100 sec., *f*/11, ISO 100

ISO

The actual shutter speed and aperture you use will largely depend on the effect you want to record, but in order to reach those settings you might have to change the ISO sensitivity you have set. Remember that ISO is a measurement of how a sensor reacts to light. ISO numbers such as 50 or 100 are generally referred to as “low” settings (more light is necessary in order to record an image) while numbers such as 1600 or 3200 are “high” (less light is necessary).

ISO numbers work in a straight numerical progression; each doubling or halving of the number represents a 1-stop change. ISO 200 to 400 is a 1-stop change. Continuing on to ISO 800 is another stop and to ISO 1600 is one more stop. It’s easy to count stops as you double or halve the number. So here is another pop quiz: How many stops’ difference is there between ISO 6400 and ISO 100? Counting backward from 6400 and halving the numbers, we get 3200, 1600, 800, 400, 200, and 100, for a total of 6 stops’ difference.

As a general rule, as the ISO number increases, image quality goes down due to noise in the image and reduced dynamic range; however, there are so many different cameras today, with different sensor technologies, that you need to run some tests with your particular camera to determine the maximum ISO that still yields an image you find acceptable.

Hoar frost on trees, Banff National Park, Alberta, Canada. Nikon D3x, Nikon 70−300mm lens, 1/8 sec., *f*/13, ISO 100

You change ISO for one reason: you need more (or less) light for a given shutter speed and aperture combination. You might need a faster shutter speed at a given *f*-stop; raise the ISO. Or you might need a more open aperture at a given shutter speed; lower the ISO. Or you might want a longer exposure time; lower the ISO. You decide what shutter speed/aperture combination you want to use and then set the ISO that gives you that combination.

Brown bear hunting for clams on mudflat, Lake Clark National Park and Preserve, Alaska. Nikon D4, Nikon 200−400mm lens, 1/500 sec., *f*/8, ISO 400

Most current cameras allow you to set the ISO sensitivity step values in 1/3-, 1/2-, or 1-stop steps. If you need a faster ISO, a 1/3-stop increase is just not much at all. I would strongly suggest either 1/2- or 1-stop steps, if for no other reason than to cut down the numbers of “button pushes” or “wheel clicks” need to make a change. Here’s the progression of ISO numbers in 1/2-stop intervals: 100, 140, 200, 280, 400, 560, 800, 1100, and 1600. In full stops this would be 100, 200, 400, 800, 1600.

Exposure Modes

Today's cameras offer the user a great variety of exposure modes. But which ones are useful?

I'm going to make an assumption: If you're reading this book, you're probably not an absolute beginning photographer. You want to be in control of your equipment; you want to make the decisions as to how the photograph looks. You want to work beyond the point-and-shoot mode.

Don't get me wrong. There's nothing bad about point-and-shoot cameras. Most of us probably own and use such a device; more and more, that point-and-shoot is the camera built into the mobile phone we carry. And point-and-shoot cameras are perfect for what they're designed to do. Most point-and-shoot cameras, and almost all entry-level digital SLRs, offer what are commonly called "scene modes." These have names such as Landscape mode, Sports mode, Night mode, Portrait mode, etc. When set to one of these modes, the camera biases shutter speed or aperture or ISO, or a combination of all of these, to favor a given result. What's surprising, though, is that most people don't actually use these settings. Instead, they set their cameras to the simply named Auto mode (usually marked in green) and leave it there forever.

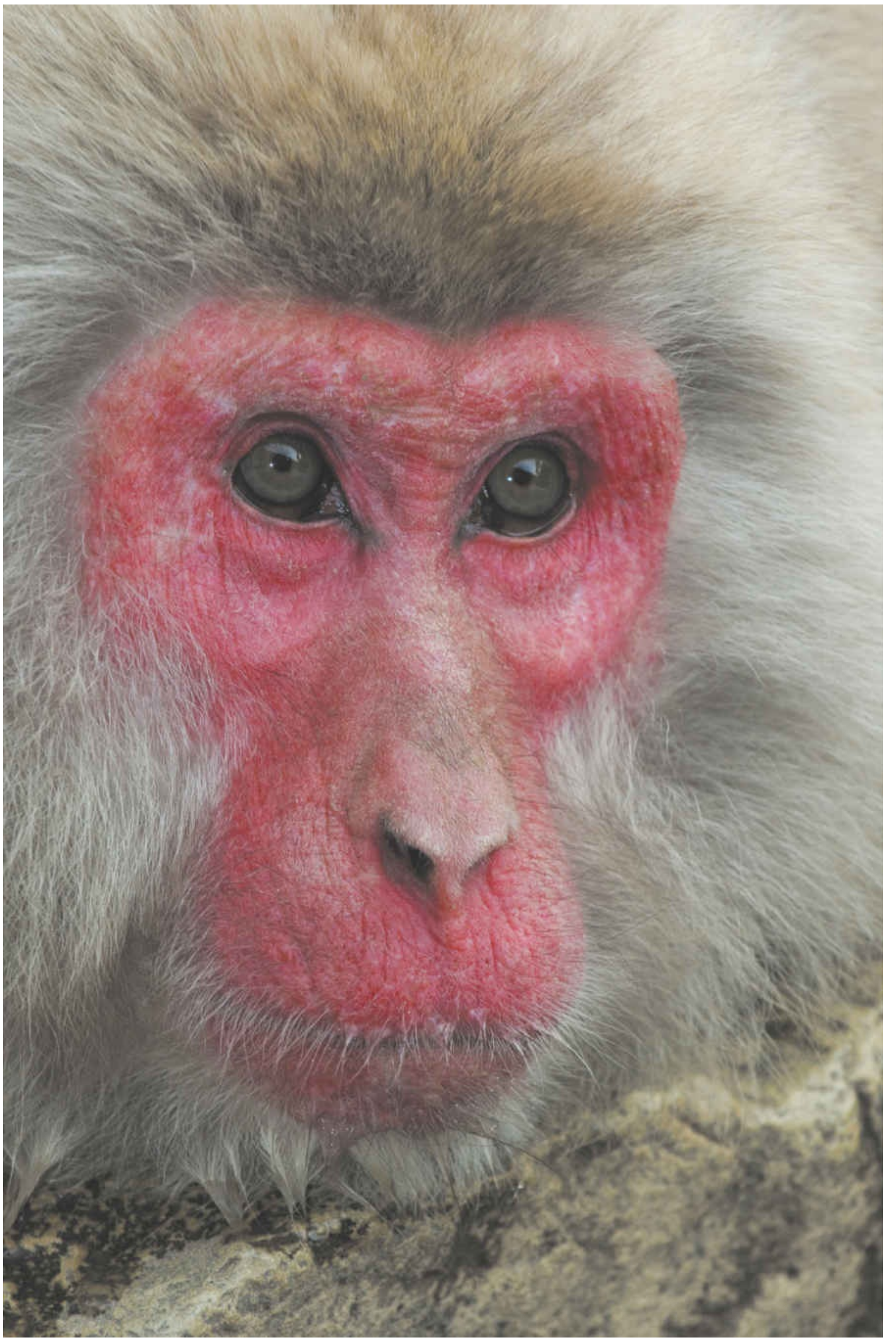
Lago General Carrera, Chile. Nikon D2x, Nikon 28−70mm lens, 1/13 sec., *f*/9, ISO 100

Again, my assumption is that we're way past this point, so I'm not going to discuss these scene modes. That leaves me the four exposure modes that are on almost all DSLR cameras: Aperture Priority, Shutter Priority, Program, and manual.

APERTURE PRIORITY (A OR AV FOR APERTURE VALUE)

In Aperture Priority, you set the desired aperture, and the camera automatically selects an appropriate shutter speed depending on the lighting conditions. This is the mode I use most of the time. If I'm shooting action, I can get the fastest shutter speed possible by setting my lens wide open. The camera then gives me the shutter speed for that wide-open setting. If I do the reverse, selecting the shutter speed first using Shutter Priority mode, I might not be able to shoot wide open. I might lose almost a full stop of shutter speed if the wide-open *f*-stop isn't enough for that shutter speed. Also, most cameras have "stepless" shutter speeds, in that they can operate in between the marked speeds—but only if they are allowed to do so. In other words, setting the *f*-stop always gives me the fastest shutter speed for any given *f*-stop, whether that be *f*/2.8 for action or *f*/16 for landscapes.

Another reason to consider Aperture Priority is that you'll run out of apertures before you run out of shutter speeds. Lenses have a very limited choice of apertures; *f*/2.8 to *f*/22 is only a choice of 7 stops, so if you choose a shutter speed first, you've got a limited choice of *f*-stops. But at any given *f*-stop there is an almost unlimited number of shutter speeds, from the fastest on your particular camera body till … well, until your battery runs out of juice. My camera offers me nineteen marked shutter speeds, from 1/8000 sec. to 30 seconds, plus Bulb, where the shutter stays open until I decide to close it.



Snow monkey (Japanese macaque), Japan. Nikon D2x, Nikon 70−200mm lens, fill flash, 1/125 sec., *f*/8, ISO 400

Sally lightfoot crab washed by surf, Puerto Egas, Santiago Island, Galapagos. Nikon D4, Nikon 80−400mm lens, 1/25 sec., *f*/16, ISO 200

SHUTTER PRIORITY (S OR TV FOR TIME VALUE)

In this mode, you select the shutter speed you want, and the camera selects the appropriate aperture. At first impression, this seems like a mode that would be ideal for photographing action. You have to make sure the available aperture range is sufficient to provide correct exposure at your selected shutter speed. If you don't, most cameras will provide some sort of indication—for example, a blinking icon in the viewfinder—and you'll then have to select a different shutter speed. I can't remember the last time I ever used Shutter Priority.

PROGRAM (P)

In my opinion, this is the least useful exposure mode. Here the camera automatically selects both a suitable shutter speed and an aperture, depending on the lens focal length being used. Once again, just like a point-and-shoot camera, you're giving up control of the photographic process to the camera. True, most program modes are "shiftable," meaning you can run through the combinations the camera is selecting. But why not just make a choice directly? If you know you need a certain shutter speed, select it. If you know you need a small aperture, select it. In all honesty, the only time any of my cameras has been set on Program mode is when I've handed the camera to a non-photographer to use. In essence, I've turned the camera into a very expensive point-and-shoot.

MANUAL (M)

Manual mode is exactly what the name implies. With the other exposure modes, some value (or values in the case of Program) is determined automatically by the camera. Program, Aperture Priority, and Shutter Priority are different flavors of autoexposure. Not here. You set the shutter speed; you set the aperture. The camera stays at these settings until you physically change one. What you set is what you get. Manual exposure mode is also how you can set longer exposure times than your camera offers directly. Set the camera to Bulb and hold the shutter open. Just keep doubling the time for each additional stop you need: 1 minute, 2 minutes, 4 minutes, 8 minutes, etc.

I’ll go into how to determine correct exposure in a later chapter, but let me remind you here that exposure compensation (the feature you use to add or subtract light) works only when the camera is in an autoexposure mode. In Shutter Priority, dial in a +1 compensation and the aperture is opened by 1 stop. In Aperture Priority, add a +1 compensation and the shutter speed is slowed by 1 stop. In Program mode, set a +1 compensation and what happens depends on the software program in the camera. In manual mode, select a +1 compensation and neither the shutter speed nor the aperture changes. The meter readout will change, but the actual shutter speed and aperture in use will not. Like I said, what you set is what you get.

Note: All of the photos in this “Exposure Modes” section were taken with my camera in Aperture Priority mode. As I said, this is my most used exposure mode.

Icicles on iceberg, Antarctica. Nikon D3x, Nikon 24−120mm lens, 1/800 sec., *f*/10, ISO 400

Metering and Metering Patterns

For almost all photographers, the day of the handheld meter is over. Camera meters have gotten so much better over the years, so much more responsive in low light, that I cannot think of any reason why I would use a separate meter. However, whether the meter is handheld or built into the camera, you have to know how to correctly use it and interpret the results.

Depending on which metering pattern you've set on your camera, the camera meter will suggest an exposure that averages out to a medium tone in luminance. It will suggest settings to record the subject as neither light nor dark but average in tonality. As I said in the previous section on exposure modes, in Program mode the camera selects both shutter speed and aperture based on what the manufacturer programmed. In Aperture Priority, the photographer sets the aperture, and the camera alters the shutter speed. In Shutter Priority, the photographer chooses the shutter speed while the camera changes aperture. In manual, the photographer fixes both values. In all of these cases, if the camera is pointed at the same subject in the same light, the answer will be the same: whatever values are needed to render the subject a medium tone. If you simply shoot all the time at what the meter suggests, with no exposure compensation added, all of your images will be recorded as having average tonality.

Receding mountain ridges, Washington. Nikon D2x, Nikon 70−200 mm lens, 1/90 sec., *f*/16, ISO 100

Saguaro cacti at sunset, Arizona. Nikon D3x, Nikon 24−70mm lens, 1.3 seconds, *f*/20, ISO 100

Notice that nowhere have I said that this would be the correct exposure. Meters do not tell you the correct exposure, unless you're photographing a medium-tone subject and want to record it as such.

In fact, let me define correct exposure. Correct exposure means that you record the image as *you* wanted it to be recorded. If you want to take an exposure with the lens cap on and you do so, then you've made a correct exposure. If you want to take an exposure with no lens on the camera and you do so, then you've made a correct exposure. In both of these examples, the results won't be very pleasing … but they will have been correct exposures. You got what you wanted to get. *Overexposure* means the results are *lighter* in tone than what you wanted. *Underexposure* means the results are *darker* than what you wanted. If you want to take a "light" exposure and you add some light to what the meter suggests, and consequently the image is "light," then you've made a correct exposure. If you want a “dark” image and indeed get a “dark” image by taking away some light from the meter’s starting point, then again you’ve made a correct exposure.

Cameras offer a variety of metering patterns; these indicate how much of the frame the meter will read when making the exposure. The first TTL meters had one choice, an *averaging* pattern, which simply disregarded any light or dark areas and averaged out the entire scene. Well, better than nothing. You might still find this option on your camera; my Nikon D4 has it buried in one of the sub-menus. Fine, it can stay there.

Historically, the next metering pattern to arrive was *center-weighted metering*, which is still found on most cameras. This targets a circular area in the center of the viewfinder screen and gives preference to that area over the rest of the frame in a predetermined ratio, such as 60:40 or 75:25. Many current cameras allow you to change the size of the central-metered area that’s metered. The default area in my Nikons is a circle 12mm in diameter, but this can be switched to 8mm, 15mm, or 20mm. I can’t remember the last time I ever used this metering pattern.

Clouds over farm fields, Washington. Nikon D2x, Nikon 28−70mm lens, 1/45 sec., *f*/11, ISO 100

Spot metering is also an option on most cameras. This pattern reads a small area of the frame, a “spot,” which is usually about 1.5 to 2.5 percent of the frame. Most cameras with spot metering allow the spot to follow the autofocus point that has been selected. But don’t think that the AF (autofocus) brackets etched on the viewfinder screen are the exact area covered by the spot. The spot might be considerably larger. Imagine the image frame divided by six horizontal and six vertical divisions to get a grid of thirty-six sections. A 2.5 percent spot meter covers one of those sections. Most of the top-of-the-line cameras have a smaller spot, usually 1.5 percent of the frame. Of course, you could always make the meter cover even less of your subject by just zooming to a longer focal length. The narrower angle of view of the long lens would also narrow the area covered by the meter.

Back in the film days, I used the spot-metering feature of my cameras all the time. I still use spot metering with my digital cameras, but not nearly as often as before.

Black-browed albatross, Falkland Islands. Nikon D3, Nikon 200−400mm lens, 1/250 sec., *f*/19, ISO 200

Be aware that if you use a center-weighted pattern or spot metering and any autoexposure mode (Aperture Priority, Shutter Priority, or Program), once you get the meter reading you want, you must then lock in that exposure. Otherwise, if you recompose your image, the meter will of course be pointed at a different area and could yield a different exposure. With manual metering, once you set the shutter speed and aperture, the two values stay set. But if you recompose so that the meter then reads a different portion of the frame, the meter might tell you a different exposure. In this case, ignore what the meter now says.

The last metering mode is *matrix metering* (also called *evaluative*). Here, the frame is divided into multiple sections—my Nikon D4 uses 91,000—and evaluates (via software) the results. I started this section on metering patterns by saying that a camera meter will suggest an exposure for average tonality. Well, that's not exactly true with the matrix metering mode. The software will bias the exposure somewhat. While matrix/evaluative metering is indeed the most sophisticated metering mode, let me once again say that meters do not necessarily give the *correct* answer for proper exposure. They give "an" answer, but "correct" is another matter. However, as I'll discuss in the section on exposure, matrix metering is what I now use almost all the time. Why? Because digital cameras also offer one of the best-of-all exposure aids: the histogram.

Mesquite Flat Sand Dunes and Grapevine Mountains, Death Valley National Park, California. Nikon D3x, Nikon 70−200mm lens, 1/100 sec., *f*/14, ISO 100

Monte Fitz Roy in morning light, Los Glaciares National Park, Argentina. This image is stitched together from several frames. Setting the exposure manually was the easy way to make sure all of the frames matched. Nikon D3, Nikon

70−300mm lens, 1/30 sec., f/14, ISO 200

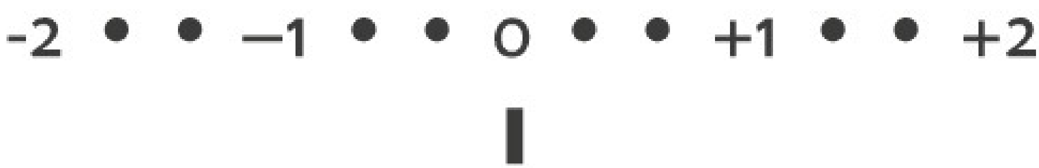
Frost on trees along river, Japan. Nikon D3, Nikon 200−400mm lens, 1/500 sec., *f*/8, ISO 1600

Manual Exposure

In the manual exposure mode, you select both the shutter speed and the aperture you want to use. Don’t confuse the *M* for the exposure mode with the *M* for manual focus on the lens. You can certainly use manual focus with manual exposure, but manual exposure mode can also be used with any autofocus mode. For that matter, manual focus can be used with any exposure mode.

Many people who are relatively new to photography, whose first DSLR camera offered all the autoexposure modes, have never used manual exposure. It’s really not very difficult—and has some distinct positive attributes. In my opinion, the major advantage of manual exposure is that the camera cannot change the exposure settings by itself. This means you, the photographer, are now in charge.

When you look through the viewfinder of a camera set to the manual metering mode, you’ll see an exposure scale (generally horizontally along the bottom of the frame or vertically along the right side). This scale looks something like this:



In this example, the camera is set in 1/3-stop increments, and the scale shows plus or minus 2 stops in these increments. Some cameras might show 3 stops either way. Of course, if you have programmed the camera in the Custom Functions to work in 1/2- or full-stop values, the scale will reflect this. One direction is the plus exposure side (more light), and the other direction is the minus exposure side (less light).

The indicator mark below the zero shows that the shutter speed/aperture you have set matches the exposure suggested by the camera meter. To get to this point, change either the shutter speed and/or the aperture until the indicator mark is at the zero position. For that matter, you could also change the ISO, or any combination of shutter speed/aperture/ISO. Make sure you have not set any autoexposure compensation.

When the indicator mark is at some other position, it is showing how the exposure you have set relates to the camera meter’s suggestion.

For example, here it shows that you have set an exposure 1 stop brighter than the meter reading, a +1 setting:

-2 • • –1 • • 0 • • +1 • • +2

▌✦ ✦ ✦

And here the readout shows a −1 stop setting:

-2 • • –1 • • 0 • • +1 • • +2

✦ ✦ ✦ ▌

Red-crowned cranes landing in snowstorm, Hokkaido, Japan. The predominantly white cranes would pass in front of a medium-tone woodlot as they landed. Manually set values kept the exposure constant. Nikon D3x, Nikon 600mm lens, 1/1000 sec., *f*/6, ISO 400

If you know that you want the final exposure at a value different from the zero position, there is no reason to first adjust the exposure to the zero point on the scale. Just change aperture or shutter speed until the indicator shows the value you want.

If your exposure settings are outside of the range of the metering scale, the scale will show something similar to the following, often with a blinking arrow at one end. Here the scale is indicating that you have set an exposure more than 2 stops above the meter's suggested exposure. You're off the scale to the right.

-2 • • –1 • • 0 • • +1 • • +2

▌✦ ✦ ✦ ✦ ✦ ✦ ▶

Just remember that going to the zero position doesn't necessarily yield a correct exposure. You will very often add or subtract light from this starting point to lighten or darken an image.

WHEN TO USE MANUAL EXPOSURE MODE

There are situations in which using an autoexposure mode is the easiest and quickest way to work, and there are situations in which using the manual exposure mode is best. The major advantage of using manual exposure is that the camera does not change the exposure by itself. Once you have set the exposure the way you want it to be, it stays that way; however, this means that you have to be very aware of any lighting changes and adjust your camera accordingly.

Consider this situation: You're photographing a bird or mammal that is a much different tone from the background behind it. The classic example would be a bison in a winter snow scene, with unchanging light. As the bison walks toward you, it fills more and more of the frame. If you're shooting with your camera set to an autoexposure mode (Shutter Priority, Aperture Priority, or Program), the exposure will adjust as the bison gets nearer and nearer. When the bison is at a distance, the camera meter mainly "sees" white snow. When the bison is closer and fills the frame, the meter mainly "sees" dark bison.

Common zebra, Maasai Mara National Reserve, Kenya. Nikon D3, Nikon 500mm lens, 1/200 sec., *f*/5.6, ISO 800

If the bison isn't moving—it's just standing there in the snow—and you're using a zoom lens, you might have the exact same problem. Zoom from a short to a long focal length, or from a long to a short focal length, and how much of the frame is filled with bison and how much is snow changes as the focal length changes.

Here's another example: There are waves breaking on a black sand beach. You've composed the shot, but at one moment it's primarily black sand with some white water and at the next it's mainly white water with some black sand.

Black-browed albatross, Falkland Islands. Albatross were gliding past a deeply shadowed cliff. Any autoexposure mode would have been influenced by the black background, so manual exposure was the answer. Nikon D3s, Nikon 200−400mm lens, 1/2000 sec., *f*/9, ISO 100

You could lock in the autoexposure. Let’s say you meter that white water, or the white snow, and use exposure compensation to get a correct exposure. Almost all cameras have an AE-L (autoexposure lock) feature tied to the shutter release, but the minute you raise your finger, the exposure is no longer locked. The camera meters again, and now you have to start over.

The easy solution is to set the camera to manual exposure mode. Once you have dialed in the correct exposure (and assuming the light doesn’t change), it doesn’t matter if the bison walks toward you or away from you. It doesn’t matter is the wave is breaking or receding. It doesn’t matter if you change focal length of your zoom lens. The exposure is consistent.

The exposure is consistent, with one caveat: If you’re using a variable-aperture zoom lens, such as a 70−300mm *f*/4−5.6, and set the lens wide open at the shortest focal length, you will lose light as you zoom to the longest focal length. If you start at the smaller aperture, *f*/5.6 in this example, there will be no exposure variation as you zoom.

One final example: You’re photographing a moving subject, but the tonality of the background changes. I was faced with this when photographing whooper swans in the winter. The white swans were feeding in a snowy field, but when they took off from the field, the background changed from white snow to a very dark-tone winter woodlot. As they gained altitude, they appeared against a medium-tone blue sky. So what’s the correct exposure? If the light doesn’t change, the exposure for the birds should be the same for all three backgrounds; however, if I had shot in any autoexposure mode, the camera would have suggested a different exposure every time the background changed. Setting the exposure manually solved the problem.

The way I use manual exposure for action subjects is to select the shutter speed and aperture I want to use and then adjust the ISO accordingly. Let's say I want 1/2000 sec. at *f*/8, a fast enough speed to stop a flying bird yet with just enough depth of field to cover its wings. I preset these and then find the necessary ISO. Basically, the ISO value becomes my exposure variable. My current cameras have such clean high ISO quality that, up to a certain point, I don't worry about noise. It's always better to have a sharp high-ISO image, even if a bit noisy, than a soft, out-of-focus low-ISO shot.

For static subjects, an advantage for manual exposure mode is that once the exposure is set, it's then not affected by light coming through the viewfinder when your eye is not up to the viewfinder. Some camera meters—such as the one in my Nikon D800E—are very sensitive to this. In my estimation, this is no big deal. I just block the light with my hand, being careful not to touch the camera, or I use the built-in viewfinder shutter. Doing the latter is such habit with me that I find myself flipping it closed even when I'm shooting with manual exposure.

HOW TO USE MANUAL EXPOSURE

Manual exposure is, in my opinion, easiest to use when the camera is set for spot metering. Spot metering measures a small section of the scene. When the indicator mark is at the zero position, the meter is suggesting an exposure to record that area as a medium tone, regardless of the area's actual tonality. A medium tone is halfway between light and dark. It's average in tonality: medium green, medium blue, medium red. If the area that you metered is indeed medium tone, and you want it to be that way, you're all set. Just push the shutter button.

Cracked mud and fallen rocks, Glen Canyon National Recreation Area, Arizona. Here is a subject that could be easily handled by any exposure mode. Nikon D800E, Nikon 24mm T/S lens, 15 seconds, *f*/11, ISO 400

You can meter any area, so long as you know what tonality you want to make it. While metering your selected area, change shutter speed/aperture/ISO to move the indicator mark away from the zero position. You’re adding or subtracting light from a medium-tone starting point, and consequently, your metered area will record as a lighter or darker tonality. Here is a simple chart in 1/2-stop increments to determine how much light to add for a lighter tone:

THE METERED VALUE

Stop Increments	Tone
Medium tone	

+1/2 stop	a *dark* light tone
+1 stop	a light tone
+1 1/2 stops	a *light* light tone
+2 stops	an extremely light tone
+2 1/2 stops	textureless white
And to darken an area, in the same 1/2 -stop increments:	
-1/2 stop	a *light* dark tone
-1 stop	a dark tone
-1 1/2 stops	a *dark* dark tone
-2 stops	an extremely dark tone
-2 1/2 stops	detail-less black

Of course, if you know you want to record a metered area at a +1 stop value, you don't have to start at the zero position. Go directly to +1 on the analog scale.

This method works fine if you're shooting JPEGs. If you are shooting RAW, you'll still want to weigh the histogram to the right (see the section on exposure and histograms). Take a test shot, check the histogram, and add light if needed, but *do not clip the highlights*.

So is manual exposure mode easier to use? Sometimes it might be a better mode to use, but I don't find it any easier to move command wheels to set aperture and shutter speed, rather than using exposure compensation in autoexposure. Still, I firmly believe you should know how and when to use it, just as you should also know how and when to use an autoexposure mode.

Autoexposure and Exposure Compensation

If you use manual exposure mode, you add or subtract light by physically changing the shutter speed or aperture selected. Autoexposure modes don’t work that way. In Aperture Priority, you change the aperture, and the camera automatically changes the shutter speed to compensate. You end up with the exact same amount of light as before. In Shutter Priority, you change the shutter speed, and the camera automatically changes the aperture to compensate. Once again, you end up with the same amount of light. What to do?

The answer is *exposure compensation* (EC), which allows you to bias the autoexposure settings chosen by the camera. If you plan on using any autoexposure mode, you must learn how to use exposure compensation. To set exposure compensation on most cameras, there is a +/- button you press down while turning one of the main control dials or wheels of the camera. This compensation works directly in stop values: 1/3 stops if you’ve programmed your camera to work in 1/3 stops, 1/2 stops if you’re programmed for 1/2 stops, full stops if in 1-stop increments.

Let’s assume the camera is set for 1/3-stop values. Hold the EC button down, turn the proper dial, and the result will show in the viewfinder and/or the top and rear LCD displays. Almost all cameras display the compensation in the same manner: some sort of indicator icon plus a readout in stop values.

So, +0.3 indicates you’ve added 1/3 stop of light. If you’re shooting in Aperture Priority, the camera will slow the shutter speed an additional 1/3 stop, letting in 1/3 stop more light. In Shutter Priority, the camera will open the aperture an additional 1/3 stop. Similarly, +0.6 would be an additional 2/3 stop of light, +1.0 would be 1 stop of light, and +1.3 would be 1 1/3 stops.

Sunset clouds reflected in water on the Salar de Uyuni salt flats, Bolivia. The colors were changing so fast that autoexposure was the easiest method of exposure. Nikon D3x, Nikon 24−120mm lens, 1/15 sec., *f*/11, ISO 100

The same concept applies for reducing the amount of light: −0.3 indicates that 1/3 stop of light is being subtracted, −0.6 is 2/3 stop, −1.0 is a full stop, etc.

How many stops of compensation are available depends on the camera model. Most Nikon and Canon cameras can be set up to +/- five stops, although you'll rarely use that many. Remember that this compensation factor stays in effect until you change it, even if you turn the camera off. Dial in a +3.0 stop exposure compensation at the end of the day and next morning that compensation is still in effect. If you don't pay attention to the compensation information displayed in the viewfinder or on the camera's LCDs, all your images will be shot at a +3.0 exposure.

Another word of caution: an EC setting has no effect on the actual shutter speed or aperture when the camera is in manual exposure mode. But the EC setting does effect the metering. If that +3.0 EC is still set, in effect, whatever area you meter will be rendered 3 stops lighter than a medium tone. If you're using manual exposure, make sure that EC has been reset to zero.

Some cameras allow you to set EC without holding down the +/- button. For example, my Nikons offer an Easy Exposure Compensation option, where compensation is set by rotating a command dial, bypassing the +/- button altogether. To enable this feature: Menu > Custom Setting Menu > Metering/Exposure > Easy Exposure Compensation > On > OK. Personally, I find that using Easy Exposure Compensation makes it a little too easy for me to accidentally change compensation values (brush up against the dial and the EC changes) … or perhaps I'm just a klutz.

WHEN TO USE AN AUTOEXPOSURE MODE

For most of my photography, I use one autoexposure mode and one metering pattern:

Aperture Priority and matrix (evaluative) metering. This doesn't in any way mean I'm setting the camera on autoexposure and blasting away. Far from it; I'll often be dialing in an exposure compensation to adjust the final image, based upon the histogram the camera gives me.

Autoexposure works great when the tonality within the framed image isn't changing between shots. In my explanation of manual exposure, I used an example of a bison in a snowy setting to suggest a situation when manual exposure mode would work best. Well, if the bison doesn't walk toward you, if the proportion of light- and dark-tone areas in the frame doesn't change, autoexposure would work just fine. Consequently, for most landscape work, most static subject photography, autoexposure is in my opinion the easiest exposure mode to use.

Matrix (evaluative) metering runs a software program to evaluate the scene's tonalities and then biases the starting exposure. In my experience, this works great for most situations. I use Aperture Priority because my first concern with landscape or close-up subjects is the depth of field. I want to select which *f*-stop to use. Once I choose the *f*-stop, the camera automatically defaults to what would be a "zeroed" shutter speed; I don't have to turn any dials to get to this starting point. I glance at the shutter speed displayed in the viewfinder, and if conditions demand a change, I'll adjust the ISO. The ISO is also shown in my camera's viewfinder, so I can make these changes without ever moving my head away from the camera. Being totally familiar with your camera to the point of being able to make adjustments by feel alone, without having to look at the camera to find the right button or knob, is well worth learning. If from experience I know I'll need to lighten or darken the exposure, I'll add my best-guess exposure compensation before I even take my first frame.

Another advantage of matrix (evaluative) metering is its sensitivity to subtle changes in the ambient light. Working in Aperture Priority, the camera will automatically adjust the shutter speed while my *f*-stop remains the same. Subject tonality does not change with a change in ambient light (after all, a white shirt remains white even in a closet at night) as the camera adjusts for subject brightness.

Just in passing, I've worked side by side with photographers who exclusively use spot metering in the manual mode, and by using Aperture Priority/matrix metering I can be shooting while they are still deciding exactly which part of the scene to spot meter and how much to compensate for that area's tonality.

Emperor penguin chicks, Antarctica. This scene averages out to be a medium tone. I was lying flat on the snow, shooting handheld, knowing that I could use autoexposure without any compensation. Nikon D2x, Nikon 28−70mm lens, 1/640 sec., *f*/11, ISO 100

Proper Exposure and Histograms

In order to discuss exposure and histograms, I'm making the assumption that you have an understanding of the relationship between shutter speeds, apertures, and ISOs. If not, please go back and review the "Working in Stops" section. Remember, a camera meter doesn't necessarily give you "correct" exposure; it tells you a suggested exposure that may or may not be correct. The values it offers are a starting point for the final settings you use to take the picture.

Sunrise light on clouds, Frenchman Bay, Maine. Nikon D3, Nikon 24−70mm lens, 1/15 sec., *f*/11, ISO 200

Back when I was shooting film, I was never totally positive that I had made a good photograph, since I never saw the results until long after I took the photo. When I was on an extended trip, there were often weeks separating shooting an image and getting the film back from the lab. Now with digital, I get almost instant feedback in two ways: on the camera's LCD, I can review the image just taken, checking the composition, and I can evaluate how the image was recorded by using the histogram display.

Ponderosa pines in winter blizzard, Oregon. Nikon D3x, Nikon 70−200mm lens, 1/30 sec., *f*/16, ISO 100

Having this information has dramatically changed how I work. In the film days, I always used manual exposure mode, spot metered the brightest area of the frame, and placed that area at the tonality I wanted. What I didn't want to happen was to blow out the highlight areas to the point they recorded as a detail-less white. After all, that's not how humans see the world. We are used to seeing blocked-up, black shadows, but we almost always see some detail in the highlights, except for small specular areas. I never used matrix (evaluative) metering, since that uses in-camera software to bias the meter reading. Spot metering suggests the exposure values to render a metered area as a medium tone, and by working in stop increments from that starting point, I could open up or stop down to record the metered area as lighter or darker than medium. I would meter a specific area, then add or subtract light to place its tonal value. One stop open resulted in recording that area as a "light" tone, while 2 stops open gave me "extremely light." One stop down yielded "dark," and 2 stops down was "extremely dark." Because I couldn't see the results until much later, I had to carefully meter a selected area of each scene. For example, fresh snow on an overcast day is basically a detail-less white. I would spot meter the brightest section of snow and open up 2 1/3 stops to record it as such.

THE HISTOGRAM

This approach still works, but since digital cameras can display a histogram, there's a much easier method, what I call "take a shot and take a look." Thanks to the histogram giving me instant feedback, I now use matrix (evaluative) metering most of the time, as it simplifies the process.

Here's what to do: First you need to make sure your camera shows you the histogram. By default, many cameras display only the image just taken. In your camera's menu choices (most likely the Playback menu or Review menu), turn on the histogram option and, if offered, the histogram display for the individual red, green, and blue (RGB) channels. Most cameras show the composite histogram in yellow, with the individual-channel histograms in their respective colors.

A histogram is just a graph, nothing more. The left side represents the shadows (black is the extreme left edge), while the right side represents the highlights (white is the extreme right edge). The histogram shows you the distribution of the pixels that you have recorded, or how many pixels your particular exposure settings have recorded at what tonal level (but see this box). The horizontal axis of the graph shows pixel brightness, and while the vertical axis corresponds to the number of pixels at each tonal level, exposure determination is totally based on the horizontal values. Don't worry if there are any tall spikes in the graph; after all, this just tells you the recorded image has a whole lot of pixels at a certain tonal level.

Here's a histogram analogy: Suppose you have a jigsaw puzzle, and you stack up all of the pieces by how light or how dark they are. There would be a stack of black pieces, a stack of dark-tone pieces, a stack of middle-tone ones, a stack of lighter ones, and finally a stack of white pieces. Put these stacks in a row, black to white, and you have a histogram equivalent.

A histogram has no perfect shape. Each subject you photograph will have a different histogram. If you photograph a dark subject, the graph should have a bulge on the left side. Photograph a light subject and the reverse would be the case. But remember that the histogram shows *how* you've captured the information. If you've made a bad exposure, the histogram will reflect this fact: if you photograph a light subject and the histogram is heavily weighted to the left (the dark side), you know you've underexposed, since you recorded the majority of pixels as "dark"; if you photograph a dark subject and the histogram is heavily weighted to the right (the light side), you know you've overexposed, since you recorded the majority of pixels as "light." Take a shot and look at the histogram. Of course, if you wanted to record a light-tone subject as dark or a dark-tone subject as light, you certainly could do so. Again, the histogram will tell you how you recorded the scene. Just remember that you *cannot* tell anything about exposure, or color, by looking at the image on the LCD. The image on the LCD shows you the composition, but only the histogram gives you information about exposure.

GETTING AN ACCURATE DISPLAY

Technically, the histogram conveys information about the thumbnail JPEG seen on the LCD—not of the actual image file you just shot. But it's the closest thing we have to real-time information. If you're shooting raw files and want the histogram to more accurately display the file's values (even though you're viewing a JPEG thumbnail on the LCD), you can (a) set the Picture Control or Picture Style in the camera to neutral and lower the contrast a bit, or (b) use UniWB. Google that term to read about it and then go back to option (a).

If you need to reshoot, add or subtract light as needed by either changing the shutter speed or aperture if in the manual exposure mode, or by using exposure compensation if in any autoexposure mode. Reshoot the scene, and now the histogram will shift to reflect this new distribution of pixels. You want to record as much data about your subject as possible. Make sure you avoid "clipping off" the ends of the graph, unless you intentionally want to drive pixels to detail-less white or detail-less black. "Clipping" is when an end of the graph does not come back down to the baseline, cutting off the end of the histogram graph. All pixels that would have had been in that clipped region are now forced to be detail-less. Clipping pixels to appear as detail-less black is not necessarily bad; after all, there are pure black silhouettes. But avoid clipping bright values to pure white; we do not see large, detail-less highlight areas in our day-to-day lives.

In your camera menu choices, you should also turn on the highlight warning display, the blinking highlights commonly called the "blinkies." When you review images on the LCD, any clipped highlight area will blink on and off. FYI, with many cameras you can set the blinkies to indicate clipping not only for the composite histogram but also for the individual red, green, or blue channels. Clipped areas have no detail; if you didn't record any information, you can't get it back. Clipping in one channel may or may not be important. You will have to decide if that color should have detail. For example, a cloudless sunset sky might show clipped reds, but this wouldn't matter.

If you're taking JPEGs, the histogram should represent how you want the final image to appear. JPEGs are processed in-camera, so you want to take the best exposure possible for a literal translation of the scene. Suppose you're photographing a scene in which almost everything is a medium tone, and you want to record it as such. A correct histogram should reflect this and show all the data massed in the center of the graph. Photograph a snow scene and the histogram should be to the right. Photograph your black lab puppy playing in the mud and the histogram should be to the left.

Gentoo penguins returning from ocean, Carcass Island, Falkland Islands. Nikon D3, Nikon 200−400mm lens, 1/750 sec., *f*/9.5, ISO 800

But if you shoot RAW, this is not the best way to record information. RAW is not a file format. It is simply the total raw information captured by a digital camera's sensor. Each camera manufacturer has a file extension name for their proprietary RAW files; Canon uses CR2 and Nikon NEF. These formats store all of the raw data recorded by the sensor, but since none are standard graphics file formats, the information has to be converted in a computer—via RAW file conversion software of some sort—into a usable file format. Adobe offers Adobe Camera Raw (which is also used in Lightroom) to convert RAW files from most cameras on the market, while the camera manufacturers generally have conversion software available for their own cameras. My advice: stick with Adobe.

A big difference between RAW and JPEG is that a JPEG is processed by the camera. You can't really change it much after the fact. What you shoot is what you get. A RAW file, however, has to be processed in the computer. One RAW file can be processed as many times as you like, in as many different ways as you want, and the results can even be saved in different file formats. A RAW file can be easily converted into a JPEG file, but a JPEG cannot be converted into a RAW file. JPEGs are also "lossy" files, meaning they discard information to keep file sizes smaller. RAW captures, on the other hand, contain all the information your digital camera is capable of producing, and it's always best to start with the most information possible. It's easiest to think of the RAW file as the original digital negative. Let me strongly suggest that for the best quality results, you should shoot RAW files, particularly if you plan on doing any sort of postprocessing of your images; however, shooting RAW means that you must spend time at the computer, and to get the most from your files, you will need to be comfortable with some version of Lightroom or Aperture or Photoshop or other editing software.

JPEG files are by definition 8-bit files; eight bits (ones and zeros in the computer) are used to define each tonal value in each color channel. This gives 256 possible tonal levels in each color channel. Raw files from current cameras are either 12-bit or 14-bit files, offering 4,096 or 16,384 tonal possibilities, respectively. You can easily see that RAW files offer a lot more editing flexibility.

For best quality, RAW files should be exposed differently than JPEGs. Bear with me, as this is going to get a bit complex.

Film was designed to record images similar to how we experience the world, in a nonlinear fashion. Consider the following: If you're in a room lit by a single 100-watt lightbulb and you turn on another 100-watt lightbulb, you have doubled the amount of light in that room. You have actually increased the light by 1 *f*-stop. However, you won't experience this doubling of light. Yes, the room got brighter, but you won't feel as if it got twice as bright even though it really did. This is a nonlinear experience. Or hold a 5-pound item and then add another 5-pound item. While you're now holding twice the weight, it won't seem like you doubled the weight. It's "heavier," but doesn't seem like "twice as heavy." Or try this photographic example: Get a 1-stop ND filter. When you look though it, does the world appear to be half as bright? You won't experience it as such, even though the view really is only half as bright. Our daily experience is in a nonlinear manner.

Digital sensors are linear capture devices. For practical purposes they are just photon counters … one photon of light, two photons, three photons, etc. Black is obviously no photons, no light at all. If that's the low-number side, the other extreme must have the most number of photons. Now, the concept of photographic *f*-stops is still the same. The number of tonal levels in any stop is twice or half the preceding or following stop.

Consider a 12-bit RAW file with its 4,096 possible tonal levels. Since each stop has twice the information as the preceding stop, here is the progression of tonal levels in each stop: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1,024, and 2,048. Wow, that brightest *f*-stop has half of all the potential information, while all of the other *f*-stops share the remaining information. One side is data rich, one side is data poor. Another way to look at this is in percentages. The brightest *f*-stop has 50 percent of the data, the next stop down has 25 percent, then 12.5 percent, 6 percent, 3 percent, 1.5 percent, and … well, almost nothing. There's not a lot of information in those dark stops.

EXPOSE TO THE RIGHT (ETTR)

Underexpose a RAW file by one *f*-stop, and you've lost all the information that would have been in that top *f*-stop. You've wasted half of all the potential information. If you're photographing a scene with a full tonal range from dark to light and you've underexposed, when you process the file, you'll have to stretch out the remaining data that you did manage to capture to cover the full tonal range of your subject, but those darker stops don't have a lot of information to stretch. While you can indeed get away with this, a better solution is a fuller exposure. With RAW files, you want to expose to the right (ETTR) to make an exposure for which the histogram is weighted to the right, regardless of the subject, *but without clipping the highlights*. Take a shot and take a look at the histogram. If necessary, add light to push that histogram to the right. ETTR.

You aren’t overexposing the RAW file. You are properly exposing so that the image capture maximizes the quality. Yes, when you first see the file displayed on the LCD, or on your computer, it will appear much too light. Don’t worry. When you process the file—and since it’s a RAW file it has to be processed in order to be used—you will reposition all that captured data. A RAW file right out of the camera isn’t a finished photograph. In the RAW file converter software, you will “tone map” the information, basically shoving a lot of that right-side data back toward the data-poor left side of the histogram.

ETTR gives a better signal-to-noise ratio, and in digital cameras, that’s a good thing. By using ETTR, by using a higher exposure value and capturing more photons, the noise level in the image is reduced while image quality is improved. But *don’t clip the highlights*. Don’t be compulsive about having the histogram touch the right edge of the graph. Just add some light to push that histogram toward the right side. When you open a RAW file in your processing software, you will probably find a bit more highlight headroom than what the camera’s histogram and “blinkies” led you to believe.

Let me reemphasize, ETTR is a method of exposure for RAW files—and RAW files only. Don’t do this if you’re shooting JPEGs. You should also realize why I’ve said there is no reason to set your camera to shoot RAW+JPEG. The best exposure values for a RAW file aren’t the best exposure values for a JPEG, and vice versa. At any time, you can easily create a JPEG from a processed file that started out as a RAW capture, but if you try to record RAW and JPEG both at once, one of the files has to be exposed in a nonoptimal manner.

Do you really have to do this ETTR stuff when shooting RAW? No, of course not. You can do anything you wish, but if you really want the best quality possible, then ETTR is indeed the answer.

These are three examples of raw-image histograms displayed on the back of my camera. Remember, you cannot evaluate color or exposure by the image displayed on the LCD. You need to look at the histograms.

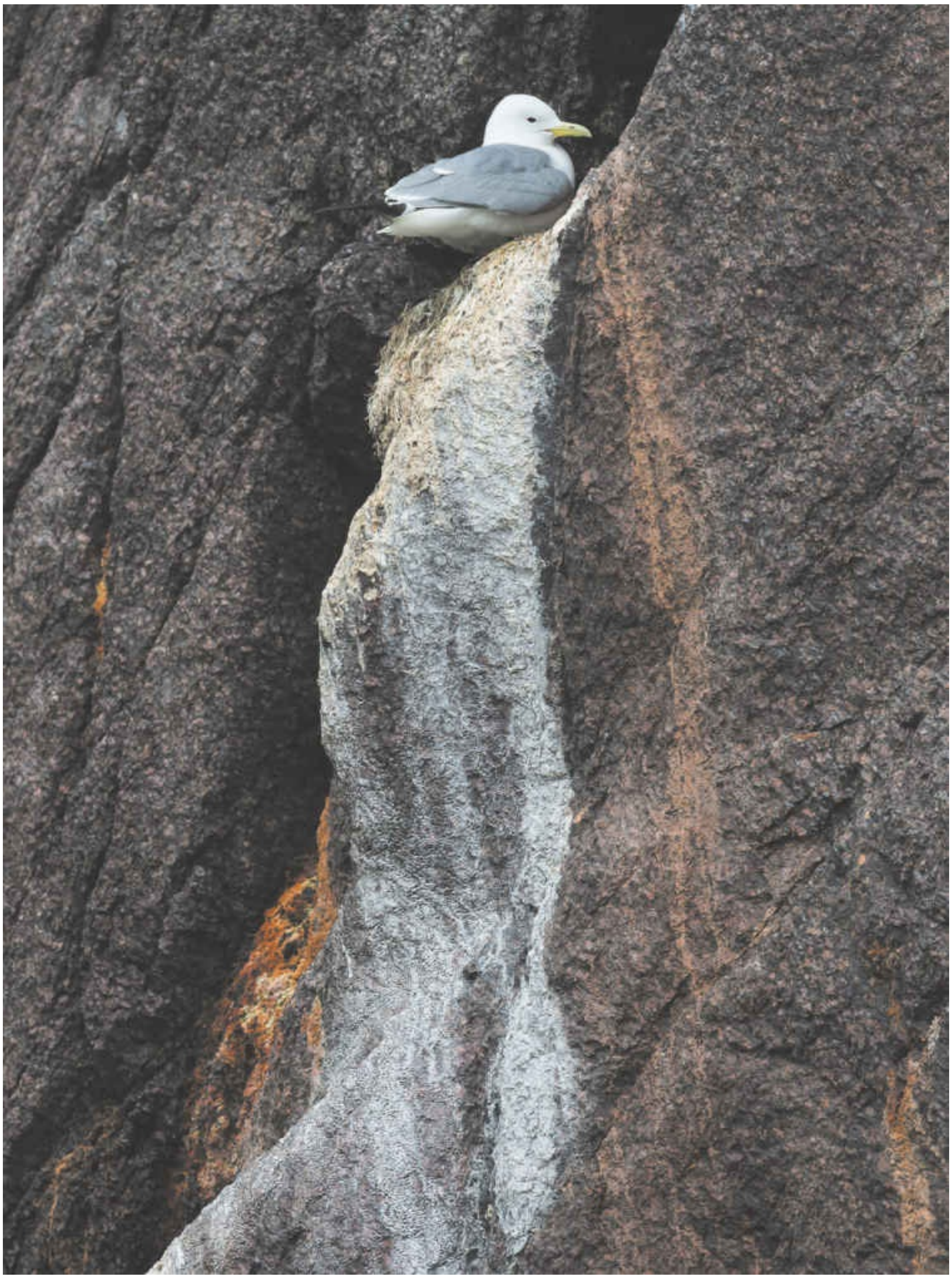
This first histogram indicates definite underexposure. While the exposure slider in the raw converter could be pulled to the right to add some exposure value, this would increase noise in the darker areas of the image.

Both the red and blue channels are clipped here. But note that the white composite histogram indicates an okay exposure was made, which is exactly why you want to have the channel histograms displayed.

The exposure values have been set so that the histograms are weighted to the right, but not clipped, in this example. The blue and green channels are clipped in the dark tones, but it doesn't matter in this case, as these represent the deeply shadowed areas.

High ISO

ISO sensitivity is a measurement of a camera’s ability to capture light. The native ISO—the unamplified electrical signal from the sensor—of almost all DSLR cameras is in the ISO 100 to 200 range. In order to take an image in really dim light, or in order to reach higher shutter speeds, at times you’ll have to increase the ISO number. As I noted before, in the “Working in Stops” section, ISO ratings work in straight numerical doubles and halves. Each doubling of the ISO number is a 1-stop increase in sensitivity. Basically what is happening is you’re turning up the volume control, you’re amplifying the signal.



Black-legged kittiwake, Cape Achen, Russia. Bouncing around in a Zodiac below this rock face while handholding a camera, I could barely keep the kittiwake in the frame. I liked the broad white stripe below the bird, indicating it's a well-used area. Nikon D4, Nikon 80−400mm lens, 1/1250 sec., *f*/10, ISO 2200

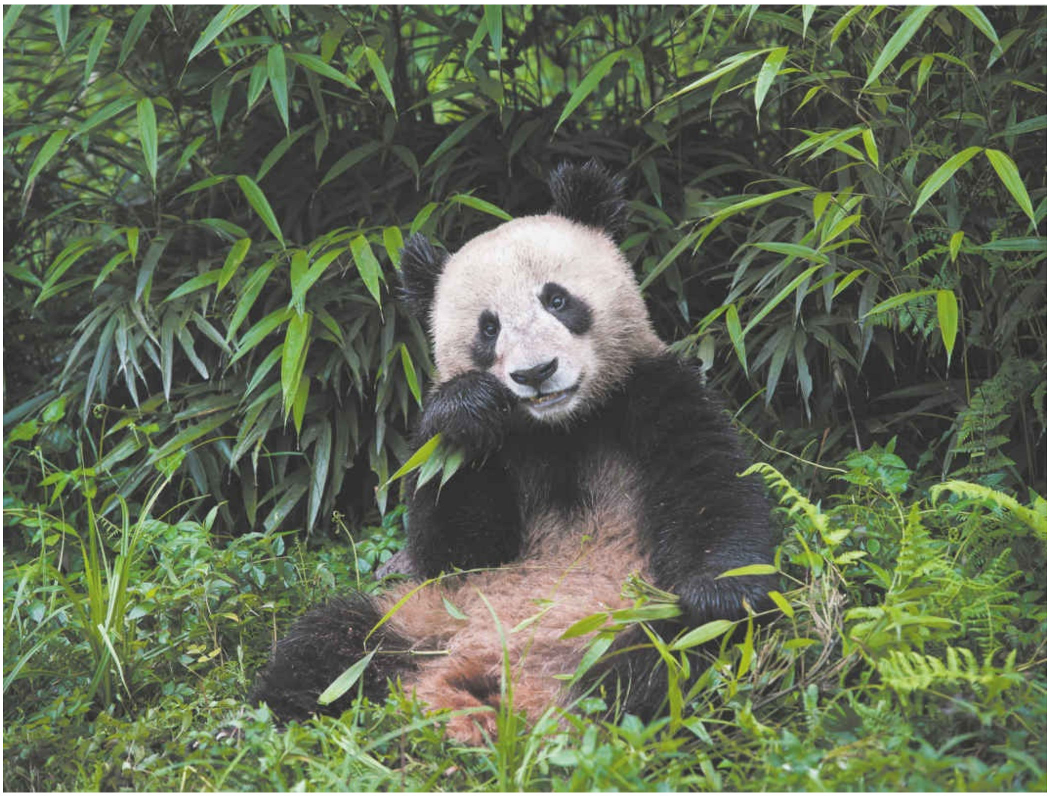
We now have cameras that offer extremely high ISO numbers: both Canon and Nikon have models that go to the equivalent of ISO 204,800. Wow! If I can play the "old guy" a bit, when I started my professional photography career, my standard "fast" film was Kodachrome 64, which, as the name implies, was a blistering ISO 64. Years later, as I was switching to digital, the final "fast" film I was using was all of ISO 200. Yes, times have indeed changed, and very quickly.

But there's no free lunch. Is that ISO 204,800 really usable? No, not unless it's your one and only chance to photograph Bigfoot or the Loch Ness monster. In that case, any photo would be better than no photo. Otherwise, forget it. Extremely high ISOs yield images with tons of luminance noise (which looks like grainy particles) and chrominance noise (which looks like random colored sprinkles).

That's not so say you have to stay at the native ISO of your camera. Although noise does build when ISO is increased from the native rating, most of the current cameras that I'm familiar with are certainly usable up to about ISO 1600. Past that, you should run a test to see what is acceptable to you. Mount your camera on a tripod and take a series of shots of the same scene, at the same *f*-stop, increasing the ISO between frames. For example, start at the native ISO, such as ISO 200, and take frames at ISO 400, 800, 1600, 3200, and, if available, 6400 and 12800. Now open these shots on your computer and compare the images. In general, raise the ISO only when you hit the lowest shutter speed usable for your shooting situation.

Knowing the highest acceptable ISO is helpful for action work, and especially if your camera offers an Auto ISO option. In this feature, you set a maximum ISO and a minimum shutter speed. For example, you might choose a maximum of ISO 1600 and a minimum shutter speed of 1/250 sec. With Auto ISO turned on, when you're shooting and the shutter speed drops t0 1/250 sec., the camera automatically starts raising the ISO until it hits the maximum allowed 1600.

In one of your camera's menus you'll find the option to turn on High ISO Noise Reduction. This is applied directly to the file if you're shooting JPEGs, since these are processed in-camera, and is applied to a RAW file only if you open the file using the manufacturer's own software. If you use Adobe software, as I do, or other RAW file converters, then it doesn't matter if you have this option turned on or off, as it won't be read by the software.



Giant panda eating bamboo, China. I photographed this panda on an overcast day in drizzling rain, hence needed a high ISO. Nikon D3, Nikon 70−200mm lens, 1/200 sec., *f*/4, ISO 2200

If you do see noise in your RAW files, you can—and should—use the noise-reduction feature in your RAW file converter software. After all, this is the least destructive point in the processing workflow to run noise reduction. Noise reduction works by slightly blurring the image, so you'll want to counterbalance by also adding a touch of capture sharpening in the RAW software. Programs such as Dfine, Noiseware, or Noise Ninja can be used after the fact, when the file is a standard graphics file such as TIFF or PSD. But be careful, as too aggressive of settings can produce unnatural "plastic surface" results.

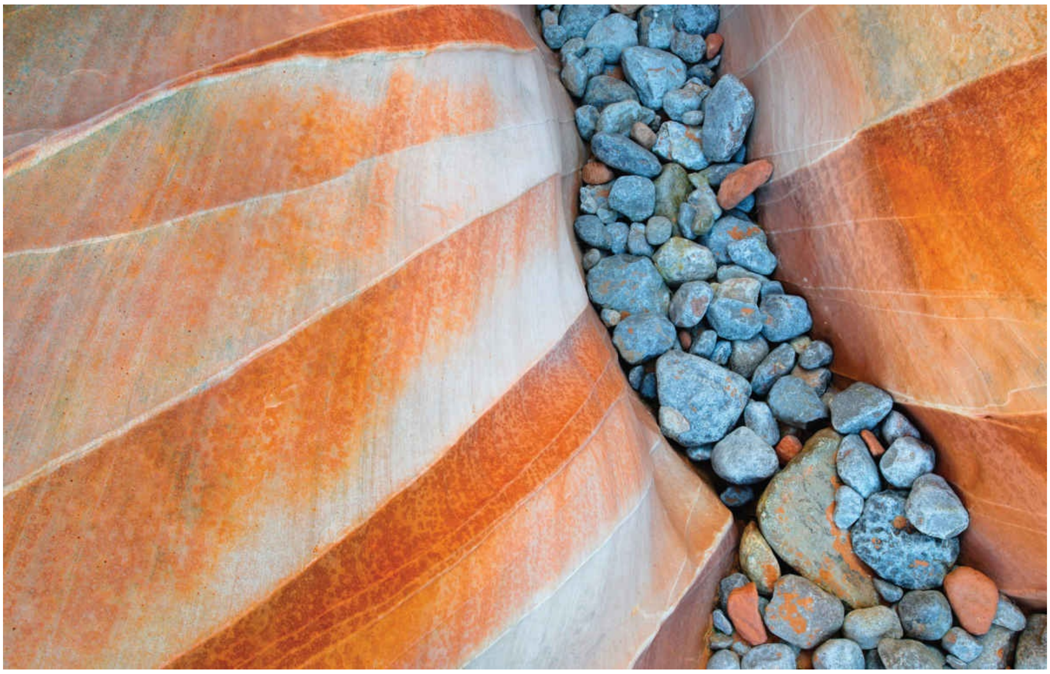
Another option is to downsize the file. Monitor display resolutions haven't grown as fast as megapixel counts; consequently, images on the Web are almost always downsized. This is why photos on the Web, shot at incredible ISOs, generally look fine. Be careful, as downsizing also removes detail from the image. Consider looking at a print. Up close you might be able to see the noise. Stand farther away and you can't see the noise. Stand far enough away and you might not be able to make out the print itself, let alone the detail in the image.

But the number one rule to control noise is *don't underexpose*. With digital capture, noise lives in the dark side.

Northern lights, Alaska. In order to render the stars as points, rather than streaks, I had to keep my shutter speed no longer than 20 seconds when shooting with my 14−24mm lens wide open at *f*/2.8 and set at 24mm. Focal length and shutter speed dictated ISO 2200 (my cameras are set in ISO 1/2-stop intervals; ISO 2200 is halfway between 1600 and 3200). Nikon D800E, Nikon 14−24mm lens, 20 seconds, *f*/2.8, ISO 2200

Chapter 3

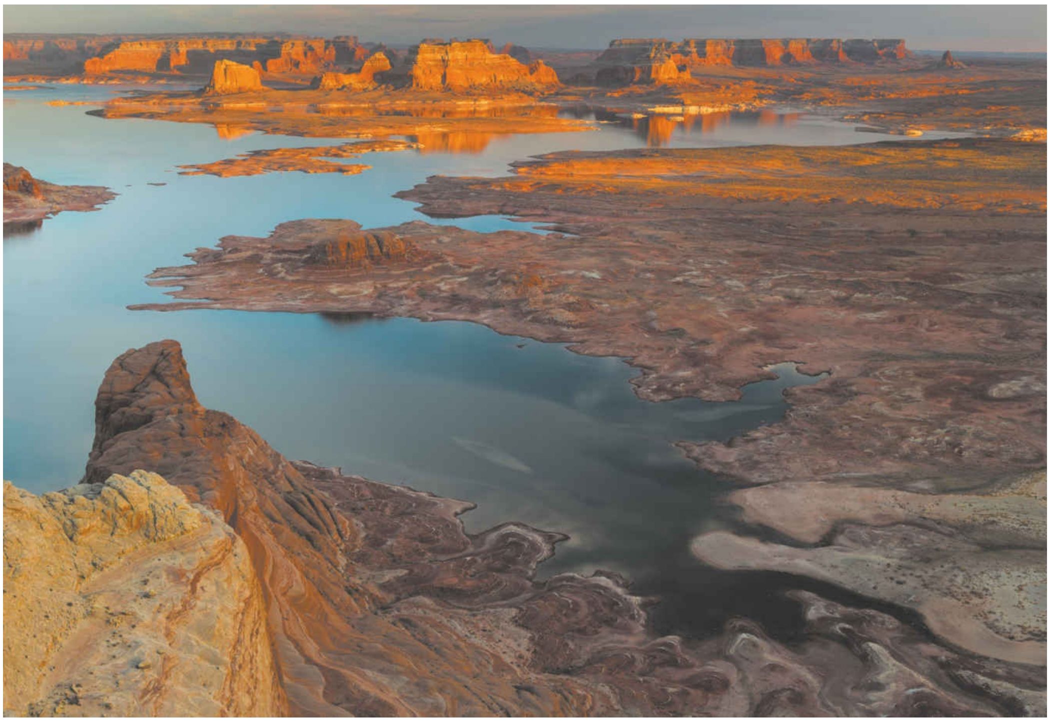
LENSES



What Lenses Do

Photography allows us to create order out of the visual chaos we encounter daily. When we take a picture, we emphasize one aspect of our experience over all others. By isolating a subject and choosing how much of it to include with the frame, we give it importance. How we compose an image, the point of view from which we take the photograph, and the photographic tools we use all contribute to our control of the viewer's perception. By making these choices, we give importance to our subject. Primary to this entire procedure are the lenses we select to use. One of the greatest strengths of DSLR cameras is that the lenses are interchangeable with minimum difficulty. Instead of being limited to one view of the world, you can switch between expansive, all-inclusive coverage and a tight selection of one detail, all by changing the focal length of the lens mounted on the camera. Let me give an overview of lens terminology and how lens choice affects visual perception.

Redwood trees in fog, Del Norte State Park, California. Nikon D3X, Nikon 17−35mm lens, 1/13 sec., *f*/11, ISO 100



Shoreline of Lake Powell, from Alstrom Point on Romana Mesa, Glen Canyon National Recreation Area, Arizona. Nikon D800E, Nikon 24−70mm lens, 1/3 sec., *f*/13, ISO 100

FOCAL LENGTH

The two most basic characteristics of any lens are its focal length and its maximum aperture, which is generally referred to as its speed. Focal length is technically defined as the distance between the optical center of a lens and the sensor when the lens is focused on infinity. This distance is almost always measured and expressed in millimeters. In far more useful and practical terms, focal length is an expression of how a lens “sees” an image and how it changes that image as compared to a basic norm. For digital cameras with a sensor size of roughly 24mm × 36mm (the so-called full-frame cameras), that norm is the image produced by a 50mm lens. (For those who have never used film, this 24mm × 36mm format is based on the image size of a single frame of 35mm film.)

The 50mm lenses are often referred to as “normal” lenses, but all this really means is that once upon a time lenses around this focal length normally came standard with cameras. Referring to the 50mm focal length as “standard” might make more sense. After all, nothing about the 50mm focal length is normal when compared to how the human eye sees, neither how much is taken in from side to side nor how its focal length relates to the focal length of our eyes. So 50mm lenses became the standard for cameras of this size mainly by historical accident, and not by any rational decision on the part of camera manufacturers.

Ice over the North Saskatchewan River, Banff National Park, Canada. Nikon D3x, Nikon 24mm T/S lens, 1/160 sec., *f*/11, ISO 100

If we use the 50mm focal length as a standard starting point, we can then compare all other lenses to this standard and group them by focal length. Any lens with a focal length numerically greater than 50 is called a “long” or “telephoto” lens, while any lens with a focal length numerically less than 50 is a “short” or “wide-angle” lens. (Technically, a telephoto lens has a specific optical design, but calling all longer-focal-length lenses “telephoto” is common usage.)

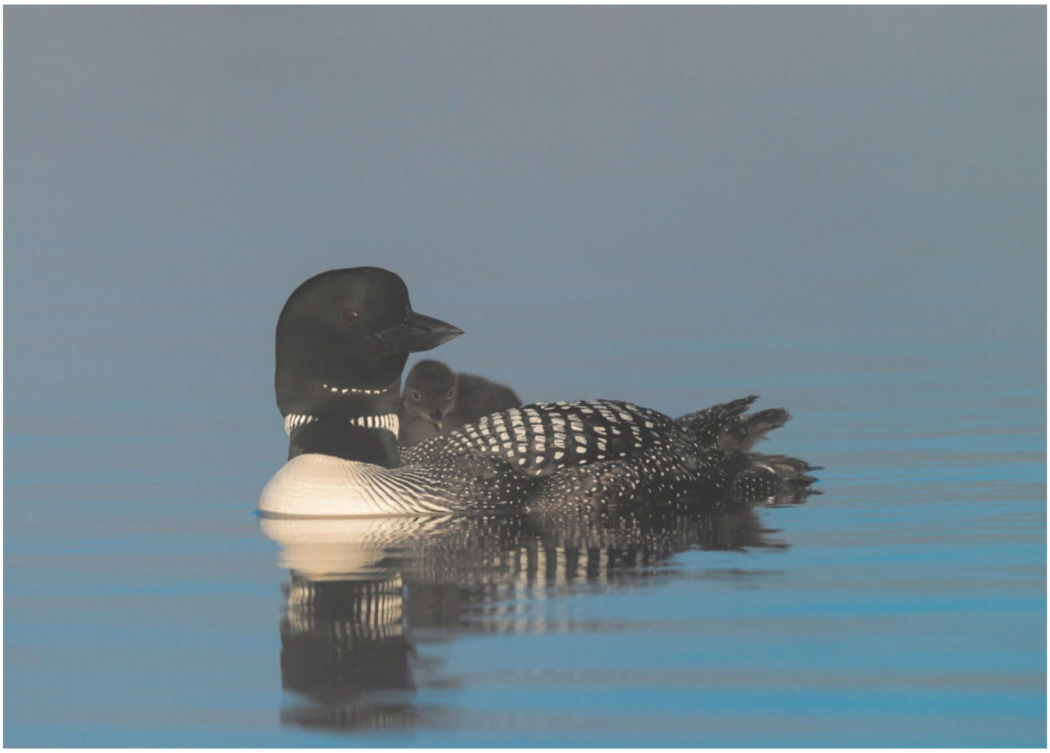
The focal length of any lens relates directly to two aspects: the lens’s angle of view and the image size it produces. *Angle of view* refers to how much of a scene a lens encompasses from any given shooting location. Angle of view decreases as focal length increases, and vice versa. From a given location, the longer the focal length, the narrower the scene a lens sees. Telephoto lenses have very limited coverage of a scene; they are “narrow-vision” or “narrow-angle” lenses. Wide-angle lenses, as their name implies, take in a broad field of view. The “shorter” a lens is in focal length, the wider its angle of view.

James’s flamingo, Bolivia. Nikon D3, Nikon 500mm lens, 1/2000 sec., *f*/11, ISO 800

JUST WHAT IS AN *F*-STOP?

Here’s a precise definition: An *f*-number is a value representing the quality of light passing through the diaphragm of a lens when the lens is focused at infinity. The *f* is an abbreviation for *factor* and describes the mathematical ratio of the effective aperture, which may not be the same as the physical diameter because the light rays entering the front element of the lens are converged toward the diaphragm. Glad you asked?

As angle of view changes, so does image size (how large things look through the viewfinder and in the resulting photograph). If you’re photographing from a fixed location, there is a direct relationship between the focal length of a lens and the size that a subject appears. The shorter the focal length, the smaller the subject will appear; the longer the focal length, the larger the subject will appear. From the same shooting location, wide-angle lenses will basically decrease the size of any subject, while telephotos will increase it. The linear size of the image varies directly with the focal length of the lens used. For example, if you double the focal length—from 50mm to 100mm, from 100mm to 200mm, or from 200mm to 400mm—you double the linear size of the subject on the camera's sensor. Let's say you're photographing a tree with a 50mm lens and the tree's image is 1/4 inch on the sensor. From that same location, switching to a 100mm lens would increase the tree's image to 1/2 inch on the sensor, while a 200mm would make it appear 1 inch. The opposite is true also: switching to a 24mm lens would decrease the tree's image to 1/8 inch.



Common loon with chick, British Columbia, Canada. Nikon D800E, Nikon 500mm lens, 1/2500 sec., *f*/8, ISO 800

LENS SPEED

The *speed* of a lens refers to its maximum aperture, its widest *f*-stop, the largest hole through which light can pass. Lenses with large maximum apertures are called "fast" lenses since they can let in more light than can "slow" lenses with smaller openings. A lens with *f*/2 as its wide-open aperture is "faster" than a lens with *f*/2.8 as its wide-open aperture, which in turn is faster than an *f*/4 lens. The *f*-stops on all lenses are determined in exactly the same way. They are numerically equal to the lens's focal length divided by the optical diameter of any given aperture hole. Assume that you have a 100mm lens. If the optical diameter of its largest aperture is 50mm, then the *f*-number of this aperture is 100 ÷ 50, or *f*/2. Another 100mm lens might be *f*/4 wide open, meaning that its optical aperture is 25mm in diameter.

Consequently, fast lenses must be physically large, and fast telephoto lenses must be extremely large. Compare that 100mm *f*/4 lens with an optical aperture of 25mm in diameter to a 600mm *f*/4 with an opening of 150mm in diameter. Fast, long-focal-length lenses mean large elements, more weight and bulk, more difficult construction, and a lot more expense for the purchaser.

But a "fast" lens is only fast in relation to its focal length. The exact same maximum aperture could be considered fast, slow, or normal, depending on the lens. A standard 50mm *f*/2 lens is rather ordinary in terms of speed, neither fast nor slow for its focal length. But a 100mm lens with the same wide-open aperture of *f*/2 is indeed a fast lens, while a 200mm *f*/2 is extremely fast. If there were such a thing as a 400mm *f*/2 lens, we would have to invent a new term for lens speed—perhaps "ultrafast"?—but the lens would also be about the size, weight, and price as a pickup truck.

Regardless of the focal length, the same *f*-stop allows the same amount of light to pass through a lens. So *f*/4 on a 50mm lens, *f*/4 on a 100mm lens, *f*/4 on *any* lens, always transmits the same amount of light. The numbers, and the concepts represented, are independent of the actual lens.

PERSPECTIVE

Perspective is the relationship between the objects in a scene as viewed from a given location. All lenses, regardless of focal length, yield the same perspective from the same camera position. If you don't change your camera position, changing focal lengths simply means that you're changing the framing—how much or how little you include—of any scene. Using a long lens allows you to crop tightly into a scene, to isolate one particular area, while a short lens expands the frame. But both lenses, indeed all lenses, show the same perspective from the same viewpoint.

When you change your physical location, you not only change perspective but also the apparent relationship between elements in a scene. The distance between two objects appears to be much greater when one of them is closer to you than when both are distant. For example, look down a long row of telephone poles that are spaced equally apart. The ones closest to you will seem to be a good distance apart, but as you shift your vision to the ones farther away from you, they appear to get closer together to one another. Photographically this is often called "telephoto compression," but that's a misnomer since it has nothing to do with focal length. We use telephoto lenses to look at distant scenes, and things far away seem closer together. Similarly, objects that are quite close to the camera position appear proportionally much larger than those far away. Think of those telephone poles again. The ones nearby are quite tall, while the ones far away shrink in size. Long focal lengths appear to compress the scene, short focal lengths to decompress it.

Knowing these facts, you can use both perspective and lens choice to affect the viewer's perception of a scene. This should be a conscious, careful decision on your part, and I'm here to help. The choices are yours to make, as long as you have a selection of lenses from which to pick.

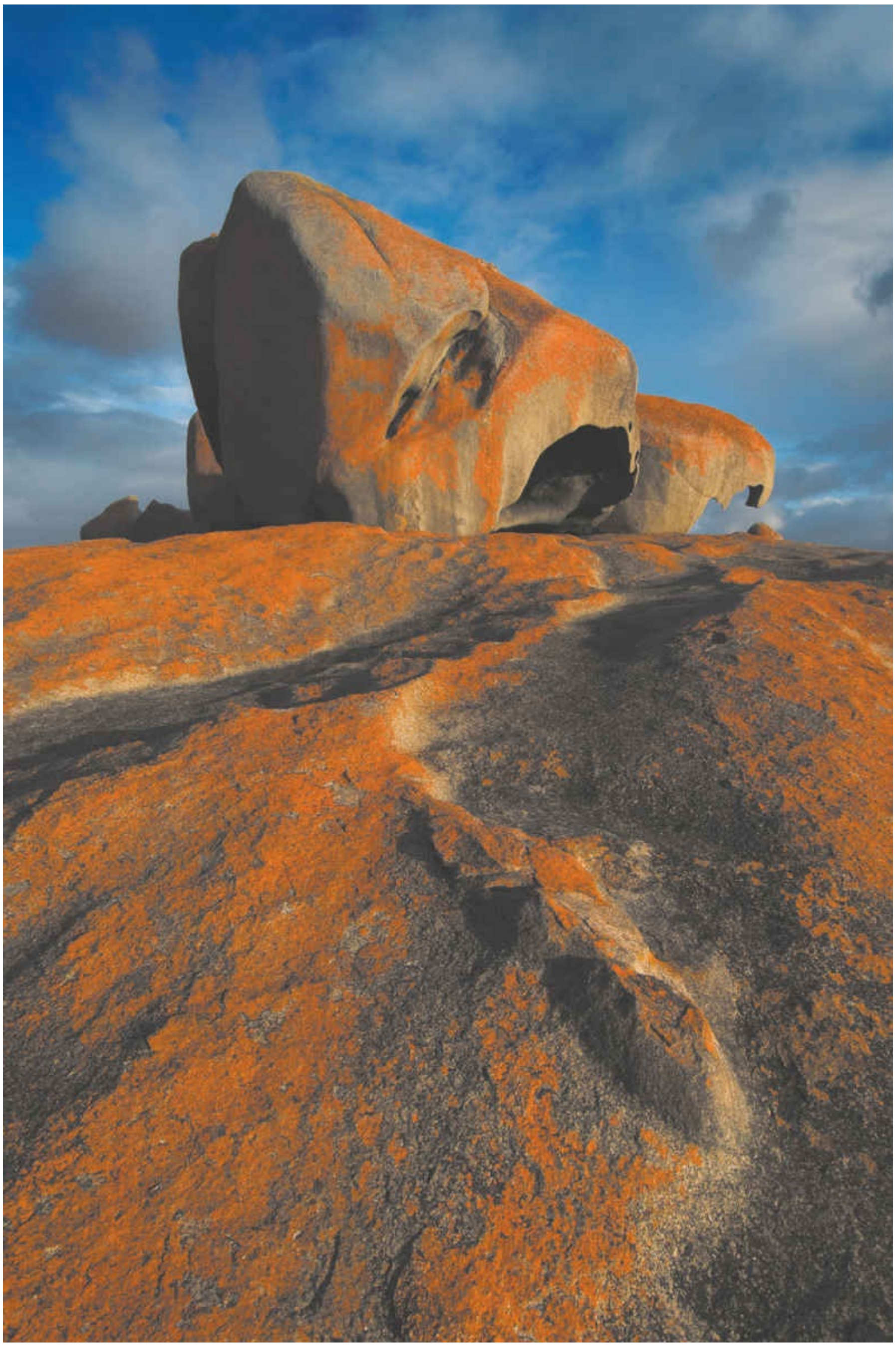
Focal Lengths

Deciding which lenses to purchase isn't easy, as there are so many choices on the market. There are zooms and fixed-focal-length lenses, fast-aperture lenses and slow-aperture ones, expensive lenses and far less costly ones. To determine what sort of lenses you need, you should define your priorities:

- What subject matter do you want to photograph?
- How many lenses, and how much weight, are you willing to carry?
- Will you be using a tripod or always handholding the lens?
- Do you really need a fast-aperture lens? Really?
- What's the maximum ISO you find acceptable on your camera?
- Do you need versatility or ultimate sharpness?
- What's your budget?

Wheat field in the Palouse region of Washington. Nikon D2x, Nikon 12−24mm lens, 1/60 sec., *f*/11, ISO 100

Mount Inglismaldie and ice formations on Lake Minnewanka, Banff National Park, Canada. Nikon D3x, Nikon 16−35mm lens, 1/10 sec., *f*/18, ISO 100



The lichen-covered Remarkable Rocks, Flinders Chase National Park, Kangaroo Island, Australia. Nikon D2x, Nikon 12−24mm lens, 1/180 sec., *f*/8, ISO 100

Notice that I said what lenses you *need*, not what lenses you *want*. Photographers tend to be gear junkies, and I include myself here. Money no object, most of us would go out and buy every lens … and end up with the even worse dilemma of deciding which ones to carry and use. I would strongly urge you to honestly state exactly how you would use a specific lens before any purchase.

In order to discuss focal lengths, I'll arbitrarily make four groups based on a "full-frame" camera: Wide-angles lenses (35mm and shorter), Normal lenses (35mm to 70mm), Short telephoto lenses (70mm to 300mm), and Long telephoto lenses (300mm and up).

WIDE-ANGLE LENSES

Wide-angle lenses take in a very broad field of view. They decompress the landscape, making distant objects seem even farther away than they appear to our eyes. One of the most effective ways of working with a wide-angle is to position the lens extremely close to a foreground subject in order to exaggerate its size. This is a traditional method used by large-format landscape photographers. Tilt the lens down at a slight angle, placing the horizon line high in the frame, and work in tight to the subject. Composing in this manner increases the three-dimensional feeling of a photo, because it increases the apparent depth of the scene. It exaggerates the near/far relationship. You are dramatically presenting a foreground in the context of its environment. Viewers are forced to participate intimately in the picture; they feel they can reach out and touch the foreground or step right into the scene.

Ice and rocks, Paradise Bay, Antarctica. Nikon D3x, Nikon 17−35mm lens, 1/160 sec., *f*/11, ISO 100

When using this technique, you must be absolutely sure that the foreground object is in sharp focus. It is extremely disconcerting to see a photograph shot with a wide-angle lens where the distant horizon is more in focus than the close foreground. After all, in everyday experience, objects farther from us appear to be less sharply focused. Don’t just point your lens at the closest object in the frame and focus on that, but rather use your depth-of-field preview to evaluate the scene. In you have to sacrifice one area or the other, let the background go soft before you give up foreground sharpness.

The closer you are to any foreground object, the more critical your tripod and camera placement become. It’s obvious how camera placement affects the appearance of any close object, but because of the wide coverage here, the shooting position of a wide-angle lens greatly influences how the foreground relates to the background. If you’re working 20 feet from the nearest part of the scene, a 6-inch change in camera location makes almost no difference at all. But if you’re working with the lens 20 inches from the subject, the same 6 inches in any direction becomes a gross movement. The closer the foreground is to the camera, and the farther away the background is, the more critical the location of the camera becomes. Any subtle shift in camera position, and the entire foreground/background relationship changes. Time spent finding the best shooting position is time well spent.

With wide-angles, a few millimeters' difference in focal length drastically changes what a lens "sees." Here are the horizontal angles of view (on a full-frame digital camera) of some popular focal lengths:

Focal Length	Horizontal Angle of View
35mm	55°
28mm	65°
24mm	74°
20mm	82°
16mm	95°
14mm	103°

The angle of view is one of the reasons for the popularity of wide-angle zooms in the 16−35mm range. Carrying one lens, rather than three or four or five, is a lot simpler. However, zoom lenses with very wide focal lengths—such as the Nikon 14−24mm f/2.8—are bulky, heavy, and expensive. As a gross generalization, below about 28mm, prime focal lenses (fixed-focal length lenses) tend to have slightly better image quality in terms of absolute sharpness, but zooms offer more flexibility. There's always a compromise. Some points to consider about wide-angle use:

- The shorter the focal length, the more that subjects near the edge of the frame will tend to appear stretched out.
- With their broad coverage, wide-angle lenses have a greater apparent depth of field, even when used wide open. Consequently, it's difficult to isolate a subject by using a fast aperture to blur the background.
- Because of their wide angle of view, light levels will naturally vary across the frame. Using a polarizing filter, where the effect depends on the angle between the lens and the sun, exaggerates this fact.
- A slight change in lens direction up or down can have a huge impact on whether otherwise parallel vertical lines will appear to converge.
- Most wide-angle lenses, and particularly the less-expensive ones, show light falloff toward the edges and corners of the image. It's easy to correct this in software programs such as Lightroom and Photoshop, but of course, this means time spent at the computer.

Gravel road between wheat and lentil fields, Washington. Nikon D3x, Nikon 16−35mm lens, 1/10 sec., *f*/11, ISO 100

NORMAL LENSES

“Normal” or “standard” lenses, in the 35mm to 70mm range, are some of the most underrated of all lenses. In truth, probably the single-most underrated lens is the plain vanilla 50mm. These are actually some of the sharpest, most highly corrected optics available, since this focal length has been around for years and is relatively easy to make. If you’re looking for a fast lens, in a small size, for a most reasonable price, look for a 50mm *f*/1.8. The *f*/1.8 is 2 to 3 stops faster than the typical slow-aperture consumer zoom lens commonly packaged with a camera body as a “kit.” In all honesty, I would recommend skipping the “kit” lens if possible, as a basic 50mm will be better both optically and mechanically.

Aside from the 50mm focal length, there are almost no other prime focal lengths available in the “normal” class, with the 35mm fixed focal length nudging into the group at one end and the 85mm focal length just outside at the longer end. There are some special-purpose lenses, such as the 45mm tilt/shift or 60mm macro lenses from both Canon and Nikon, and at *f*/2.8 maximum apertures, these can all be used as standard lenses. Besides the inexpensive kit lenses, there are quite a few zooms available, including the very useful Canon 24−105mm *f*/4 and the Nikon 24−120mm *f*/4. Optically, the best of the medium-range zoom lenses are the 24−70mm *f*/2.8 ones, which, of course, come with a price tag to match.

Lenticular cloud at sunset over the Alabama Hills, California. Nikon D3x, Nikon 24−70mm lens, 1 second, *f*/11, ISO 100

Stark, high-elevation landscape in the dry Atacama Desert, Bolivia. Nikon D3x, Nikon 24−120mm lens, 1/100 sec., *f*/10, ISO 100

Sea stacks and beach at low tide, Oregon. Nikon D3, Nikon 24−70mm lens, 1/5 sec., *f*/16, ISO 200

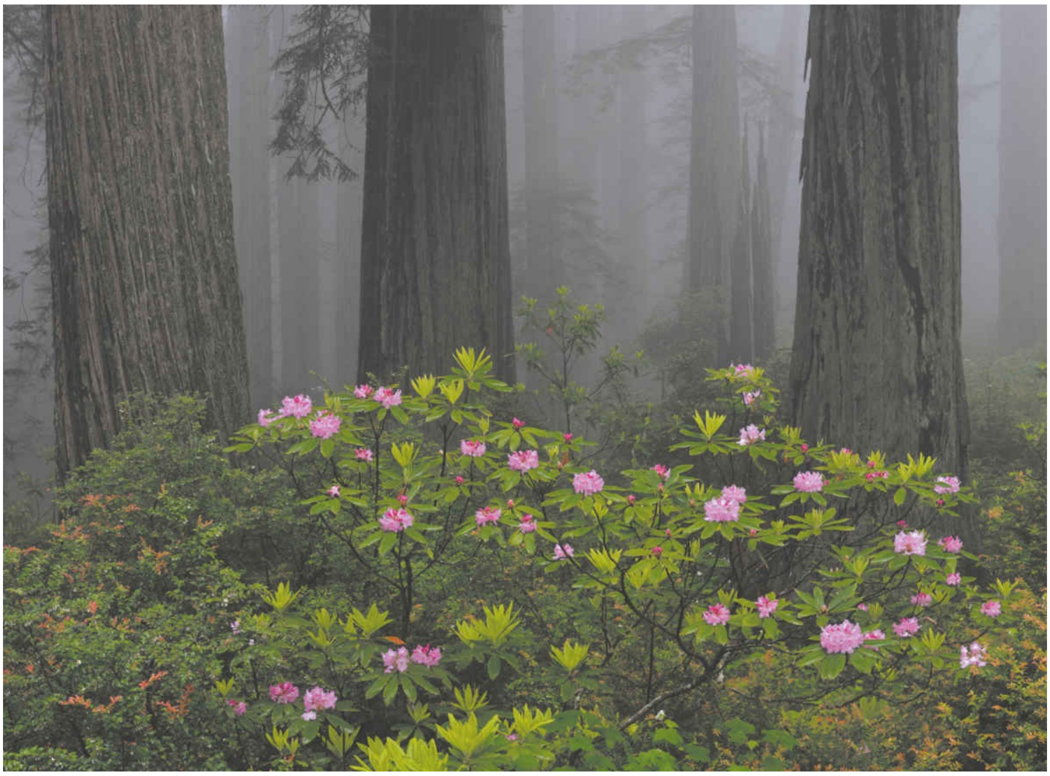
SHORT TELEPHOTO LENSES

The 70−200mm zoom lens is probably the most popular of all lenses today. Zooms in this range are some of the best available, maintaining high image quality across their entire focal-length range.

As with all lenses, you get what you pay for, so buy the best quality you can possibly afford. I would suggest you get a lens no slower than *f*/4 wide open, as you'll use a lens in this range a lot with filters, especially a polarizer, and every filter cuts down the amount of light available for focusing and composing. There are a few zooms in this range that have a variable wide-open aperture—*f*/4 to *f*/5.6, for example—but my suggestion is to avoid these and go for a constant-aperture model instead. Working landscapes in the beautiful but marginal light of dawn and twilight is much easier with faster lenses, especially for those of us with middle-aged eyes.

If you are considering an *f*/2.8 lens, make sure it has a tripod collar so that you can mount the lens, rather than the camera body, to your tripod. Having an 8-inch-long lens weighing 2½ to 3 pounds cantilevered out into space from the camera body is definitely a liability if you desire sharp images.

Paradise Bay, Antarctica. Nikon D2x, Nikon 70−200mm lens, 1/320 sec., *f*/11, ISO 100



Rhododendrons and redwoods, Del Norte State Park, California. Nikon D3x, Nikon 70−200mm lens, 0.4 sec., *f*/13, ISO 200

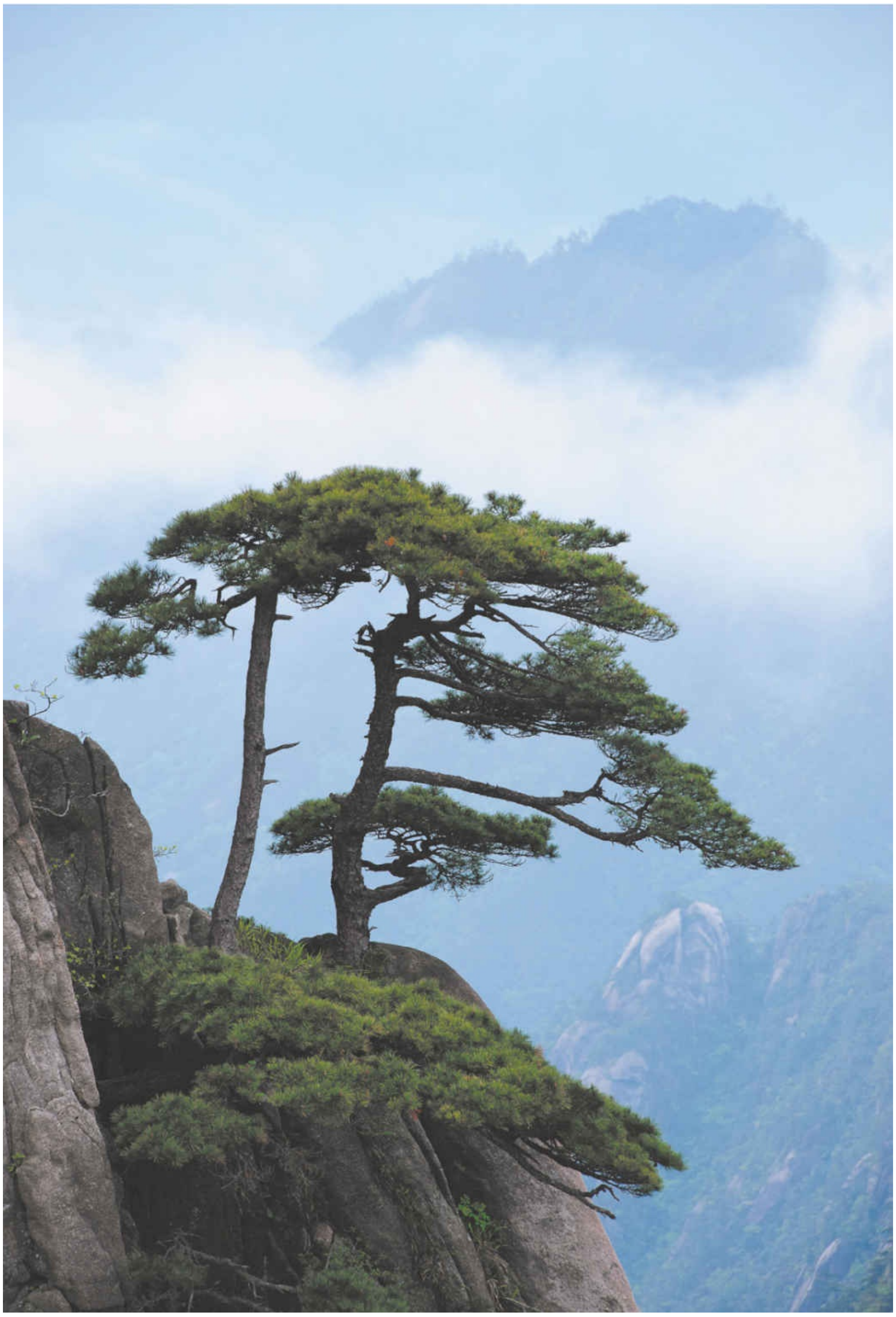
At the 200mm end, a 70−200mm is a four-power optic, magnifying vibration or movement problems by four times, so good technique on your part is mandatory. Having a tripod collar isn't quite as critical with the smaller and lighter 70−200mm *f*/4 lenses, but I would still want a collar if one is available. Using a collar for vertical or horizontal framing of the image, without having to flop the tripod head over to one side, is a much better way to work. The lens stays above the tripod head, and by rotating on its optical axis, maintains foreground/background relationships in both portrait and landscape orientation.

All internal-focusing lenses (lenses that don't change their length when you turn the focusing ring) actually change focal length slightly when focused closer. This happens with fixed-focal-length lenses as well as zooms and is just a consequence of the internal focusing design. As you focus closer, the effective focal length shortens somewhat. Of course, this in turn changes the angle of view of the lens and the subject coverage. Some lenses do this more than others. Personally, I've never seen this as any sort of problem; I can't think when it has affected my work in any manner. I simply ignore this "focus breathing." A simple solution would be to add an extension tube for closer focusing, but in my thinking, that "solution" just adds another layer of complexity to fieldwork.

I've always liked short telephoto lenses for field nature photography, because they are reasonably easy to handle outdoors. At the shorter end, around 100/135mm, they don't decompress a scene or compress it much either. I've often thought of myself as a portrait photographer, just taking portraits of nature rather than portraits of people, and lenses around 100mm are often called portrait lenses. I believe that thinking of your photography this way helps in your compositional decisions. Just as when you take a portrait of someone you try to do so in the most pleasing manner, trying to take a pleasing portrait of the landscape should remind you of the importance of lighting, perspective, composition, framing, and subject placement.

LONG TELEPHOTO LENSES

Once you go past 300mm, you're in a different photographic world. In fact, I tend to think of the 300mm focal length as a class unto itself. It's either the longest of the short lenses or the shortest of the long lenses. There are a number of decent 70−300mm zoom lenses available, all of which are *f*/5.6 wide open. These are relatively small in size, small enough that few have tripod collars (which I think would improve their tripod use quite a bit). The shortcoming with almost all of these is that optical quality starts to go down as they approach the 300mm end of the zoom range; however, for an initial step into the long lens world at a reasonable price, the 70−300mm *f*/5.6 is a great choice.



Chinese white pine, Mount Huangshan, China. Nikon D3, Nikon 70−200mm lens, 1/8 sec., *f*/8, ISO 400

Atlantic puffin, Iceland. Nikon D4, Nikon 500mm lens, fill flash, 1/400 sec., *f*/8, ISO 800

Eland, Maasai Mara National Reserve, Kenya. Nikon D3, Nikon 500mm lens, 1/1500 sec., *f*/8, ISO 800

Increase the aperture 1 stop, to *f*/4, and size, weight, expense, and optical quality all increase. Prime 300mm *f*/4 lenses are good all-around lenses and still relatively affordable while easy to carry. That one additional *f*/stop of light makes a major difference in fieldwork, being fast enough to easily focus either manually or with autofocus. While great for landscape work, it's on the short side for most wildlife photography.

Increase the aperture one more stop, to *f*/2.8 wide open, and weight, size, and cost all grow exponentially. A 300mm *f*/2.8 is not a lens you would carry for a casual walk in the woods. Granted, that big *f*/2.8 aperture allows easy focus and these lenses are incredibly sharp, but is getting one worth the expense? Just how often will you actually use the lens at that wide-open aperture? For wildlife photography, it's still a slightly short focal length, unless you can work close to your subjects. The nature photographers I know who own this lens almost always have a teleconverter mounted.

Photographing wildlife is exactly why most nature photographers want a long lens. In the non-photographer's imagination, a photographer using a long lens can stand about a half mile from a deer and take frame-filling photos. Even with the biggest lens you can carry into the field, you need to be close to your subject—a lot closer than most people realize. To fill the frame with a subject that's 2 feet across, with a 300mm lens you need to be about 16 feet from the subject. That's pretty close.

Let me immediately state that there is no such thing as a small, lightweight, low-cost, high-quality, fast-aperture long lens. Big fast glass = big heavy lens = big price tag. Whether it's worth that big price tag depends on the subject matter you want to photograph. Environmental photos with wildlife in the scene or animal portraits? Does "wildlife" only mean large mammals, or does it include small birds? Are you planning on working close to your vehicle or backpacking into the wilderness? Are you taking your lens to Africa or to the local city park? If you answered that you want to do all of the above, be warned: you have just concluded that you need not one but at least two—if not three—long lenses.

Selecting a long lens always involves some kind of compromise. Maximum aperture, size, cost, or a combination of these elements (which are all directly related) will probably have to be sacrificed to some degree. Fast long lenses are physically large, heavy, and very expensive. Autofocus works best with fast lenses, and manual focusing is much easier since every stop of speed doubles the amount of light coming through the lens. Really long lenses also tend to be used fairly wide open, in order to keep shutter speeds up to stop action, and you pay for this maximum aperture optical quality.

One determining factor in lens choice is how close you can get to your subject. Obviously, the larger the subject, the shorter the focal length needed from any given shooting position. Moving closer to your subject is always a good solution to focal length, but this isn’t always practical. A 50mm lens used at 10 feet from the subject yields the same subject size as a 500mm used at 100 feet. But can you get 100 feet from your subject, let alone 10 feet? Let me here caution you about close approaches, which can put undue stress on animals. I’ve seen far too many photographers push wildlife for the sake of a shot. No photograph whatsoever is worth harassing the subjects, so stay back and use a longer focal length.

King penguins huddled together during windstorm, Salisbury Plain, South Georgia Island. Nikon D4, Nikon 200−400mm lens, 1/400 sec., *f*/11, ISO 800

Spotted hyena, Lake Nakuru National Park, Kenya. Nikon D2x, Nikon 200−400mm lens, 1/350 sec., *f*/8, ISO 200

However, past 300mm, there aren't a lot of choices. Want a 500mm *f*/4 lens? Sony makes one, Nikon makes one, Canon makes one. Here are my recommendations for prime long lenses:

- 300mm *f*/4: a good compromise lens in terms of focal length, speed, and weight, especially when used with 1.4X teleconverters. Easy to carry if you have to walk any distance.
- 300mm *f*/2.8: optically superb and offers fast autofocus. As with all 300mm lenses, works great when you can get close to subjects. Works extremely well with both 1.4X and 2X teleconverters.
- 400mm *f*/5.6: a reasonably affordable, lightweight focal length, mainly available in nonmanufacturer brands.
- 400mm *f*/2.8: big, heavy, expensive, and immense for its focal length. It's great once you get it on location and works wonderfully with teleconverters.
- 500mm *f*/4: for a fast long lens, this is the best compromise in size, weight, and price. This would be my pick in an all-around, multipurpose bird and mammal lens. Add teleconverters to get a 700mm *f*/5.6 or 1000mm *f*/8. For practical purposes, this is the longest lens you can handhold even for a short time, unless you're young and strong.
- 600mm *f*/4: if you are a bird specialist, buy this lens. Be warned that it will sag your shoulders while lightening your wallet.
- 800mm *f*/5.6: another bird specialist's lens. The problem I see is that for many subjects it's too long of a focal length; try to photograph a giraffe and you'll end up going away from the animal in order to fit it in the frame.

There are also some zoom lens options, which I would definitely consider:

- 28−300mm *f*/5.6: very useful as a general lens.
- 80−400mm *f*/5.6: Sony and Nikon have new versions of this lens, and Canon is due for replacement in the near future. Given how good the new designs are, this would be my suggestion over a 300mm *f*/4, although a 300mm would be considerably less expensive. In my opinion, the flexibility of the zoom outweighs the cost differential.
- 200−400mm *f*/4: a great focal length range if you don't need really long focal lengths, and it's a full stop faster than the 80−400mm lenses. Canon has a version with a built-in 1.4X teleconverter.

And there are one-of-a-kind lenses such as the Sigma 50−500mm *f*/4−6.3 OS. I've not used this lens and have read conflicting reports about it; however, the price is relatively reasonable for the focal length.

A two-lens combination might be an 80−400mm and a 600mm or a 300mm *f*/2.8 and a 500mm, or … well, you pick and choose. While I actually know some people who own multiple long lenses, I would think long and hard about the justification for doing so. Big glass is extremely expensive. For example, at the time I write this, both the Sony 500mm *f*/4 and the Canon 600mm *f*/4 II retail for over $12,000, while the Nikon 800mm *f*/5.6 is pushing half again that price. Once you've bought the lens, can you afford to go out in the field to photograph?

It's worth mentioning that a "crop-factor" body, in effect, gives you a bit more reach. For example, Nikon's DX bodies have a 1.5X crop sensor, so, in effect, a 500mm becomes a 750mm. Many wildlife specialists use such bodies just for this reason. Some cameras offer even more of a choice. I have a Nikon D800E, which is a full-frame body. Normally, it is a 36 megapixel camera, but it also has two crop modes that are user selectable, even while keeping your eye to the viewfinder. There's a 1.2X crop mode, which yields 25 megapixels, and a 1.5X mode, for just over 15 megapixels.

Finally, I have to mention one more lens: the Sigma 200−500mm *f*/2.8. Weight (of the lens alone, no tripod, no camera body): 34½ pounds. Price: over $26,000. For that amount of money, you could buy a car and drive over to your subject. And try to imagine the words you would say if you ever dropped this lens. Your mother would not be pleased.

Arctic tern, Iceland. Nikon D4, Nikon 500mm lens, 1.4X teleconverter, 1/5000 sec., *f*/8, ISO 1600

Depth of Field

All field nature photography involves compromises. Exactly which combination of aperture and shutter speed you use depends on a whole variety of factors: whether you're photographing action or static landscapes, whether or not the subject is in motion, the length of your lens and/or the magnification rate at which you're working, how sharp or how soft you want the resulting image to be. There is never one correct answer for all situations; rather, you must decide how you want the photograph to appear and then take the appropriate steps.

The most basic decision of all is that of shutter speed and aperture combination. Do you need to stop action, or do you want a lot of depth of field? Depth of field refers to the section of a photograph that appears in focus. Theoretically only one plane of any subject can be in perfect focus, the plane on which the lens is focused, but in the real world, things on either side of this plane of sharpness appear to be in focus also. Beyond this section of relative sharpness, on either side of it both near and far, the image definitely appears to be out of focus. The actual size of this zone of sharpness, the depth of field, is controlled by four factors:

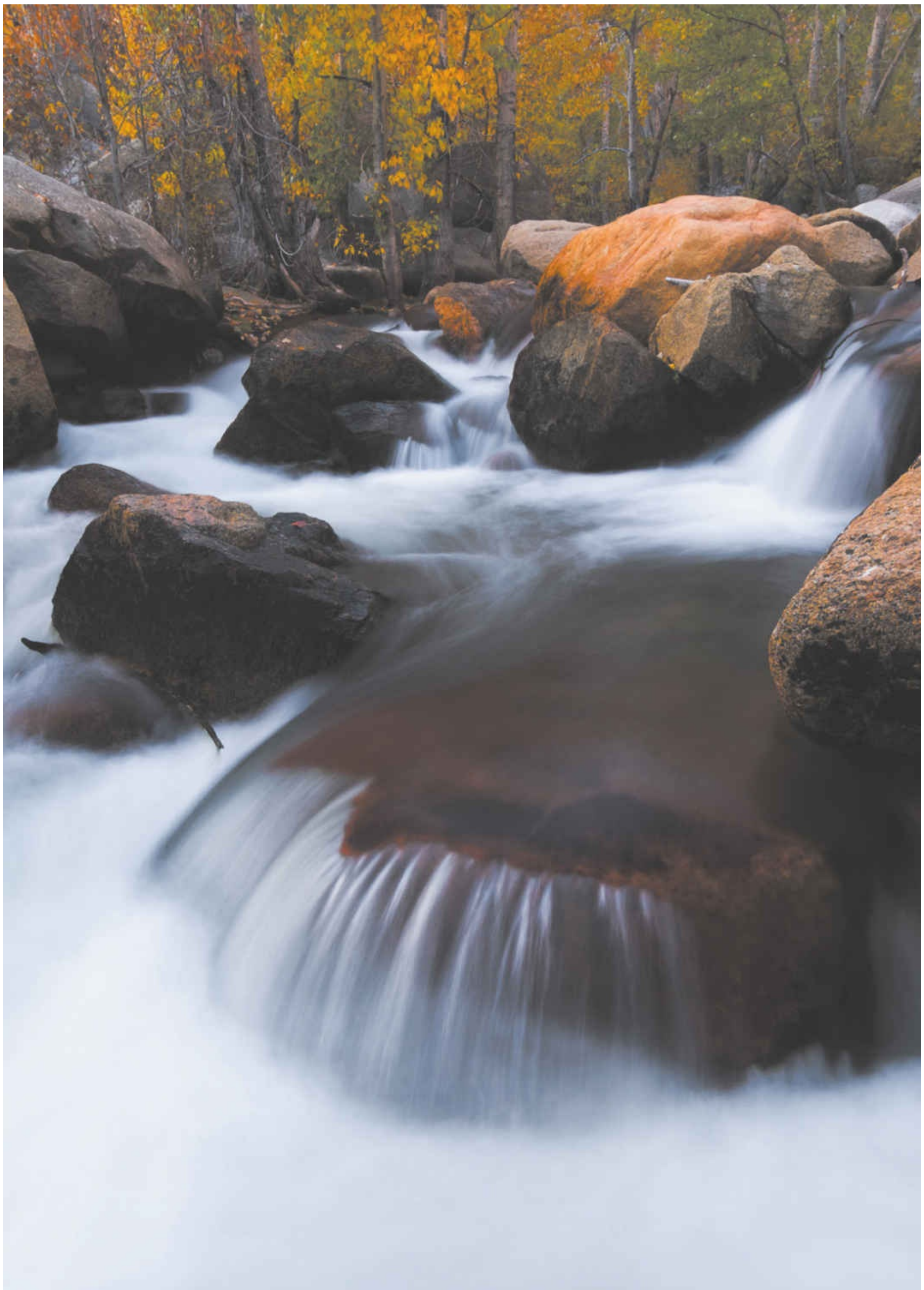
- The aperture—the actual *f*/stop—at which the picture is taken
- The focal length of the lens being used
- The size of the subject being photographed
- The distance between the camera and the subject

Along the Rio de las Vueltas, Los Glaciares National Park, Argentina. Nikon D3x, Nikon 24−120mm lens, 1/30 sec., *f*/16, ISO 100

Let’s look at each of these points. With all lenses, as you stop down to a smaller aperture you increase the depth of field in the image (i.e., the area from near to far that appears to be in focus). The reverse is also true: as you open up to a larger aperture, the depth of field decreases. Apertures such as *f*/16 or *f*/22 yield greater depth of field on any composition compared to apertures such as *f*/2.8 or *f*/4 on the same lens. The smaller the aperture hole, the greater the depth of field; the larger the hole, the shallower the depth of field.

If you photograph the same subject from one location (if you don’t move your shooting location, that is), then depth of field decreases at any given *f*-stop as you increase the focal length of the lens you’re using, and vice versa. For example, if you’re shooting with a 28mm lens and switch to a 200mm lens, you’ll have a lot less depth of field even though you’re using the same marked *f*-stop on both lenses. What you’ve changed as you switch lenses is how much of the subject you include in the photograph. The perspective remains exactly the same in both photos, since you’ve haven’t changed shooting location; but by going to a longer lens, you’ve increased how large the subject appears in the viewfinder. You are now seeing less of the subject than you did with your wide-angle lens, and whenever this happens you lose depth of field. To sum up, as you gain magnification, you lose depth of field.

With any given lens at any given *f*-stop, depth of field decreases as you decrease lens-to-subject distance. As you move closer to a subject, you see less of it through the lens. Let’s say you’re looking at an entire mountainside of trees and flowers. Photograph the whole scene with any lens—let’s assume a 50mm lens used at *f*/16—and depth of field is measured front to back in hundreds of yards. Now move up closer and photograph a single tree with the same lens and *f*-stop, and depth of field at *f*/16 is measured in feet. Move in even closer and work just one branch of that tree, with the 50mm lens still set at *f*/16, and depth of field is measured in inches. Go in tighter still, photographing one small flower blossom at the base of the tree with the same lens and same aperture, and depth of field has become fractions of an inch. As I said before, as you gain magnification, you lose depth of field.



Cascading stream, California. Nikon D2x, Nikon 12−24mm lens, 1/5 sec., *f*/19, ISO 100

Lioness looking at distant wildebeests, Maasai Mara National Reserve, Kenya. Nikon D3, Nikon 500mm lens, 1/320 sec., *f*/6.3, ISO 800

But if you keep the image size the same, then all lenses used at the same *f*-stop will yield photos with the same depth of field. You might have heard it said that wide-angle lenses give you great depth of field, while telephoto lenses yield shallow depth of field. This statement is not true. From a given shooting location, wide-angle lenses take in broad coverage while telephotos pull out selected areas. Well, that's the point right above. But if the coverage stays the same, then all lenses yield the same depth of field when used at the same *f*-stop. Shoot a picture with your 50mm lens, back off so that you're four times the distance from your subject, and you'll be shooting the same coverage with your 200mm lens (four times the focal length of the 50mm lens). If both lenses are set at the same *f*-stop, depth of field will be the same in both resulting photographs. Double the shooting distance you were at with the 200mm, use a 400mm from this new location, and at the same *f*-stop depth of field is still the same. Halve the distance you were at with the 50mm lens, shoot with a 25mm lens set at the same *f*-stop, and depth of field still remains constant. The photographs will look radically different, since background coverage changes due to the lenses' different angles of view, and perspective will be different also, but depth of field will be the same in all the photos.

So I'm back to my original question: Do you want great depth of field or a fast shutter speed? You could get both if you were willing to raise the ISO, but remember that high ISOs create their own problems (primarily more noise and decreased dynamic range). Most of the time, the real answer will be a compromise between what you would like to have and what you can get away with given the dictates of your shooting location. You would love to work that landscape using *f*/16, but the resulting shutter speed would be too slow to stop the wind-blown grasses. Or you would like to have 1/1000 sec. shutter speed to freeze the subject motion, but the resulting lack of depth of field means only a shallow plane of focus. Compromise, compromise … but you should make your decisions wisely and deliberately.

I have heard some photographers advocate always shooting landscapes at the smallest possible *f*-stop on a lens, in order to get the most depth of field. I would strongly disagree with this philosophy. Pick the *f*-stop that gives you the depth of field you desire. There is no valid reason to stop down any more than necessary for any given photographic situation. If an exposure setting of 1/60 sec. at *f*/8 yields the depth of field you want, shooting at 1/8 sec. at *f*/22 only increases the probability of lack of sharpness due to subject or camera movement. Why risk that?

On the other hand, I've heard other photographers suggest that you should never use the smallest *f*-stop on any lens, as it's not the sharpest due to diffraction problems. In simplified terms, diffraction is what happens when light passes through a very small opening. Since light acts as both a particle and a wave, it bends a bit passing through a small hole and creates an interference pattern, called diffraction. Almost all lenses are sharpest at about 2 stops down from wide open, and diffraction problems will definitely be apparent at the smallest *f*-stop.

But what if "2 stops down" doesn't yield the depth of field you want? If you're working a moving subject, you're stuck; you'll have to make a decision as to what to do. With a stationary subject, you might want to think digitally and shoot several frames at different focus points, stacking the images later in Photoshop (see Working in the Digital Darkroom).

Rock outcropping with lichens, Half Moon Island, Antarctica. Nikon D3x, Nikon 70−200mm lens, 1/13 sec., *f*/16, ISO 100

Focusing a Lens

Manually focusing a lens seems easy: you turn the focusing ring on a lens until a particular section of the image appears sharply defined. Simple, right? In practice, it's not quite so easy. Modern cameras have viewfinders that are optimized for autofocus (AF) photography, lacking the contrast "snap" that older non-AF cameras offered. This is particularly true of the lower-priced entry-level cameras. Compounding the problem is the slow speed of the kit lenses often included when camera body and lens are purchased as a package. An *f*/5.6 lens gives enough depth of field that finding the precise point of true focus is extremely difficult. On the other hand, focusing a really fast lens, such as an *f*/1.4, is just as difficult if the camera isn't mounted on a tripod; your slightest movement forward or backward throws the viewfinder image out of focus.

To help with manual focus, you'll definitely want to adjust the viewfinder diopter adjustment for your eyesight. See the instructions for this in the section on setting up your camera in Chapter 1. You will never be able to manually focus a lens precisely if the image on the viewfinder is always blurry.

Iceberg with icicles, Antarctica. Shooting with a handheld camera while bouncing around in a Zodiac, I was thankful for autofocus. Nikon D3x, Nikon 70−200mm lens, 1/320 sec., *f*/14, ISO 400

Blue-eyed shag carrying nesting material, Sea Lion Island, Falkland Islands. I might have been able to focus manually on the landing shags, but autofocus gave me far higher percentage of “keepers.” Nikon D4, Nikon 200−400mm lens, 1/3200 sec., *f*/6.3, ISO 800

One semi-helpful feature is the “in-focus” indicator that appears in the viewfinder. Unfortunately, watching the indicator means you’re not looking at the image itself. Plus the indicator is generally linked with whichever AF point has been previously selected, even though you’re manually focusing the lens. If the AF point happens to be over the wrong area, the in-focus indicator tells you the wrong information.

When your subject is stationary and the camera is on a tripod, the best solution for precise manual focus is to use Live View. This mode lets you preview the image on the camera’s LCD. You’re seeing exactly what the sensor sees. The best part: you can zoom in (see your camera instruction manual for how to do this) and magnify what’s shown on the LCD. I would suggest not using the highest magnification view possible but rather a step or two less, as, depending on the camera in use, the most magnified image might appear pixelated. I use Live View mode so much, especially with my manual focus tilt/shift lenses, that I’ve programmed a button on each of my cameras so that with one touch I can automatically zoom in on the LCD image.

Every current camera has autofocus as a built-in feature, and over the last few years, AF technology has greatly improved. What used to work okay some of the time now works well most of the time. In truth, modern AF has made possible action photography as was never before possible, to the point that many action photos are a basic combination of being in the right place at the right time with the right equipment.

However, that is not to say you don’t need to be concerned with how the autofocus system is configured. Many times, AF will indeed bring a point in the frame into sharp focus, but that point may not be the one you wanted to be in focus. You must maintain control of all aspects of the photographic process, so setting up and controlling autofocus is critical.

A reminder: The autofocus or manual focus choice is in no way dependent on the exposure mode you set or the metering pattern in use. Focus mode, exposure mode, and metering pattern are three independent choices for you to make, with distinct locations on your camera to set each. How you turn on AF depends on your particular camera. Most cameras have an AF switch on the body, while some lenses—particularly the more “pro” ones—have a switch that must also be set in the On position.

WHY IS MY PICTURE OUT OF FOCUS?

- You didn’t use a tripod or a fast shutter speed, so there is camera shake.
- You have a cheap “protective” filter on the lens, which is acting like a bad lens element.
- You focused on the wrong area. Is any part of the image sharp?
- You tried to use single-shot AF on a moving subject.
- You shot at a very wide aperture; consequently, there is little depth of field.
- You tried to focus on a low-contrast subject. AF needs contrast to work. No camera will focus on the clear blue sky.
- You really do need to run AF Fine-Tune.
- You have a bad lens. While a possibility, this would be the least likely answer.

Agave and lichen on rocks, Grand Staircase-Escalante National Monument, Utah. I used a non-AF lens here, but I would have focused manually no matter what lens I might have used. Nikon D800E, Nikon 45mm T/S lens, 0.6 sec., *f*/20, ISO 100

Current cameras have a number of AF sensors in the frame. Long gone are the days when there was a single AF point dead center in the viewfinder. How many AF points there are varies by camera model; for example, the Nikon D4 has fifty-one AF points, while the Canon EOS-1D × has sixty-one. A single point—the beginning primary point for AF to work—is normally selected by using a rocker dial on the camera. To initiate AF, the default on all cameras is to press the shutter release part way.

You can set your camera to use only one AF sensor or a group of them. In the group mode, once focus is acquired with your initially selected point, the camera can hand focus off to any of the other sensors in the group if the subject briefly leaves the selected point. For example, on my Nikon D4, I can opt to have all fifty-one sensors available for use or only eleven. If I choose fifty-one, I can have only a single point active or a group of nine, twenty-one, or fifty-one points surrounding my selected primary point. I can even let the camera track subjects as it selects new primary focus points based on color (Nikon's 3D-tracking).

Autofocus looks for contrast. If you're using a group of sensors and your primary AF point happens to be over a low-contrast area, the AF system might actually choose to use a different AF sensor out of the group if that AF point happens to be over an area of higher contrast. An easy test will determine if your camera does this: Aim your lens at a subject where a high-contrast area is under one of the group points—but not the main one. Have these two targets at different distances to quickly determine which point the camera selects.

All current DSLR cameras offer two modes of AF, one for static subjects (called Single Servo by Nikon and One Shot by Canon) and the other for moving subjects (called Continuous Servo by Nikon and AI Servo by Canon). In the first mode, the focus locks at the selected AF point. To make the camera refocus, you must raise your finger off the shutter release and then depress partway again.

In my opinion, a much better way to use AF is to avoid the single-shot-static-subject mode altogether. Instead, I would suggest taking AF activation off of the shutter button and instead using back-button AF along with the continuous AF mode. Read the section on autofocus activation in Chapter 1. If you make these adjustments, simply lowering or raising your thumb will activate, or lock, autofocus. In the continuous mode, so long as AF is activated, the camera will track a moving subject if the AF point, or group of points, remains over the subject. It will be able to predict where the subject will actually be located at the moment of exposure and focus to that point. We've come a long way.

While autofocus works best with fast lenses in bright light, I'm amazed at just how well it works in really low light; however, there's a cutoff point based on lens speed. We're just now seeing systems that will allow AF at a maximum aperture of *f*/8. The problem in the past has been one of accuracy; there is enough depth of field at apertures such as *f*/8 that finding the actual plane of focus is difficult. Read your camera manual to determine what is possible with your system.

Most AF lenses have an antivibration feature called Image Stabilization (IS) by Canon or Vibration Reduction (VR) by Nikon. This feature is user selectable; you can turn it on or off. It affects focusing a lens in two contradictory ways: (1) it allows you to handhold a lens at slower shutter speeds than would normally be advised and still produce acceptably sharp images, and (2) at certain moments, especially at faster shutter speeds, it can do the reverse of its intended function and blur the focus.

Gentoo penguin porpoising, Pebble Island, Falkland Islands. I could not have made this image without autofocus. Nikon D800E, Nikon 200−400mm lens, 1/1600 sec., *f*/11, ISO 800

I constantly get asked as to when to use IS/VR and when not to. First of all, realize that IS/VR does nothing in terms of subject motion; a fast shutter speed is the only solution to freezing action.

If you do a Web search on IS/VR, you'll discover that almost everyone has a different opinion as to what to do. A problem is that there are several versions of IS/VR out there, and what might be right for version 1 might not be best to do with versions 2 or 3 or 4, and what might work for camera brand A might not work for brand B. Given those facts, here are my generalizations, distilled down as much as possible:

- Don't blindly trust my advice. Run some tests of your own. Shooting test images, and evaluating them yourself, is the only real answer as to what *you* should do. After all, the pictures you take are *your* pictures, and you have to decide what "quality" means to you. In passing, I am a great believer in running tests, whether for IS/VR or any other photographic concern.
- Don't turn IS/VR on unless you really need it. Basically this means you're in a situation in which you have to handhold the camera and are forced to use a slow shutter speed.
- If your camera's IS/VR offers different modes, Normal should be used when you're on a stationary platform, Active when on a moving platform.
- Run a test (not just a couple of frames but fifty or so) to determine if your lens's version of IS/VR is useful when the camera is mounted on a tripod.
- Again, shoot test frames to see if IS/VR affects images when the shutter speed is over 1/500 sec.
- Don't worry if IS/VR is on or off if all you're doing is posting images in a website gallery. You won't (can't) see a difference in such small images.

And one final comment: Many cameras now allow the user to adjust the AF distance that the camera selects, near or far, using Autofocus Fine-Tune. The theory is simple: With the camera mounted on a solid tripod, you shoot a test target with the lens wide open using one AF point and then check the resulting image to see if it’s sharp. With the correct target, you can determine if the camera’s AF system has slightly back-focused or front-focused and then dial in a plus or minus compensation. Be warned, this is not a casual test to run, as you’ll need to do repeated trials and evaluations. In my opinion, the LensAlign kit, available from most camera retailers, is the best solution.

Zoom Lenses or Fixed-Focal-Length Lenses

Just in case you haven't paid any attention to photography for the last twenty-five years, a zoom lens is simply a lens that incorporates many focal lengths into one lens. Most photographers today are using zoom lenses; in fact, it's extremely rare at the workshops and tours I conduct for anyone to not have at least a couple of zooms. Ever rarer is someone using fixed-focal-length lenses only.

Given the same quality of optics, and given the same focal length, there is no difference between a photograph taken with a zoom lens or a photo shot with a fixed-focal-length lens. A zoom lens set at 100mm and a prime 100mm lens will produce the exact same photograph. The focal length used determines the "look" of a photograph, and the shooting location determines the perspective. Keep these the same and the results are the same.

Panda, China. Nikon D3, Nikon 70−200mm lens, 1/640 sec., *f*/4.5, ISO 1600

Autumn quaking aspen, California. Nikon D3, Nikon 70−300mm lens, 1/4 sec., *f*/13, ISO 200

But the question is, do you (or can you) get the same quality of optics in a zoom as with a fixed lens? Well, yes and no. Some prime lenses are indeed spectacular, and some zoom lenses are indeed terrible, but the reverse can also be said. Basically, you get what you pay for. Inexpensive lenses on the whole tend to have more optical defects than more expensive lenses.

So, as almost always, the choice comes down to cost, convenience, and quality. If cost is your only concern, then I might ask if you're willing to give up some convenience features, such as autofocus. If so, depending on the camera you own, used manual-focus lenses might be the answer. What were at one time top-of-the-line, professional-quality lenses can now be purchased at extremely reasonable prices, particularly Nikon and Canon lenses. If you're predominately a landscape photographer, using a manual-focus lens is no big deal. In fact, all tilt/shift lenses (expensive, highly corrected lenses used by many pro landscape photographers) are only available as manual focus.

But convenience is one of the big attractions of a zoom, in that a zoom lets you carry a lot of focal lengths all together in one package, rather than carrying a number of individual lenses. Suppose your composition calls for a 148mm lens; that's only possible if you're shooting with a zoom, although using a high-megapixel camera would give you the equivalent. If you start with a large enough file, you can crop the image, in essence giving a longer focal length. Just be aware that all cropping is "lossy." You're always losing information when you crop. Crop to 1200 pixels on the long dimension, print at 300 dpi, and the resulting print is only 4 inches on that long side. But if all you want to do is upload to the Web, 1200 pixels is a decent-size image. As I said much earlier, you need to define what you want to do with your photography.

Zoom lenses do tend to be bulky compared to single-focal-length lenses, but not quite so bulky when compared to all of the lenses within the zoom's range. Consider a 70−200mm zoom; the focal lengths would include carrying an 85mm, a 105mm, a 135mm, a 180mm, and a 200mm. And there's no denying the convenience of not having to change lenses. At times, it's really difficult to do so because of environmental conditions such as blowing dust or shooting locations (just try changing lenses while in a Zodiac, bouncing around in rough ocean swells!).

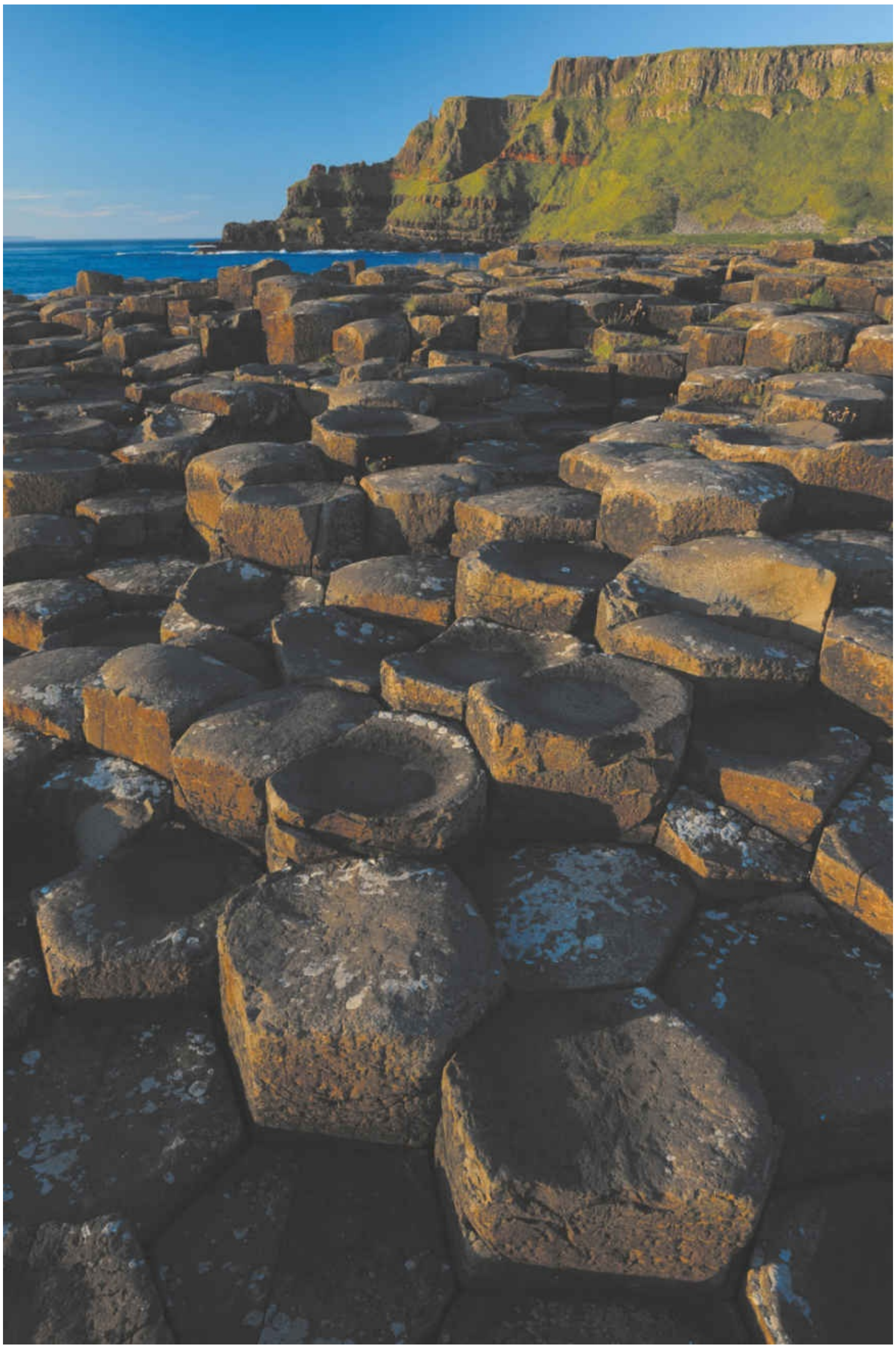
On the other hand, if you need really fast-aperture glass, a zoom lens is definitely not the answer. The fastest zoom lenses for full-frame DSLR cameras are all *f*/2.8 wide open, and most zoom lenses on the market tend to be at least a stop slower. Look at some of the fast lenses currently available from Nikon (Canon choices would be similar):

- 24mm *f*/1.4
- 28mm *f*/1.8
- 35mm *f*/1.8
- 50mm *f*/1.4 and *f*/1.8
- 85mm *f*/1.4 and *f*/1.8
- 200mm *f*/2

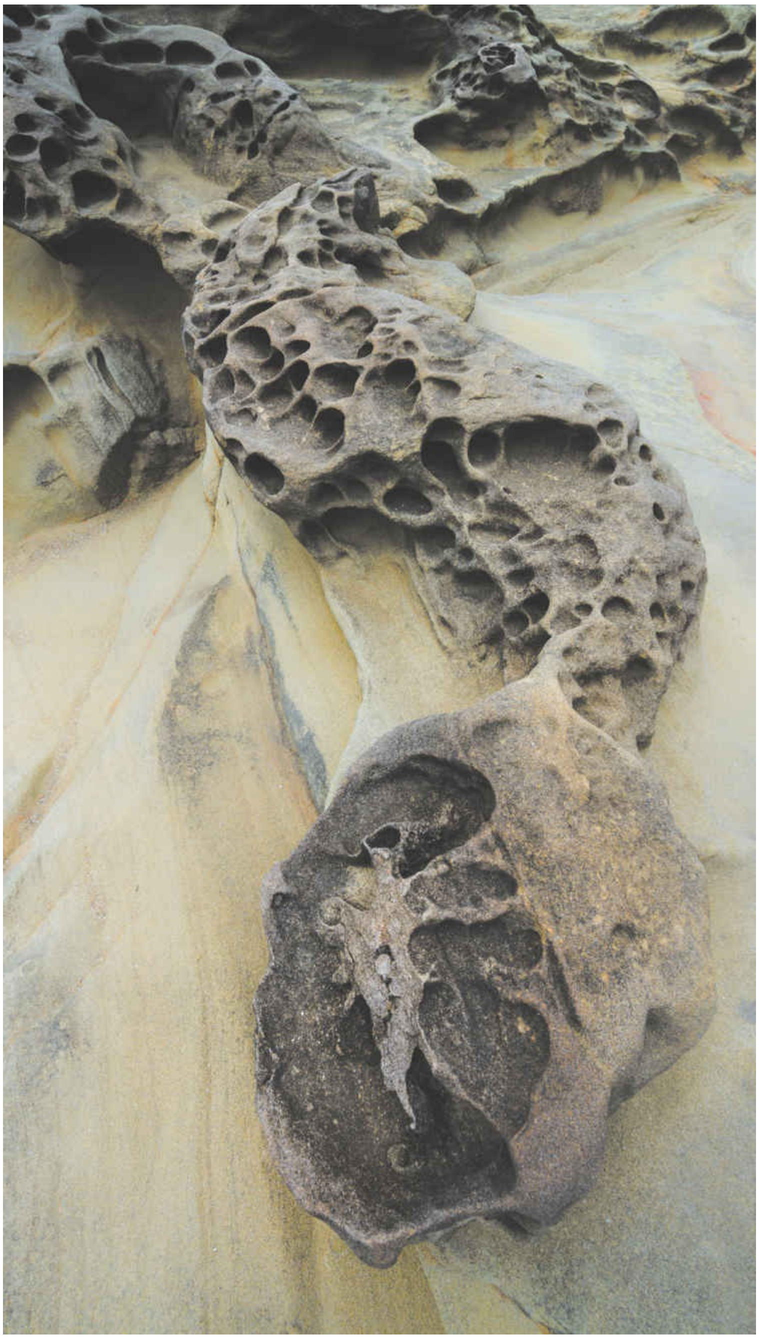
My question is, are you really going to be shooting at those wide apertures? If so, then these prime lenses are the solution. But is there any reason to purchase a fast lens, even a fast zoom, if you end up stopping down when photographing? Actually, I think there is a reason. Fast lenses—whether fixed focal lengths or zooms—are easier to see through, and this simple fact comes into play when you're working early or late in the day, at the edge of light. Start with an *f*/5.6 lens, add a polarizer, photograph at twilight … and it's hard to see through the lens to compose. The viewfinder image is just too dark. Personally, I'm also discovering that the older I get, the dimmer the world is becoming. Consequently, I like fast glass.

Some zoom lenses change aperture as you zoom, such as a 28−105mm *f*/4−5.6 lens. The change in *f*-numbers means it is a variable-aperture lens. If you set the lens wide open at *f*/4 at the 28mm end and zoom to 105mm, the aperture will change as you zoom until it becomes *f*/5.6. The diameter of the hole in the lens has stayed constant, but since aperture is a ratio of hole/focal length, as the focal length changes, the *f*-number must also change. This is a problem only if you're using manual exposure mode with the lens set at the *f*/4 end. If you're using any autoexposure mode, the camera will automatically compensate for the change in aperture.

If you're handholding a zoom lens, remember the old rule of thumb that says for consistently sharp photos you need a shutter speed at least equal to the focal length used. That is, to handhold a 50mm lens you need a shutter speed of at least 1/50 sec. Don't forget that as you zoom, the focal length changes. Start with a 100−400mm lens set at 100mm, handhold it at 1/125 sec, and you're marginally okay, but if you zoom to 400mm, you're almost 2 stops too slow. You must remember this focal length change even when the lens is mounted on a tripod. The tripod legs and head and the photographic techniques that are borderline for a 100mm lens are definitely not good enough for a 400mm. Perhaps it's best to always think about a zoom lens in terms of its longest focal length.



The Giant's Causeway, County Antrim, Northern Ireland. Nikon D3x, Nikon 24−70mm lens, 0.6 sec., *f*/16, ISO 100



Eroded rocks, Shore Acres State Park, Oregon. Nikon D800E, Nikon 14−24mm lens, 1/25 sec., *f*/11, ISO 100

Zoom lenses with very wide focal-length ranges, such as 18−200mm and 28−300mm, have become popular. If you own one of these, be extremely careful. Many people purchase these lenses for travel photography, but heaven forbid the lens malfunctions. “One lens does everything” can all too quickly become “one lens does nothing.”

The major problem I see with zoom lenses isn’t the lens but the photographer using the lens. Too many people stand rooted in one spot and zoom their lens in and out, trying to find a composition. You should first find the composition you want and then select the focal length that frames that composition. Zooming a lens, when you remain in the same location, changes the angle of view the lens “sees,” while the perspective remains exactly the same; that is, it just crops or expands the image area. If you want to change what you see, you have to change your shooting location. “Zooming” with your feet—changing your position—is often a better answer.

Whether you want the convenience of a zoom lens or the fast aperture and possibly better optical performance of a prime lens, my advice is the same: purchase the best lens you can afford. If the choice is between a better lens or a less-expensive camera body, go with the lens. The image the camera records can be no better than what the lens is capable of producing. Buy the best.

Tabular iceberg, Scotia Sea, Antarctica. Nikon D3x, Nikon 70−200mm lens, 1/320 sec., *f*/4, ISO 200

Teleconverters

Teleconverters are optical magnifiers that mount between the camera body and your lens and increase the magnification of whatever you put in front of them. You might hear them referred to by all sorts of names: teleconverters, tele-extenders, converters, or (inaccurately) doublers. I like to think of them as “multipliers,” since that name reflects what they really do—they multiply the magnification of whatever you point your lens at, allowing you to get a bigger image from the same working distance.

Teleconverters are available in powers of 1.4X, 1.7X (Nikon only), and 2X. When a teleconverter is mounted behind a lens, it multiplies both the focal length and the *f*-stops of the lens by the power of the converter. For example, a 2X converter doubles the focal length of whatever lens it’s used on and at the same time changes the marked *f*-stops by 2 stops. A 200mm *f*/4 lens becomes a 400mm *f*/8 lens. A 1.4X converter magnifies focal length by 1.4 and changes the *f*-stop by 1 stop, while a 1.7X converter magnifies focal length by 1.7 and changes the *f*-stop by 1 1/2 stops. The exposure readout in the camera, and the exposure meter, should reflect these changes.

Yellow-headed blackbird, British Columbia, Canada. Nikon D4, Nikon 500mm lens, 1.4X teleconverter, 1/400 sec., *f*/8, ISO 800

Basically, there are two types of teleconverters on the market. Dedicated units are available from the major camera manufacturers and are designed specifically to work with certain lenses, primarily the longer focal lengths. Universal models are available from the accessory manufacturers such as Tamron and Sigma. These universal models will work on any lens on which they can be mounted, but they are not designed for any one particular lens. Think of these as the one-size-fits-all product versus the exact fit of the models.

Most photographers use teleconverters to make a long focal length into an even longer focal length. Bird and wildlife photographers are never satisfied with the focal length of their big lenses; they always want more telephoto magnification. Own a 300mm and you want a 500mm; get that 500mm and you want an 800mm. The problem is that lens size, weight, and price all dramatically increase as focal length and maximum aperture increase. Even if you could afford to purchase all of the lenses you wanted, it would be impossible to carry them simultaneously in the field. Teleconverters offer one solution. Here are some considerations:

Red-winged blackbird, Oregon. Nikon D4, Nikon 500mm lens, 1.4X teleconverter, 1/800 sec., *f*/10, ISO 2200

- For the best results with a long lens, use the dedicated teleconverters made by your camera manufacturer. These teleconverters tend to have the best glass and the best coatings, so they preserve color fidelity without softening the image through lowered contrast or added flare. Of course, these camera-brand teleconverters are more expensive than the universal models, but as with most things, you get what you pay for.

- Use the best prime lens you can. The highest-quality teleconverter will yield mediocre results if used on a mediocre lens. Teleconverters magnify whatever is put in front of them, so you want the best possible starting point. All teleconverters magnify defects, optical aberrations, and lack of sharpness. If you use a lens that already produces these faults, you'll just get more of them.

- Use the fastest lens you can. When you're photographing birds and mammals, you're generally working with the lens at the wider apertures. Start out with a lens that is *f*/5.6 wide open, add a 2X converter, and suddenly you're at *f*/11 maximum aperture. Unless you're working at high noon, you'll barely be able to see through the lens, let alone hit sharp focus. No current autofocus system will function at this maximum aperture. Birds and mammals are active early and late in the day, when light levels are already low; hence, you need all the lens speed you can have. To get any sort of fast shutter speed in low light at *f*/11 you'll have to raise the ISO a lot. Better have a really low-noise camera.

Black-shouldered kite, Maasai Mara National Reserve, Kenya. Nikon D3x, Nikon 500mm lens, 1.4X teleconverter, 1/320 sec., *f*/8, ISO 400

- Use a 1.4X teleconverter in preference to a 2X. When making long lenses into longer lenses, 1.4X teleconverters are by far a better choice, because image integrity is better maintained. All teleconverters degrade the final image, but the lower the power, the less you lose. Resist the temptation for power, unless you just have to have the added focal length. As a gross generalization, with the lens wide open, you'll lose about 15 percent of resolution by adding a 1.4X converter and double this amount with a 2X. You can gain some of this back by stopping the lens down 1 stop, which is another reason you want to start with a fast-aperture lens. Of course, a 1.4X teleconverter lets you use a 1-stop faster shutter speed than a 2X does, and a faster shutter speed helps reduce both camera and subject movement. You may not have as much focal length, but you'll get sharper photos.

- Use the best photographic technique you can. If you've created a longer focal length, you have to treat it as such. Suppose you have a 300mm lens and you add a 2X teleconverter to make it a 600mm lens. Using 50mm as a standard, the 300mm is a six-power optic, but the 600mm is a twelve-power one. You have to be that much better, that much more aware of image-degrading factors, than you were before you added the teleconverter. Problems such as vibrations and atmospheric heat waves and haze play a much bigger role as focal length increases. If you have a tripod that's barely adequate for a 300mm lens, it definitely isn't enough for a 600mm. If you absolutely must handhold to photograph, remember that you need a considerably faster shutter speed for sharp results, since you're now using a much longer lens.

- For the most part, avoid using zoom lenses. Zoom lenses are optically complex, with many elements in the light path. Add a teleconverter, with its optics, and image quality quickly falls apart. There are some exceptions, primarily the 70−200mm *f*/2.8 zooms from Nikon and Canon. These are top-of-the-line lenses, with price tags to match. While you might want to test other zooms that you own, most of the results I've seen are not encouraging. Adding a teleconverter to a 28−300mm lens will not yield quality images. Of course, you must define exactly what "quality" in an image means to you. Just getting a recognizable image of any sort might be enough, or perhaps you demand absolute sharpness. You'll have to make this decision.

- You get the depth of field of the new lens. Adding a teleconverter changes the effective *f*-stop in use. Since the optical hole in the lens doesn't change when you add a teleconverter but the focal length does, the lens becomes slower. Depth of field depends on the *f*-stop you're using, whatever that might be.

- Autofocus may or may not work. The slower the aperture of the final lens/teleconverter combination, the less likely that AF will be functional. Most camera bodies cut off autofocus at *f*/5.6, although a few can autofocus when the effective aperture is *f*/8. Don't expect AF to work if the maximum aperture is any slower.

- Teleconverters let you try out focal lengths you don't own. There's one instance when I would recommend using a generic teleconverter with a zoom, and that's when you're trying to decide if you should buy a long-focal-length lens. There's no such thing as an inexpensive, high-quality long lens. We're talking many thousands of dollars for such a lens. Before you spend all this money, try to borrow a long lens for a few days, or even rent one. If none are available, consider spending about $150 to add a generic teleconverter to your 70−300mm zoom lens. Now go out and shoot some pictures. How often did you actually use the long focal length? Do you see shots where you really needed a 500mm, or are you pulled back to the shorter end of the zoom? You might discover that you love the long focal length; okay, then spend the money and get a good lens. On the other hand, you might find out that you rarely see images with such as lens, or that the quality yielded by using the teleconverter is good enough for you. Take the extra cash you didn't spend, buy a better tripod, and go take a photo trip.

Cheetah cub, Maasai Mara National Reserve, Kenya. Nikon D3x, Nikon 500mm lens, 1.4X teleconverter, 1/350 sec., *f*/5.6, ISO 400

Male common eider, Spitsbergen, Norway. Nikon D4, Nikon 500mm lens, 1.4X teleconverter, 1/400 sec., *f*/8, ISO 800

Tilt/Shift (T/S) Lenses

A regular lens for a DSLR can be focused near or far, but the axis of the lens is always at a right angle to the sensor. The plane of focus (the slice of space that is in focus) is also always at a right angle to the axis of the lens, which is just another way of saying that the plane of focus is always parallel to the image plane in the camera. No matter what, there is only one plane that is in absolute sharp focus, but by using a smaller aperture, depth of field can be increased on either side of that plane of focus to yield apparent sharpness. With a regular lens, if you need more of the image to appear in focus, your only choice is to shoot at the smaller apertures. This has two major drawbacks: (1) Small apertures mean slow shutter speeds. If you try to photograph a field of flowers at *f*/22 for enough depth of field, but *f*/22, in turn, means a shutter speed of 1/15 sec., that's not enough to stop any wind movement. Now you're faced with upping the ISO, which means the probability of increased noise. And (2), small apertures introduce diffraction problems, reducing sharpness. The edges of the aperture blades tend to disperse the light coming through the lens. At larger apertures this diffracted light is only a small percentage of the total amount of light hitting the sensor, but at smaller *f*-stops, the amount of diffracted light becomes a larger percentage of the total light being recorded. You gain depth of field, but you lose sharpness. All lenses suffer from diffraction to some extent, and the latest high-megapixel cameras, with their ability to record small detail, will all too readily show diffraction problems.

The solution is to reposition the plane of focus, to *re-designate* where it lies, and in order to do this, you need a specialized lens: a tilt/shift (T/S) lens. For DSLR landscape photographers, T/S lenses are a godsend in that they are the closest option to using a view camera.

For a moment let's consider a view camera, the most common being one that uses 4 × 5-inch sheets of film. A view camera has two "standards": one in front to hold the lens and one in back to hold the film. These are connected by a flexible bellows, which allows both lens and film to articulate in any direction. In other words, they have "movement." The lens plane and the film plane do not have to be parallel but can be angled or displaced relative to each other. This allows the plane of focus, the slice of space that is in sharp focus, to be repositioned left or right, up or down, tilted forward or backward, or swung to either side. Wow! T/S lenses do most of this.

Morning light and iceberg calved from the Grey Glacier at Lago Grey, Torres del Paine National Park, Chile. Nikon D4, Nikon 70-200mm lens, 6 seconds, *f*/14, ISO 100

Tulips, Skagit Valley, Washington. Nikon D2x, Nikon 85mm T/S lens tilted forward, 1/20 sec., *f*/16, ISO 100

However, there aren’t a lot of T/S lenses on the market. About once a week I get an email asking me which T/S lens one should purchase. My response? Of the lenses available, which focal length sees the world as you do? Are you primarily a wide-angle shooter? A short-telephoto-lens user? Consider how you photograph, and you will answer your own question. Nikon calls its version PC-E lenses and makes a 24mm *f*/3.5, a 45mm *f*/2.8, and an 85mm *f*/2.8. Canon refers to its as T/S and offers a 17mm *f*/4, a 24mm *f*/3.5, a 45mm *f*/2.8, and a 90mm *f*/2.8. Samyang has entered the market with a 24mm *f*/3.5 in mounts for Sony, Canon, and Nikon and promises other focal lengths in the future. (Schneider offers three T/S lenses in Canon and Nikon mount, but I would think twice. They are roughly double the price—and weight—of the Nikon and Canon lenses and take expensive 95mm filters. Basically, the Schneider lenses are really medium-format lenses with different mounts.)

Notice that there are no zoom T/S lenses; all T/S lenses are manual-focus prime lenses. For most photographers, myself included, these lenses duplicate focal lengths already owned, which is one of the strikes against purchasing a T/S lens. In fact, if movements aren't used, a T/S lens is just the same as any other lens of the same focal length. A 24mm lens is a 24mm lens, however you get there.

With the Nikon, Canon, and Samyang lenses, the camera body is mounted on the tripod and remains stationary, while the front section of the each lens can be rotated and/or repositioned. The front of the lens can shift to the left or shift to the right. Imagine yourself standing. You could take a step to the left or a step to the right. You're moving from side to side, you're shifting your position. Rotate the shift movement 90 degrees, and now the shift movement becomes rise, or fall. Once again, imagine yourself standing. If you don't shift your location, you could stretch up on your toes, or lower down a bit. Rise and fall. Swing to the left, or swing to the right. Without moving your body position, you could twist your torso to the left or right. Swing to the left, swing to the right. Rotate the swing movement 90 degrees, and now the swing movement becomes tilt down, or tilt up. Lean forward, lean backward. To some extent, these movements can be combined; for example, you could shift the lens to the left and also tilt it down.

HOW AND WHY TO USE TILT

The tilt movement is, in my opinion, what makes a T/S lens magical for nature photographers. You'll often hear that using a tilt creates more depth of field. Not true. What a tilt movement actually does is to reposition the plane of focus so that it no longer lies perpendicular to the lens axis. In doing so, at any aperture it creates a wedge-shaped depth of field that increases farther from the camera. By repositioning the plane of focus, by tilting the plane of focus one way or another, part of the image close to the camera will be in focus and part of the image far away from the camera will be in focus simultaneously. Depth of field is always on either side of the plane of focus, with less depth of field at close focus distances and more depth of field at far focus distances, hence a wedge shape. A really common misunderstanding of the tilt movement is the belief that using a tilt will bring everything in the photograph into sharp focus. Sorry, not true; you'll still need to stop down. Aperture controls depth of field, not tilt.

Nikon T/S lens tilted downward.

Nikon T/S lens shifted upward.

Nikon T/S lens rotated 45 degrees around the lens axis. Tilts and shift can still be used while the lens is rotated.

But how do you figure out how much to tilt? Using a tilt movement throws part of the viewfinder image out of focus and part of it into focus, and increasing or decreasing the tilt angle changes everything. The problem is that two functions need to be done as one: both tilting to move the location of the plane of focus and actually focusing on that plane once it's been moved.

First, you need to know a bit of background knowledge about the Scheimpflug principle (named after Austrian army captain Theodor Scheimpflug). There are three imaginary planes infinitely extended: the plane of the sensor, the plane of the lens, and the plane of sharpest focus (the part of the image where you want the focus to fall). With a standard lens, only two of these planes can ever have a common intersection, because the plane of focus is always parallel to the sensor. But if you can tilt the lens, all three planes can meet in a common line of intersection, and a photographic miracle happens. You've moved the location of the focus plane to where you want it to be. You've tilted it.

Okay, but now what? First of all, you are always tilting the lens *toward* the plane you want in focus, no matter the orientation of the camera body. Fine. But just how do you get all those planes to intersect? Here are several ways:

Lone Pine Peak from the Alabama Hills, California. Nikon D3x, Nikon 45mm T/S lens tilted toward the mountains, 1/6 sec., *f*/13, ISO 100

Tilt/Focus Method 1

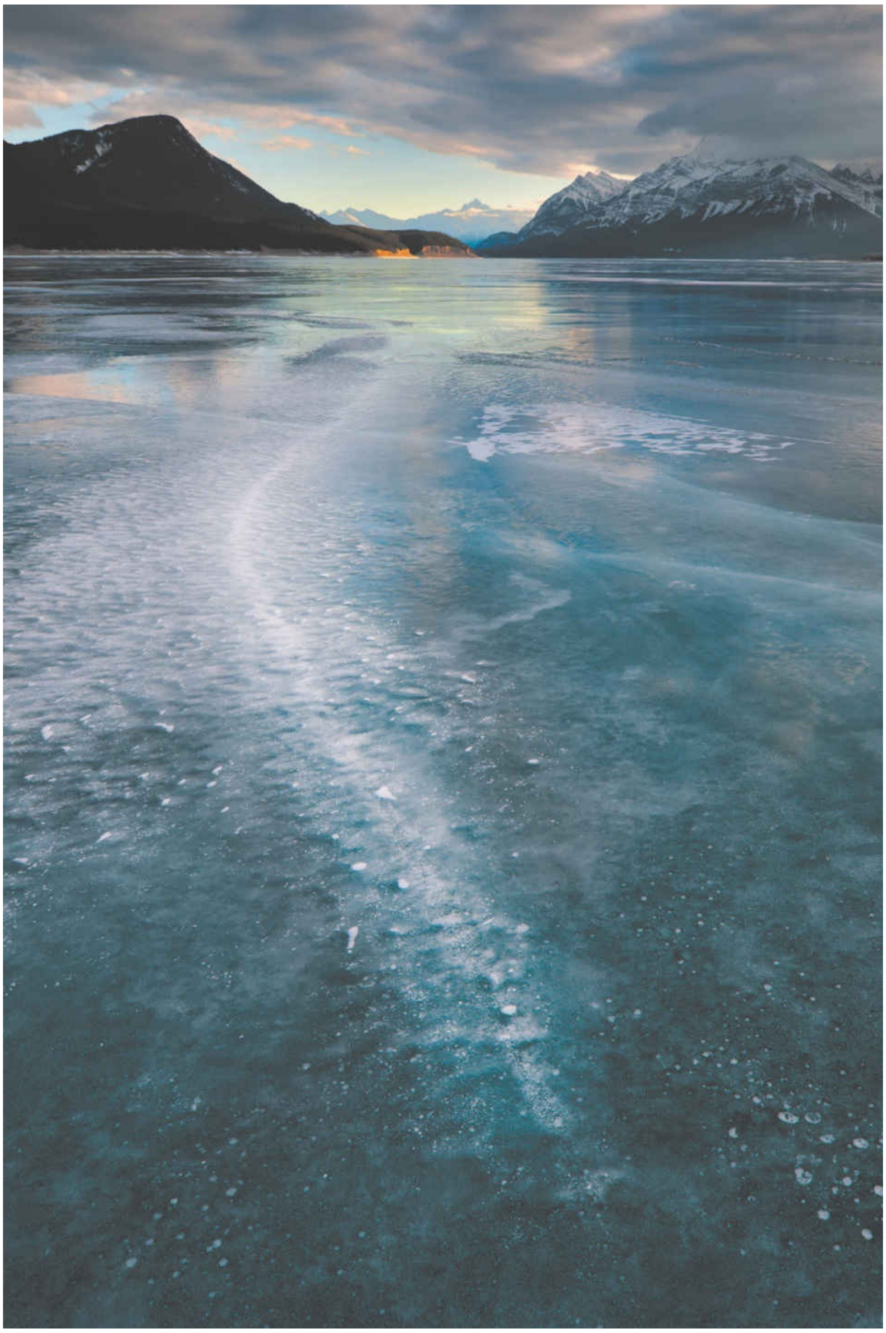
This is the "wild-guess" method. If you're shooting from eye level and your subject is basically a flat surface in front of you, you'll only need a degree or two of tilt. After all, the sensor plane and the lens plane have to intersect down at your feet, which are standing on the subject plane. This method works okay if you're photographing a flat plane from your standing eye level, such as the salt flats in Death Valley.

Tilt/Focus Method 2

This is the "out-of-focus" method. Pick a prominent feature in mid-foreground and focus on it. Now tilt until both near and far are equally out of focus; then refocus the image. Personally, I can never determine exactly when areas are "equally out of focus." It all just looks blurry to me.

Tilt/Focus Method 3

This is the mathematical way. The angle of tilt is the reverse sine of the focal length of the lens divided by the distance from the object plane to the axis of the lens. Got that? There are charts and tables on the Internet that tell the angle of tilt to use when a T/S lens is a measured distance from the subject plane (see www.luminous-landscape.com/tutorials/focusing-ts.shtml, or Google "tilt/shift lens tables" for even more information). There's even an iPhone app (Tilt Calculator, from the iTunes store). Personally, I don't want to refer to a chart before every shot, and when I'm in the field shooting, I generally want to get away from my phone, so I leave it in my truck.



Pattern on frozen Abraham Lake, Alberta, Canada. Nikon D3x, Nikon 24mm T/S lens tilted toward the horizon, 1/5 sec., *f*/11, ISO 100

Here are two methods that I think are better. Method 4 is based on a 1998 Howard Bond article titled "Setting Up the View Camera."

Tilt/Focus Method 4

Do the following steps:

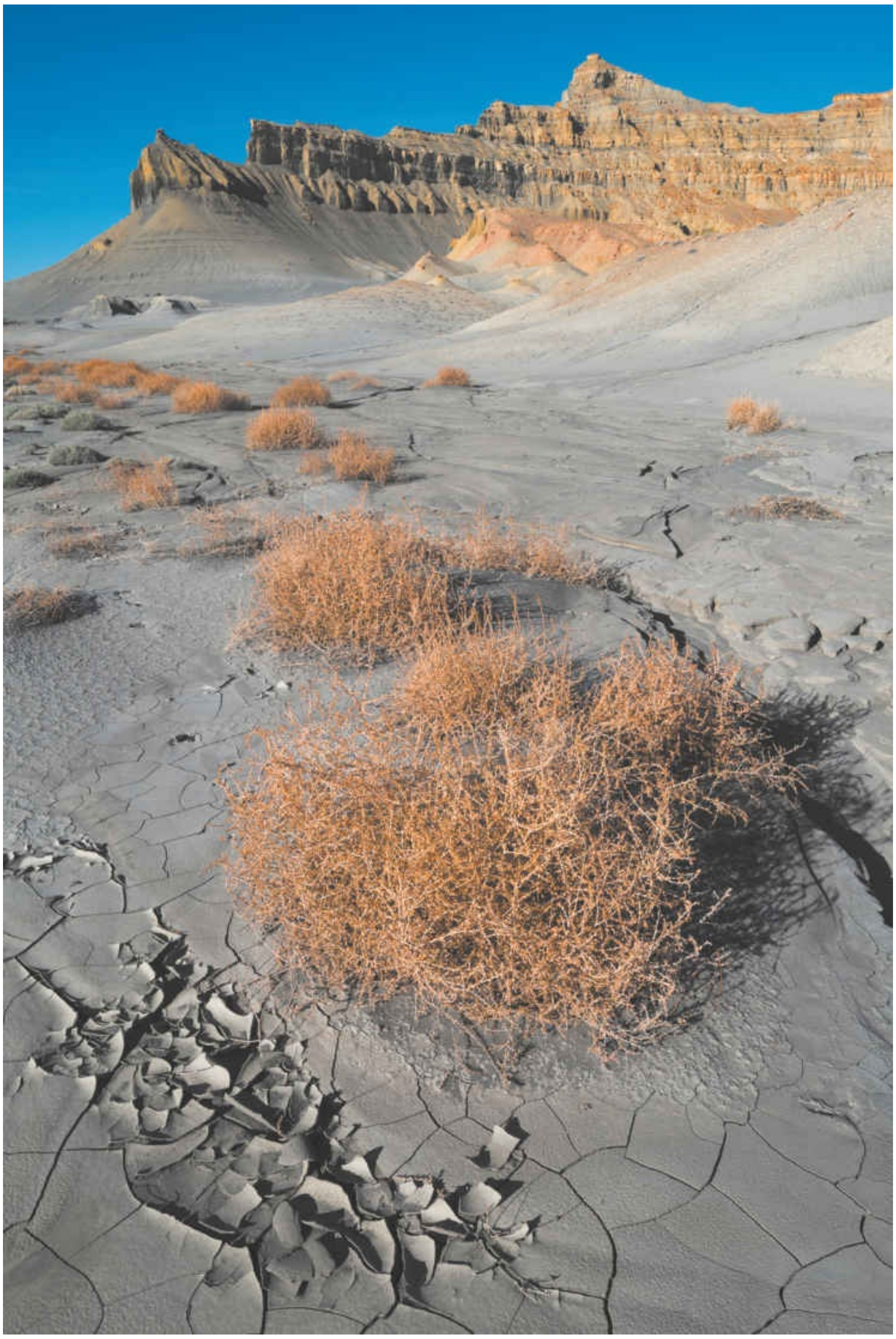
1. Choose a near point and a far point in the plane you want in focus.
2. Tilt the lens about 4 or 5 degrees.
3. Focus on the far point. The near point will be out of focus.
4. Decrease the lens focus distance just slightly and evaluate what happened to the near point (Live View helps here).
5. If the near point has become sharper, you need more tilt. Add some tilt and repeat steps 3 and 4.
6. If the near point has become more out of focus, you need less tilt. Remove some tilt and repeat steps 3 and 4.
7. When both near and far points seem roughly in focus, increase the focus distance slightly and evaluate what happened to the near point.
8. If it becomes sharper, you need less tilt.
9. If it becomes softer, you need more tilt.

Whew. Yes, this does work. Practice all of the steps at home, until you memorize the procedure. You can read the Howard Bond article on the Web at www.largeformatphotography.info/articles/bond-checklist.html. A concern is that view cameras have either base tilts (tilting from the bottom of the lens board) or axis tilts (rotation around the axis of the lens). T/S lenses for DSLR do not work this way.

Tilt/Focus Method 5

This a variation of Method 4, and is the method I use:

1. Choose a near point and a far point in the plane you want in focus.
2. Have the tilt set at the zero position (no tilt at all).
3. Focus on the near point.
4. Tilt toward the plane, until the far point comes into focus. The near point is now out of focus.
5. Refocus on the near point. The far point will now be out of focus.
6. Tilt away from the plane, until the far point comes into focus.
7. Repeat steps 4, 5, and 6 if necessary.
8. Trim the overall focus.



Tumbleweeds in Nipple Bench Badlands, Glen Canyon National Recreation Area, Utah. Nikon D800E, Nikon 24mm T/S lens tilted toward the mesa, 1/50 sec., *f*/16, ISO 100

No matter which method you use, determining exposure with a tilted lens is easy. Take a shot, a look at the histogram, and add or subtract light as needed. Remember that you still have to stop down. Tilting lets you bring one subject plane into sharp focus, but depth of field has to include anything outside this plane. Once established, you can reposition this wedge-shaped depth of field by focusing the lens slightly closer or farther. Live View really helps in establishing focus on specific areas and in positioning the depth of field, especially when viewing the LCD at a magnified setting.

If you want to stitch images using a shift with a tilt, you must set the exposure manually. Start with the lens not shifted, make whatever tilt you need, and use the histogram to determine the exposure. Manually set this shutter speed/aperture and use this setting for all of the frames you plan on stitching.

The major problem that I see with people using T/S lenses is overtilting. Most of the time you really don't need much of a tilt angle.

HOW AND WHY TO USE SHIFT

The shift movement keeps the front of the lens parallel to the sensor plane and is the simplest lens movement to learn. Shift is most often used to correct for converging vertical lines. If you use a short-focal-length lens to take a photo of a building or trees or any other subject with vertical lines, and if you have to aim the camera upward, those vertical lines will appear to converge. This happens because the bottom of the sensor is physically closer to the subject than the top of the sensor.

The solution is simple: keep the camera back parallel to the subject. Now the camera is aimed at the bottom of the building or trees or whatever you're photographing. Shift the lens upward (this would be a "rise" movement) and the camera looks up at an angle, and "sees" the entire subject—with no converging lines. If you're photographing buildings, you'll want to allow a small amount of convergence; a photo of a building with no convergence at all, with the sides perfectly parallel, makes the structure appear top-heavy and as if it's about to tumble over.

Photoshop can correct convergence in an image taken with a standard lens. For the occasional fix, this is a decent solution, although there will clearly be a resolution sacrifice since you're stretching pixels. A shift lens would yield much better results.

Besides working with subjects with converging lines, another time you might want to use shift is when something is blocking the camera position. You could change your shooting position slightly and then use a shift movement to photograph from one side or the other. For example, suppose your subject shows your reflection; moving your shooting position to one side and using a shift keeps you out of the picture.

Since you've changed the light path through the lens, you would think that determining exposure for a shifted photo would be difficult. Not so, thanks to the histogram. As mentioned in the previous section, take a shot, take a look at the resulting histogram, and make any exposure adjustment needed.

Shift can also be used in the creation of stitched images to make panoramic photos, to get larger file sizes, or to increase resolution. For a panoramic image, keep the camera in a horizontal position and take a series of shots—shifted left, at the null position with no shift, and shifted right—and combine these using Photoshop or other software. Avoid shifting to the absolute maximum on either side, due to image-edge problems. Since you're combining images, you end up with a larger file. Theoretically, you should move the camera body to the right the same distance you shift the lens to the left, and vice versa, but my experience is that Photoshop's Photomerge command automatically corrects for this. Just in passing, a 24mm T/S lens used this way, at maximum shift both left and right, yields a final stitched image with a horizontal angle of view that's roughly equal to a 15mm lens. Note that shifted images will show chromatic aberration, easily fixed in Lightroom of Adobe Camera Raw. But you cannot "sync" such correction, since each shift position shows a different amount of aberration. Fix each frame separately.

If you work with the camera mounted on the tripod in a vertical position and then shoot with the lens shifted left, with no shift, and shifted right, the file size will be increased even more. With a full-frame-sensor camera, you'll end up with an image that is almost exactly 4 × 5 proportions … and a lot of pixels for printing.

Of course you could combine these shift movements, since the front section of a T/S lens rotates 360 degrees. The Canon and Nikon T/S lenses have click stops at the 30-degree, 60-degree, and 90-degree positions, but these are only for convenience. The lens can be set at any rotational position. Great. Shift the lens either left or right, and then take a series at all the rotational positions. Let Photoshop stitch them together.

When shooting for stitching, you must set the exposure manually, based on a meter reading with the lens in the neutral, no-shift position. Keep this exposure for all the subsequent frames.

SOME THINGS TO CONSIDER

The current Canon T/S lenses allow having tilts and shifts in different axes or in the same axis. Nikon T/S lenses have to be modified so that both tilt and shift are in the same axis, and although this would be useful at times, I haven't made these modifications to my Nikon T/S lenses, as I often stitch images. I want to be able to shift the lens in one direction while tilting in the other axis.

The plane of focus doesn't have to be a horizontal plane. Rotate the front section of a T/S lens, and tilt becomes swing, but the photographic procedure is exactly the same. The plane of focus just lies in a different orientation.

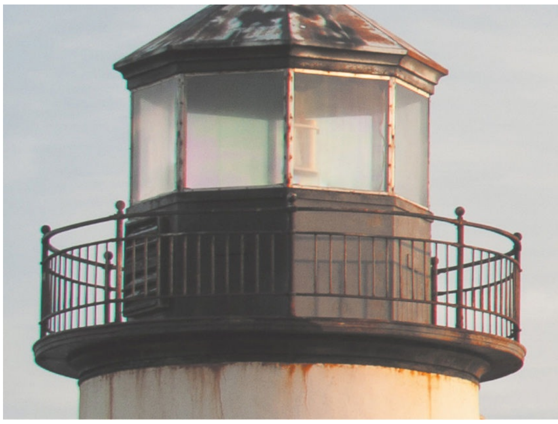
T/S lenses are not inexpensive and are very specialized in application. I would strongly suggest renting one first, to see if a T/S lens fits your style of photography. Using a T/S lens demands a very methodical, studied approach. Use of a sturdy tripod is an absolute necessity. However, for landscape work in particular, tilt/shift lenses allow one to make images that cannot be made in any other way.

Chromatic Aberration

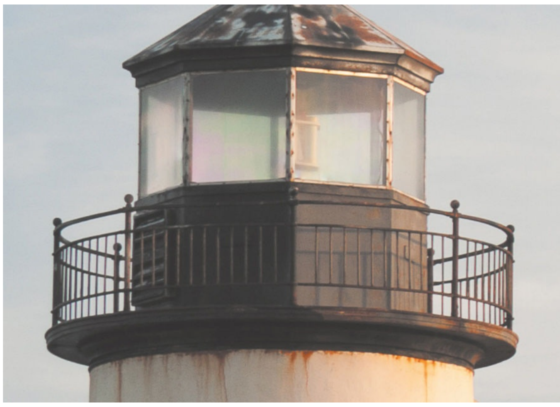
Chromatic aberration, often called “color fringing,” is a relatively common problem with many lenses, especially wide-angles. It is caused by the inability of a lens to bring light of different colors—different wavelengths, that is—to the same plane of focus. When you look very closely at an image, what you see are noticeable colored edges around objects, most obvious in high-contrast situations. Even some of the best lenses available, the ones with special glass in them (such as the Canon L series lenses or the Nikon ED ones), have this problem.

Lateral chromatic aberration is the most commonly seen problem. Most often it appears along the outer parts of an image as a red/cyan or blue/yellow fringe. Longitudinal chromatic aberration is seen as a green/purple fringing.

Many photographers never notice this problem, especially if they only post photos on the Web at relatively small sizes. Consider this image of a lighthouse on the Oregon coast. While this isn’t a straight nature photo, it best illustrates chromatic aberration in that the fringing is so easy to see. With the full-frame image printed at the size it is in this book, no chromatic aberration (no color fringing) is apparent. (Note that I’ve done no additional work on this image; it’s just the RAW file opened though Adobe Camera Raw directly into Photoshop.) But when I view the image at 200 percent on my monitor (the equivalent of a 20 × 30–inch print), I can easily see the color fringing, particularly around the banister railing at the top of the lighthouse. Look at the tight crop view. The other detail image shows the chromatic aberration removed. So how was this done?



Chromatic aberration.



No chromatic aberration.

It’s an easy solution if you use Lightroom or Adobe Camera Raw. In both programs there is an option to remove chromatic aberration. I use Lightroom to process all my RAW files, as well as using it as the image database of all my photographs. Since Lightroom lets you set its default processing starting points, I have Remove Chromatic Aberration automatically applied as images are imported. Adobe Camera Raw also lets you set processing starting points, and it, too, has a Remove Chromatic Aberration checkbox. Tick this, save as a default setting, and whenever you open an image in Camera Raw, the operation will be automatic. Neat.

Lighthouse. Nikon D3x, Nikon 70−200mm lens, 1/10 sec., *f*/13, ISO 200

Chapter 4

COMPOSITION

Learning to See Photo-Graphically

Composition is the art of clearly presenting your creative vision in an appealing manner. You do this by imposing order and structure on the chaotic world around us, first by your lens choice and placement, then by how you position the frame itself, and finally by your processing and development of the image. Anything within the frame that dilutes or distracts from your creative vision adds visual confusion and should be eliminated if at all possible by repositioning the camera or changing the lens. Simply pointing a camera at a subject, no matter how interesting you may find that subject to be, does not guarantee that the resulting photograph will engage the viewer's mind or emotions. To make successful photographs, you must make conscious, deliberate compositional decisions.

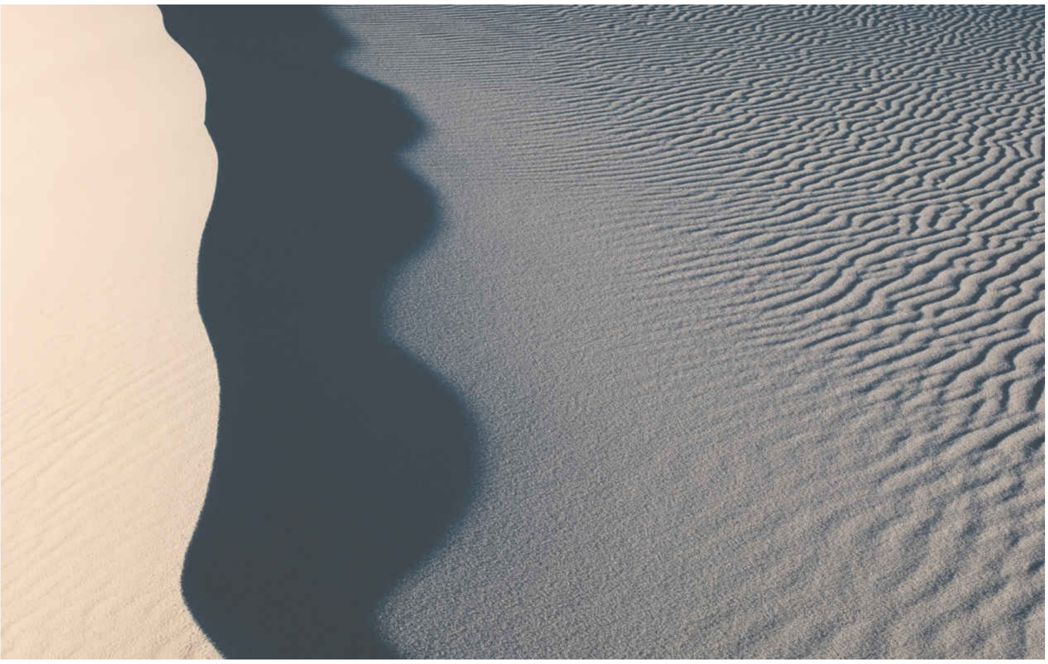
Sedges along edge of pond, Torres del Paine National Park, Chile. Nikon D3, Nikon 70−200mm lens, 1/40 sec., *f*/14, ISO 100

Salt cones on the Salar de Uyuni, Bolivia. Nikon D3, Nikon 70−200mm lens, 1/3 sec., *f*/16, ISO 200

Cracked mud and fallen rock, Glen Canyon National Recreation Area, Arizona. Nikon D800E, Nikon 45mm T/S lens, 1/8 sec., *f*/18, ISO 400

Your first decision is always what to photograph. Choose a subject—but only one. Most beginning photographers make the major mistake of not simplifying their pictures. They include everything: not only the flower, but the meadow, the trees in back, the stream, and all the surroundings. Yet when they're asked what they are photographing, they answer, "A flower." If that's true, then everything else shouldn't be within the frame. To put it simply, visual clutter ruins pictures. Define your subject precisely and specifically, then include only what fits your definition.

Once you're decided on a subject, there are a couple of questions you should make sure you answer before you ever press the shutter release. The first is "Why am I taking this photograph?" If you don't know, then your photography is random. Then you should ask, "What do I want to show the viewer?" If you don't know the answer to this one, you're not communicating. If there are several answers to each question, you probably should be taking several photos, not just one.



White Sands National Monument, New Mexico. Nikon D2x, Nikon 28−70mm lens, 1/25 sec., *f*/14, ISO 100

Pattern of wheat and freshly cultivated land in the Palouse region of southeast Washington. Nikon D2x, Nikon 70−200mm lens, 1/3 sec., *f*/11, ISO 100

Think graphically. Be concerned with the basic elements of graphic design. What you're really doing when you take a picture is making a graphic arrangement of elements. Most of the time, however, we lose sight of graphics and deal more with subject matter. Most of our day-to-day photography is actually photojournalism, where we're concerned more with the content of an image than its design. That's fine for recording events in our lives but shouldn't carry over to the rest of our photography. Keep in mind that there is a vast difference between "interesting" and "photogenic." A pile of garage-sale items may be interesting, but I doubt you would want to hang a large print of it over the mantel.

When planning a photo, I would urge you to say the following sentence out loud (this forces you to really concentrate on your answers), filling in the blanks and being as specific as possible:

What I like about this scene is _______________, so I will use this equipment, _______________, and these photographic techniques _______________.

Articulate exactly what you're planning on doing. Instead of saying, "I like this pretty flower, so I'll take a picture," say, "I like the way the color and texture of these blackberry leaves contrast with the softer, muted green background, so I'll use my 200mm macro lens to give me some working distance while narrowing the background to include only the grasses, with my tripod in a low position so that the sensor plane is parallel to the blackberry bush in order to maximize the depth of field." There's a world of difference between these two descriptions.

Then, before you actually trip the shutter, go over this checklist:

- Have you chosen a good subject, out of all that are available to you?
- Is this good light for the subject, or can it be improved?
- Is there a pleasing background behind the subject?
- Have you made a pleasing composition that reflects what you want to communicate?
- Are you sure about your choices?

Suppose you're photographing a fallen autumn leaf. Why did you choose that particular leaf to photograph out of the thousands of leaves on the ground? Is this the right light for the message you want to convey about fallen autumn leaves? Would modifying the light in some manner—with a reflector, for example—help? Does the background complement the message, or at least not conflict with it? Is this the best location from which to photograph? Remember that tripods have legs, but so do you. Walk around until you find the best location from which to work. Don't allow yourself to be lazy and settle for less than your best. Don't just take pictures … make *photo-graphics*.

Bristlecone pine, Inyo National Forest, California. This was taken in the hard light of a blue-sky morning. Nikon D2x, Nikon 28−70mm lens, 1/80 sec., *f*/13, ISO 100

Lighting

Light is what makes photography possible. In essence, the very word *photography* means "painting with light." Notice that the subject of the photograph is not mentioned in this definition; photography is the process of capturing light, not capturing a subject. Dull light equals a dull photograph, no matter how strong the subject matter might be. Being aware of how light transforms a subject, how it influences our perceptions, is one of the most basic requirements of a photograph. We must literally "see the light" before we start to worry about taking an image.

Light has a direction, a character, and a color. The ability to recognize these distinctions and the ways in which they can be used graphically, both singly and in combination, is one of the things that sets the professional photographer apart from the amateur.

DIRECTION

Light's direction is usually described by how it falls on any subject relative to the camera's position. There are three basic types of directional lighting: frontlight, sidelight, and backlight. How a subject is illuminated—the angle at which the light falls on the subject—directly affects both the technical aspects of a photograph (for example, how easily exposure can be determined) and the emotional aspects.

As the name implies, *frontlight* is light falling on the side of the subject facing the camera. The sun is directly behind the photographer, coming right over his or her shoulders. Direct frontlight wipes out any shadows. It is probably the worst lighting possible for landscape photography, because it makes the scene appear flat and one-dimensional. On the other hand, it is perfect lighting for most tight bird and mammal portraits, because all parts of the subject are illuminated equally. It's disconcerting to see an animal photo in which one side of the creature is totally lost in deep black shadows; we want to see the entire animal, not just part of it. Whatever the subject, determining exposure for a frontlit scene is rather easy and straightforward, since everything in the frame is receiving the same amount of light.

Sidelight emphasizes the shape and texture of a subject, since it creates shadows. In turn, the shadows created by sidelighting add to the three-dimensional feeling of a photograph. For these reasons, landscape photography is often done in the soft sidelight of early morning and late afternoon. In terms of exposure, take a shot and check your histogram to make sure you haven't clipped the sunlit areas or totally blocked up the shadows.

While the light at high noon, like sidelight, also comes from 90 degrees to our viewing angle, it is generally referred to as *toplighting*. Rare indeed is the successful picture taken at noon, due to the harshness of the midday light. At that hour you can scout locations, call home, take a nap, or write your notes, but don't plan on photographing.

Not quite 90 seconds separates these two images, just time enough for the sun to hit a distant mountain ridge:

LEFT: Bristlecone pine, Inyo National Forest, California. Nikon D3x, Nikon 17−35mm lens, 1/20 sec., *f*/8, ISO 100

RIGHT: Bristlecone pine, Inyo National Forest, California. Nikon D3x, Nikon 17−35mm lens, 1/90 sec., *f*/8, ISO 100

Here are two images taken one week apart, from the same location. The desert snow was an ephemeral event, lasting less than one full day:

Saguaro cacti at sunrise, Honey Bee Canyon, Arizona. Nikon D800E, Nikon 70−200mm lens, 1/13 sec., *f*/20, ISO 200

Saguaro cacti in snowstorm, Honey Bee Canyon, Arizona. Nikon D800E, Nikon 70−200mm lens, 1/50 sec., *f*/14, ISO 100

When you are facing a light source, what you see is *backlight*. Backlight outlines shapes by creating glowing halos or by silhouetting subjects. There's really no one correct exposure. Your settings will depend on what mood you want to convey. You can change the feel of an image from light and airy to dark and brooding.

CHARACTER

Light's character is directly related to its source. In can be hard, as when the sun lands high in a cloudless sky, or soft, as on an overcast day when the entire sky is one giant, diffused light source. Hard light is high-contrast light, with black, sharp-edged shadows. On the other hand, soft lighting is low-contrast light, great for close-ups and delicate colors; shadows are diffused or nonexistent and depth perception is limited, while colors saturate. Soft light can be created by haze or dust in the air, moisture such as fog or clouds, or even the atmosphere itself just before sunrise and just after sunset.

COLOR

Light's color ranges from warm reds and oranges early and late in the day, to cooler blues at midday. Overcast conditions also tip the light toward the cool side; the "heavier" the sky, the cooler the color. Cool light can emphasize the coldness of winter or frost, while warm-toned subjects will jump out at the viewer. Basic color theory says that warm colors advance, while cool colors recede. Having warm highlights, with cooler shadow areas, is one way to emphasize three-dimensionality in a two-dimensional image.

LIGHT CHANGES

We tend to forget about how quickly and often light changes. How a subject appears in one light at one moment in time is not how it will appear in another light at some other time. Since photography is “painting with light,” we must learn to continue painting *even after we have taken one successful shot*. It’s all too easy to tell yourself that you are “finished” with a subject, when all you’ve done is photograph it at a certain time in a particular light. As the light illuminating a subject changes, so does the viewer’s emotional response to a photograph; so chances are you haven’t exhausted the subject. Changes in lighting can occur as quickly as moment to moment or as slowly as season to season.

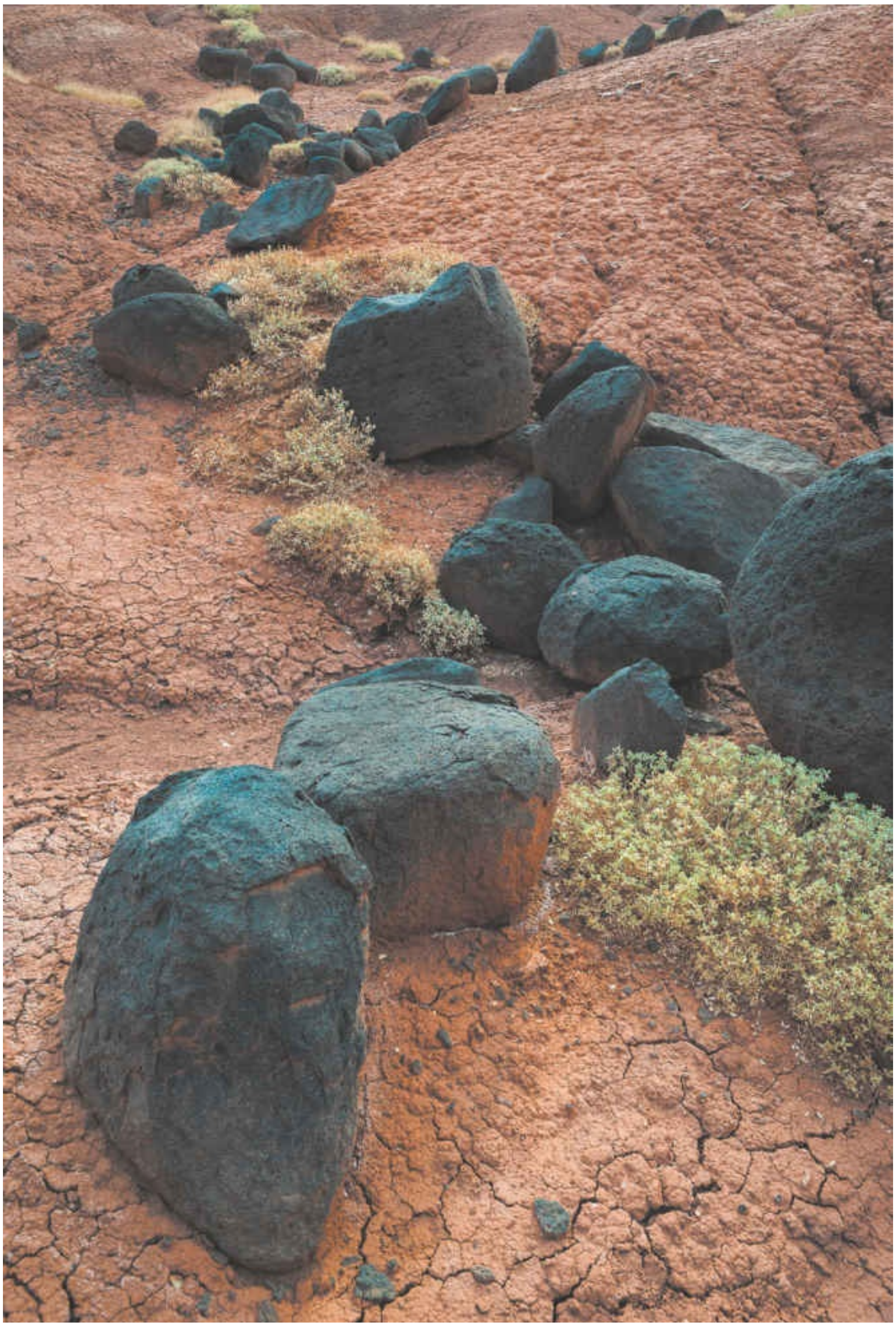
Vertical or Horizontal?

One of the most basic composition decisions is whether the picture frame should be a vertical or horizontal orientation. By far, most pictures are taken in the horizontal format. Granted, DSLR cameras are much easier to use, and far more comfortable to handle, when used horizontally. Flopping a camera to the side on a tripod head is not the easiest thing to do either, particularly if you’re using a poorly designed tripod head. In addition, the information displayed in the viewfinder and the LCD is certainly harder to read when the camera is tipped over on its side. Of course, the preference for horizontal compositions may also be influenced by the natural orientation of our field of vision, which takes in far more across the horizontal than it does the vertical. And today, the vast majority of pictures are viewed on a computer screen, and all screens favor a horizontal image over a vertical one.

I suggest that you evaluate your own work. Look at a lot of images from a recent shoot all at once, using the Grid View arrangement in Lightroom, Bridge, and many browsers. Looking at lots of unedited images all at once lets you see trends in your work. If you look at one image at a time, you’re concentrating on that particular image, so it’s very easy to forget exactly what you’ve seen previously. With a grid of images on the screen, your photographic tendencies will jump out at you. How many horizontal pictures are there? Are your exposures consistently good, bad, or all over the place? Are all your pictures taken from the same vantage point—your own eye level—or are low subjects photographed from a low position? What about your choice of lenses? Do you favor one focal length over others? Did you use a tripod at all times or only when it was most convenient? If you were photographing a nonmoving subject where you had time to think about exposure and composition, are the results what you expected? Looking at a lot of unedited pictures all at once is one of the best ways to evaluate trends in your work.

Tree and fog, Mount Huangshan, China. The strong horizontal limbs dictated a horizontal image. Nikon D3, Nikon 70−200mm lens, 1/20 sec., f/16, ISO 200

I’ve heard it suggested that the horizontal format (often called the landscape format) is emotionally quieter, more tranquil and calming, than a vertical (or portrait) one. Along the same lines, some say that a vertically framed picture conveys strength, power, vitality, and authority. I disagree with both these statements. While changing an image’s orientation certainly changes its emotional impact, I believe you cannot separate out the content of the image from this discussion. In my mind, form and content go hand in hand and must support each other coherently.



Rocks along a watercourse, Capitol Reef National Park, Utah. Here is an obvious vertical composition. Nikon D3, Nikon 17–35mm lens, 1/6 sec., *f*/16, ISO 100

Try this little exercise: take a rectangular sheet of paper, hold it at arm's length, and view it first in a horizontal orientation and then in a vertical one. Did your emotional response change at all? Or does that only happen when you visualize a subject within this rectangle? I think you will most likely agree that it is extremely difficult to separate what is included within an image from how the picture is oriented. The graphic structure of the image and the subject go hand in hand, supporting and reinforcing each other to make the strongest emotional impact on the viewer. A good photographer controls this response by choosing the appropriate vertical or horizontal format. You want to honor the subject in deciding the format.

Mesa at sunrise, Glen Canyon National Recreation Area, Utah. These two images are emotionally different. One invites me to walk into the frame, while the other is more of a barrier. These were shot from the same tripod position by simply rotating my zoom lens using its tripod collar. Both photos: Nikon D800E, Nikon 70−200mm lens, 1/13 sec., *f*/13, ISO 100

Indian rice grass and wind ripples, White Sands National Monument, New Mexico. I think the horizontal shot is stronger. Both photos: Nikon D2x, Nikon 28−70mm lens, 1/15 sec., *f*/16, ISO 100

Soaptree yucca at twilight, White Sands National Monument, New Mexico. Photographed in the very soft light of twilight. Nikon D2x, Nikon 70−200mm lens, 1 1⁄2 seconds, *f*/16, ISO 100

TILTING HORIZONS

Regardless of the orientation you use, try to keep the horizon line square with the world. Tilting horizons are one of my pet peeves. Are such shots taken halfway around the globe or during an earthquake? I'm particularly annoyed by photographs of leaning lakes—I keep waiting for all the water to start pouring out one side of the picture.

One primary cause of tilting-horizon photos is the use of tripods that are just a little too short. If you're photographing from even a slightly bent-over position, you will lean your head one way or the other in order to see through the viewfinder. Which way you lean depends on which eye you normally use when viewing through your camera. If you use your right eye to focus, you'll tip your head slightly to the left; if you use your left eye, you'll tip to the right. The horizon line in your photo goes in whatever direction your head goes.

Here's a quick exercise that will illustrate this problem to you. Mount your camera on a tripod and raise it until the viewfinder eyepiece is about 1 foot below your eye level. Use whichever eye you normally use to compose a photo with an obvious horizon line and make sure that horizon is level. Now look through the camera with your other eye and carefully check the horizon. It will appear tilted. Keep viewing as you are and straighten out the horizon. Now, switch back to viewing with the eye you started with and—guess what?—the horizon is tilted once more, this time in the opposite direction. When you review a lot of your images at once for vertical/horizontal framing, check out the degree of tilt of the horizons. Most likely if you discover that your pictures do indeed tip one way or the other, they will all tilt in the same direction, since you focus with the same eye most of the time.

The good news is that fixing tilted horizons is one of the easiest things to do with software. There are several solutions. Plus, many cameras today have the option to show a grid overlay in the viewfinder. If your camera has this option, use it. If your camera doesn’t offer a grid, purchase a bubble level that slides into the camera’s hot shoe and works for both vertical and horizontal shots. These are available at almost all camera stores.

Framing and Placement

Once you have chosen a subject to photograph and decided whether to take a vertical or horizontal picture, you have two other major decisions to make. The first one is how tightly or loosely to frame the subject—that is, how much of the area surrounding your subject to include. Where should the edges of the photographic frame fall? How much of your subject do you want to include, and what do you want to exclude? Once you've made this choice, you need to move to the second decision: where within the frame to place your main subject. Do you position it at the top or at the bottom? On the left or on the right? Dead center or at one edge? These choices should be studied decisions on your part, as a good photograph is carefully planned, not haphazardly created.

Precise framing of a subject can be achieved in several ways. The easiest method is to use a zoom lens, carefully and precisely zooming in and out to place the frame edges exactly where you want them to fall. From any one given shooting location, changing focal lengths by zooming (or by switching fixed-focal-length lenses) alters the cropping of the frame but not the perspective. Another possibility would be to move around the subject while using the same lens; this alters both the point of view and the background seen behind your subject. And of course you could move closer to or farther from your subject while using exactly the same focal length.

Brown bear on tidal mudflat, Lake Clark National Park and Preserve, Alaska. While action, or the implied path of action, should normally be going into the frame, here the bear's position is counterbalanced by the gulls and the strong diagonal lines of the light rays in the sky. Nikon D4, Nikon 200−400mm lens, 1/640 sec., *f*/10, ISO 400

Tree in winter field, Hokkaido, Japan. There’s a difference between the emotional messages of these two images, between the isolated tree by itself and the tree in context of the distant forest. Nikon D3x, Nikon 70−200mm lens, 1/90 sec., *f*/11, ISO 100

Final precise cropping can be done when you process your image files in software. Be careful as to how much you crop. A little is fine, but you should remember that all cropping is “lossy,” so check the final pixel dimensions. A 600 × 900–pixel image might look okay on the Web, but printed at 300 dpi, that’s only going to be a 2 × 3–inch print.

While determining the framing, watch out for several compositional problems. Objects that barely touch the edge of the frame leave your viewer wondering about your intentions. Did you purposely position the object right there at the edge, or is its location pure happenstance? Is there more to be seen, or is that the entire subject? Leave some space around anything that could direct the viewer’s eye out of the picture so that visually he or she doesn’t “leave” your image. You want to hold on to your audience, not direct them elsewhere.

Along the same lines, don’t let little things creep from nowhere into the picture edge. I call these “apparitions,” since they seem to materialize out of thin air. Imagine a beautiful landscape photo, lovely clouds hanging over a majestic mountain range. But up in the top corner of the frame, the end of a branch sticks out into the picture. Where did it come from? What is it doing up there? Is it attached to something or somehow levitating? Either include enough of the branch so that the viewer knows without a doubt that you wanted it to be part of your composition, or change your framing to get rid of it. Unclear framing motives will confuse your audience; when you incorporate part of an object, do it deliberately so that your viewers know you intentionally chose that composition. When you edit an image in the digital darkroom, check the edges of the frame and clone out any minor intrusions.

The goosenecks of the Colorado River, Dead Horse Point State Park, Utah. By zooming my lens from 40mm to 70mm, I changed the framing of the picture and, consequently, the emphasis of the image. Nikon D3x, Nikon 24−70mm lens, 1/4 sec., *f*/11, ISO 100

Trying to determine where to position the edges of the frame is almost impossible if you’re handholding the camera, particularly if you’re using a longer-than-normal lens. Any motion on your part is magnified by the lens, causing the viewfinder image to wander around. One of the biggest advantages of using a good tripod is that it allows you to compose with precision. You can examine your composition before you press the shutter, fine-tuning it to resolve any framing problems.

Along with your framing decisions, you must decide where to position your subject within that frame. The most common mistake made by beginning photographers is to place the main subject dead center in the frame. Most of the time that bull’s-eye composition is visually unexciting and should be avoided at all costs. If you’re photographing large mammals, be particularly careful. All too often, you are so excited to see a big, hairy mammal in the viewfinder that compositional decisions aren’t a consideration at all. Generally speaking, with animated subjects you want the action, or the implied path of action, to be going into the frame, not leading out of it.

If you don’t know where to begin in terms of subject placement, you might try the old standby Rule of Thirds. Divide your frame into imaginary thirds both vertically and horizontally, like a tic-tac-toe grid. Where the grid lines fall are strong placement positions for major lines in your scene. Horizon lines, for example, are far stronger when placed roughly one-third of the distance from either the top or bottom of the frame rather than directly across the middle of the image. The grid’s intersection points are also very powerful locations for positioning subjects and important visual elements. This basic compositional device is so ingrained in our Western art tradition that we tend to be unaware of just how often it is used.

Now I’m certainly not suggesting you should compose all of your pictures in this fashion. That would be terribly boring. Good composition is very subjective, and you want to please yourself. Most of all, you want to celebrate your own unique creative vision.

Working a Subject

I urge you to find a subject that you like and work it as completely as you can. Walk around the area, view it from different sides, study it in different lights. Too often we're concerned with rushing off to our next location, as though we think motion itself somehow equals productivity. Slow down, take your time, and look closely at what's there. And always believe that the next frame you shoot will be an even better image.

All too often, I see people take one photograph of a subject and then declare that they've captured that subject. Case in point: I was once at the Grand Canyon when I saw a family walk up to an overlook and quickly snap a photo. The father declared, "All right, we've done the canyon. Let's go!" and off they went. This was not an isolated incident. A few years ago, I was in Kenya photographing some very cooperative cheetahs when a van roared up. As heads popped up through the open roof hatches, a man pointed his camera at the cheetahs and then loudly exclaimed to his driver, "It's just a cheetah. We've already seen a cheetah." I would hate to be that jaded about the world around us.

But we photographers are guilty of a similar crime: taking the easy way out. Time after time, I see photographers in national parks working at the overlooks. There's nothing inherently wrong with that; the pull-off is probably there for a good reason. But what I've noticed is that most people photograph from directly in front of where they parked their car, as if the car knew the best location from which to photograph. Now I'm not suggesting that we all need to become distance hikers, carrying our gear for miles over hill and dale. But we should walk around a bit to check out different locations, even if that be only a few hundred feet.

Along the same lines, we all brag about how many images we've shot. I've been guilty of this, too. In fact, all too often I find myself using how many gigabytes I've shot in a day as a gauge of my worth as a photographer. Come on, John; are the number of frames exposed directly proportional to how many good pictures you've taken on any given day? I don't think so. After all, you can sit indoors, hold down the shutter release, and shoot hundreds of gigabytes without getting one good photograph. In truth, I think you're an excellent photographer if you can produce just one exceptional shot, one knock-your-socks-off photo, one "WOW!" picture every day.

But most of all, we should not let ourselves feel satisfied too quickly. We should always strive to better our craft and to work at producing new images of subjects that are new to us. If you find yourself in a rut, try working with a different lens from what you normally use. If you often photograph landscapes with a 70−200mm, use a 24mm or a 500mm. If you do close-ups with a 100mm macro, find out what's possible with a 16−35mm zoom lens. If you always take head shots of animals using a 600mm, how about trying landscapes with a normal lens? Mixing things up will bring back some of the fun of your photography.

Nikon D3x, Nikon 24mm T/S lens, 1/8 sec., *f*/14, ISO 100

This photo, and all the ones on this page and this page, were taken at the same location: the beach at Bandon, Oregon, well-known for its offshore sea stacks. The beach is a popular public location, but by working early and late on low-tide days, I can often be alone. The beach is quite flat, and low tide reveals barnacle-covered rocks, sea stars, and ripple patterns.

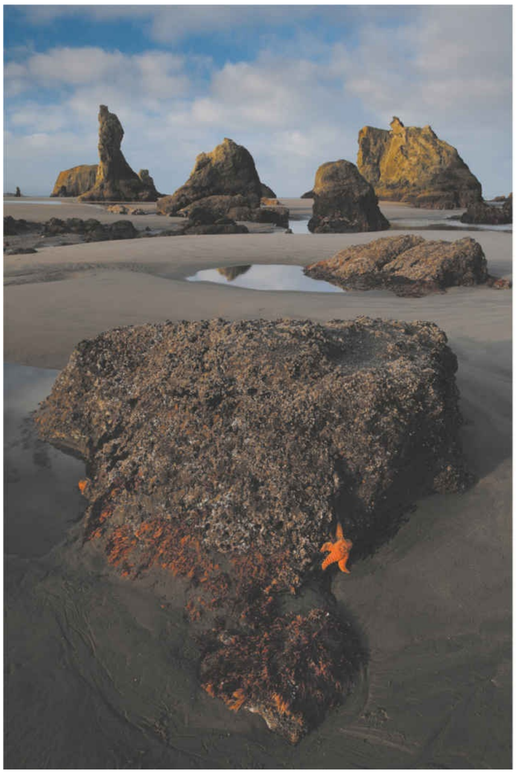
Nikon D800E, Nikon 45mm T/S lens, 0.4 sec., *f*/10, ISO 100

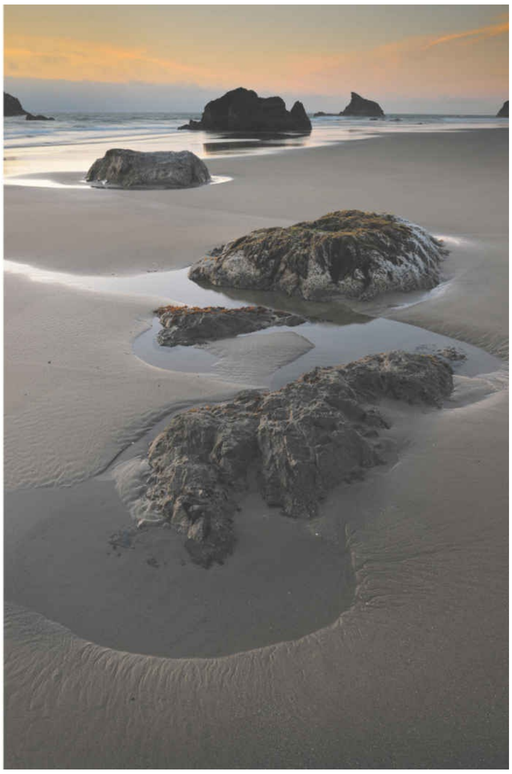
Nikon D800E, Nikon 85mm T/S lens, 30 seconds, *f*/18, ISO 140

Nikon D3x, Nikon 24−70mm lens, 2 seconds, *f*/11, ISO 100

LEFT: Nikon D2x, Nikon 12−24mm lens, 1/50 sec., *f*/13, ISO 100

RIGHT: Nikon D2x, Nikon 12−24mm lens, 1/20 sec., *f*/18, ISO 100





LEFT: Nikon D3x, Nikon 24mm T/S lens, 1/6 sec., *f*/14, ISO 100

RIGHT: Nikon D3x, Nikon 24mm T/S lens, 1.3 seconds, *f*/14, ISO 100

Chapter 5

CLOSE-UPS

Defining a Close-up

A beginning photographer often asks, “How close can I get with this camera?” This person is thinking in ordinary terms. If you’re using a fixed-focal-length lens, and photographing normal subjects at normal distances, then it’s true that the closer you are to your subject, the larger the subject will appear in the resulting image. But with interchangeable-lens DSLR cameras, the question needs to be rephrased. There is no longer a simple answer, because the physical distance between camera and subject doesn’t in and of itself determine how much of the frame the subject will fill in the resulting photograph.

In order to talk about close-up photography, we need to develop a mutual vocabulary, defining our terminology precisely and establishing our parameters. The best way to talk about close-ups is by making reference not to the distance from the subject but to the magnification rate of the image. Doing so provides us with a constant, which is always crucial when making comparisons. Here’s a definition: the *magnification rate* is the ratio between the physical size of the image on the sensor and the physical size of the actual object being photographed.

Lichens on rocks and old bone, Sea Lion Island, Falkland Islands. Nikon D800E, Nikon 24−120mm lens, 1/40 sec., *f*/16, ISO 100

Let me be clear on one important point: I’m not referring to how large you make a finished print or how large an image is when projected. I’m talking about the actual measurable size of the image on the sensor.

The magnification rate is normally written as a power. Fractional sizes such as 1/4X or

1/8X mean that the image on the sensor is smaller than the actual size of the subject. At a fractional magnification rate, a 1-inch-long object will be less than 1 inch long if you could measure the image on the sensor. At 1X, the image and the subject will be identical in dimension; the image on the sensor of a 1-inch object would measure 1 inch. At rates over 1X, such as 2X or 4X, the image size is actually larger that the subject. Past 1X you're starting to magnify the subject image.

As you can see, the magnification rate of 1X is a dividing line. It is often referred to as "life size," since at 1X, the image on the sensor is the same size as the subject is in real life. At life size, what you photograph has the same dimensions as whatever camera format you happen to be using. If you're using a full-frame DSLR, the sensor is 24mm × 36mm, roughly 1 × 1½ inches, so at 1X, life size, you're photographing a subject area that is this exact size.

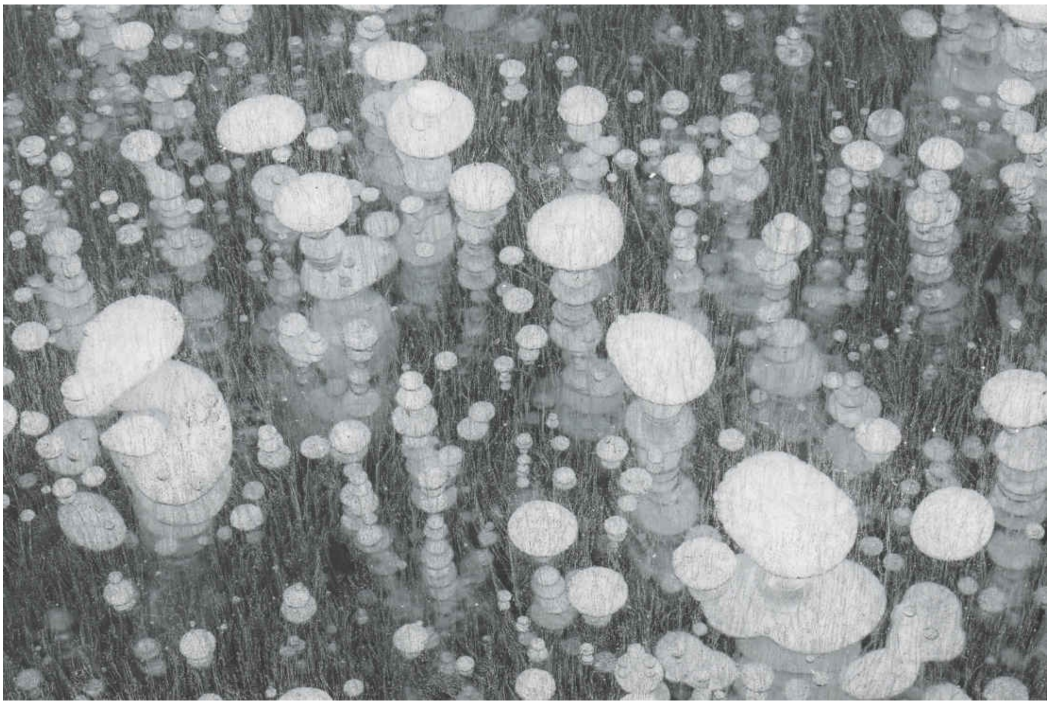
Bear in mind that the actual measurements of a life-size subject area vary depending on the camera format you're using. Besides full-frame digital cameras, there are, and have been, various "crop" sensor sizes. The chart below lists some sensor dimensions (I've rounded these off a bit).

Sensor Crop	Sensor Dimensions
Full frame	24mm × 36mm
1.2X crop	20mm × 30mm
1.3X crop	19mm × 29mm
1.5X crop	16mm × 24mm
1.6X crop	15mm × 22.5mm

Using any of these, if you fill the frame with a subject of those dimensions, you would be at life size, or 1X. As I said before, life-size means you're photographing a subject area the same size as the sensor in your camera. Medium-format digital cameras might have a sensor that is 30mm × 45mm or 40.5mm × 54mm, and life size with those cameras would be those dimensions. But with all of these formats, if you shoot at a magnification rate of 1X, the measured size of an object would be exactly the same. A dime, exactly 17.91mm in diameter, would appear 17.91mm in diameter on any of these sensors. There would be more or less space around that dime, but its diameter would be the same. The coverage, how much of the surrounding area you see, would vary, but not the size of the coin's image.

If you know the magnification rate and the size of your camera sensor, you can easily figure out the size of the area you're photographing or vice versa. Divide each dimension by the magnification rate, and you'll get the size of the subject covered at that rate. For example, let's assume you have a full-frame camera such as a Nikon D4 or Canon EOS-

1DX, which have sensors that are 1 × ½ inches (24mm × 36mm). A magnification rate of 1/8 × means you're photographing a subject that is 8 × 12 inches, 1/10 × is 10 × 15 inches, and 1/6X is 6 × 9 inches. Two rates and sizes you should learn, since they are often referred to in advertisements, are 1/4X (subject size: 4 × 6 inches with that full-frame camera) and 1/2X (subject size: 2 × 3 inches with the same camera). (For the rest of this entire section on close-ups, the discussion assumes we're talking about a full-frame camera; you'll have to translate a bit if you have a crop-sensor model.)



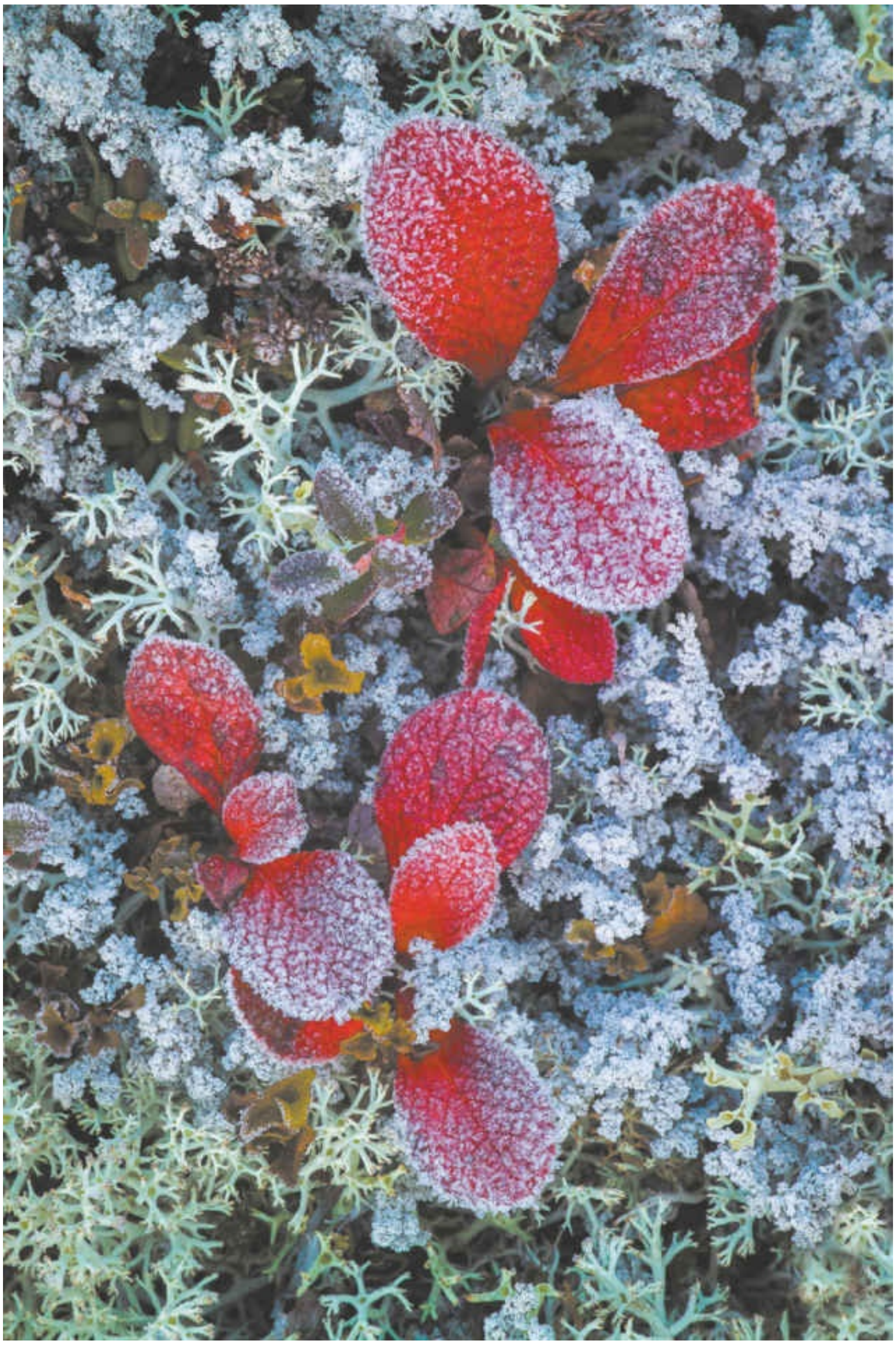
Bubbles in ice, Abraham Lake, Alberta, Canada. Nikon D3x, Nikon 85mm T/S lens, 1/6 sec., *f*/16, ISO 100

Once you get past 1X—past life size, that is—the subject area is of course going to be smaller than the format. Again, let's consider a full-frame camera. At 2X, you're photographing an area that is ½ × ¾ inch; at 4X, ¼ × $^3/_8$ inch; and so on. To find the magnification rate when you know the size of the subject you're photographing, divide the dimensions of the sensor by the dimensions of the subject.

Do you actually have to do all this math? No, not at all. To be perfectly honest, you'll almost never have to know a precise magnification rate unless you're doing scientific work; however, knowing the approximate magnification rate has many practical uses, as you'll see when I discuss ways of making lenses focus close. Besides, as I've already said, the magnification rate is the only constant factor there is to help discuss close-up photography.

Used alone, most current camera lenses can focus a bit closer than 1/10x, which would cover a 10 × 15-inch subject. To work any subject that size or larger, you can just focus normally. Regular lenses are restricted to this range for several reasons, including the extra cost and complexity of making a closer-focusing lens as well as the slight loss in image quality when a lens designed for normal photography is used for close-ups. So does this mean that you have to purchase special lenses to make high-quality close-ups? No. Almost all lenses can be used for close-up photography when combined with a variety of accessories, as I'll discuss shortly.

In all close-up work, however, good photographic technique is absolutely mandatory. When you're magnifying an image, you are also magnifying its problems, whether they are caused by the optics or by you, the photographer. The higher the magnification, the more precise and careful you have to be in your approach. Most of what we think of as close-ups actually fall between 1/10 × and 1X magnification. As you will see, a few added accessories, used with care and precision, will let you work in this range with excellent results.



Frost on arctic bearberry and lichens, Denali National Park and Preserve, Alaska. Nikon D1x, Nikon 105mm macro lens, 0.7 sec., *f*/16, ISO 200

Checkerspot butterfly on goatsbeard, Colorado. Nikon D1x, Nikon 70−180mm macro lens, 1/4 sec., *f*/11, ISO 200

Working Distance and Background Coverage

An important concept to understand for close-up photography is the relationship between the your focal length (the working distance between lens and subject) and the appearance of the background. Since all lenses can be made to focus closer, why would you pick one lens over another? What are the advantages and disadvantages of different focal lengths?

The location from which you take your photo—the actual physical spot where you place your tripod and camera—determines the "look" of your photo. Perspective is governed by location, not by lens choice. When you're shooting from any given spot, changing focal length, either by switching lenses or zooming a zoom, changes the framing or coverage of the subject, but it does not change the perspective in the photo.

Given the perspective you want, one of the most important considerations for nature close-ups is the amount of available *working distance* a lens offers. Let me define working distance: it is the open space between the front end of the lens and your subject. (If they even publish working distances at all, lens manufacturers normally measure the distance from the sensor to the subject, rather than from the front of the lens to the subject. But in fieldwork, how much room you have between the *lens* and subject is what's important.) Having sufficient working distance is vitally important in fieldwork, because you often cannot get close to your subject without encountering problems. You might have difficulties working your tripod into location; you might have a physical barrier, such as rocks or brush between you and the subject; or you might need room for reflectors, diffusers, or flash units.

For those of you who've never seen a film camera, here's what one looks like. This is the "antique" Nikon F5, photographed using my 200mm lens. This focal length gives quite a bit of working space, along with a narrow angle of view. I measured 68 inches from the front of my lens to the F5 camera body.

Here, I photographed the F5 using a 50mm lens. I tried to keep the same optical axis and subject image size as before. The shorter focal length used for this image has a much wider angle of view, hence a far more confusing background is included. Perspective has also changed, since I moved my shooting location. The free working distance measured 15 inches.

Brittlebush and cholla, Arizona. I definitely wanted some working room when taking this photo. I was extremely cautious while positioning my tripod, as cholla seems to have a real affinity for photographers. Nikon D2x, Nikon 105mm macro lens, 1/4 sec., *f*/22, ISO 100

Working distance is roughly proportional to focal length. The shorter the lens, the closer you must be to your subject. The longer the focal length, the farther back you can work while still getting the same image coverage you would with the shorter lens. If you can work 12 inches from the subject with a 50mm lens, you will get the same coverage at roughly double the distance with a 100mm lens and four times the distance with a 200mm lens. This is true with lenses used in normal, non-close-up situations. If you photograph your car with a 100mm lens and then switch to a 50mm, you'll have to move roughly half the distance closer to get the same coverage. This is true for all lenses, whether fixed-focal-length or zoom.

Trying to photograph close-ups in the field with focal lengths of less than 100mm is extremely frustrating, especially with your camera mounted on a tripod. It's difficult enough to position yourself and the camera, let along arrange the tripod legs and tighten leg locks. Too often you'll bump your subject with your body, the lens itself, or the tripod legs. The solution is easy: use a longer-focal-length lens.

A longer lens offers better working distance while at the same time making tripod placement much simpler. If you're photographing with the lens 12 inches from your subject, a 1-inch discrepancy in any direction in camera location is a gross discrepancy. You will need to be extremely precise and fussy here. Back off and shoot from 3 feet away, and suddenly that inch either way becomes a lot less meaningful.

The other major consideration in selecting a lens for a close-up is its *angle of view*. Angle of view determines how much of a scene a lens takes in, how much it "sees" from side to side. Long lenses have a much narrower angle of view than normal lenses or short lenses. For close-up work, angle-of-view considerations are most important in terms of background coverage—what you see behind your subject and how it appears. The narrower the angle of view, the less coverage behind the subject. Do you want to emphasize the relationship between a subject and its background, or do you want to isolate your subject from its background? Your decisions about focal length and camera placement will determine your results.

All lenses used at the same image size and the same *f*-stop give the same depth of field. Long lenses don't have a shallower depth of field to blur out the backgrounds; they have a narrower angle of view. You can use this to your advantage, if you're careful in your camera placement. Pick a shooting location that ensures the narrow angle of view is restricted to a non-confusing area. Actually, backing away from a subject and using a long lens is often the solution to working with a chaotic background. You keep the subject's image size the same but see less background behind it. The less area back there, the easier it is to compose.

Another advantage to using a longer-than-normal lens for close-ups is that you can often change the background tonality by shifting your shooting position a little bit. If you're using a short lens, you take in a lot of background behind the subject whether or not you want it. Because long lenses have narrow angles of view, changing the camera position just a little will totally change what appears behind your subject.

Background control is absolutely essential in close-up photography. One effective technique is to isolate a subject against a solid-color background. Use a long-focal-length lens, carefully position the camera, make sure there is nothing distracting right behind the subject—and the narrow angle of view will work to your advantage.

Leaves frozen in ice, Utah. In this case, the physical situation dictated my working distance. The ice on this puddle wasn’t thick enough to support my weight, so I had to straddle it with my tripod and work from a slightly stooped position. Nikon D3, Nikon 70−300mm lens, 1/5 sec., *f*/13, ISO 200

Arizona sycamore leaf caught in sotol, Arizona. Nikon D3x, Nikon 200mm macro lens, 0.6 sec., *f*/22, ISO 100

Making Lenses Focus Closer

Lenses have a focusing range from infinity down to a fixed close-focusing point. How close a particular lens actually focuses depends on the lens itself, but almost all lenses can close-focus on a subject size of roughly 10 × 15 inches. To go beyond this point, to make a lens focus closer, you must add either a supplementary lens or an extension tube.

EXTENSION

Any lens will focus closer if you can move it away from the sensor plane. Physically moving the optics away from the camera is called *extending the lens* and is exactly the manner in which many standard lenses focus down to their closest position. Take a normal 50mm lens, turn the focusing mount, and the lens physically grows longer. You're adding extension.

And adding extension, however you get that extension, is about the simplest way to make any lens focus closer. Some special-purpose lenses have a lot of built-in extension, particularly macro lenses in the 50mm to 100mm range. As I say in the section on macro lenses, for practical purposes a macro lens is one that focuses extremely close, down to around 1X magnification, without the need for any added accessories. While macros lenses are very convenient, they are by no means a necessity for fieldwork. For most close-up subjects, non-macro lenses work just as well if you make them focus closer.

Extension is extension is extension. It is simply a spacer placed between the lens and the camera body. In terms of the results, it doesn't matter at all how you get a given amount of extension, although there's a vast difference in terms of convenience and handling. Extension can be built into a lens or added to a lens in the form of hollow extension tubes or a combination of these two. (A bellows, a variable extension device, is another option; but for practical fieldwork, don't even think about using one.)

Extension tubes are rigid, fixed-length spacers that can be bought individually or in sets. An extension tube is just that: a tube with no glass in it, with the correct camera mount on both ends. Be extremely careful when you purchase extension tubes, as many brands advertised on the Web do not have all the electronic connections needed by current cameras and lenses. While Canon itself does offer properly working tubes in 25mm and 50mm lengths, neither Nikon nor Sony have tubes for current autofocus gear. The solution is the set marketed under the Kenko name, available in mounts for Nikon and Sony, and Canon also for that matter. This is a set of tubes in 12mm, 20mm, and 36mm lengths. Tubes of different lengths can be combined, but the fewer connections you make, the better things work. Using one 36mm tube is a better option than three 12mm tubes stacked together. As a side note, Nikon does offer three tubes (8mm, 14mm, and 27.5mm) for the older manual-focus lenses, but these won't work with any of the current Nikon G series lenses, which set the aperture electronically.

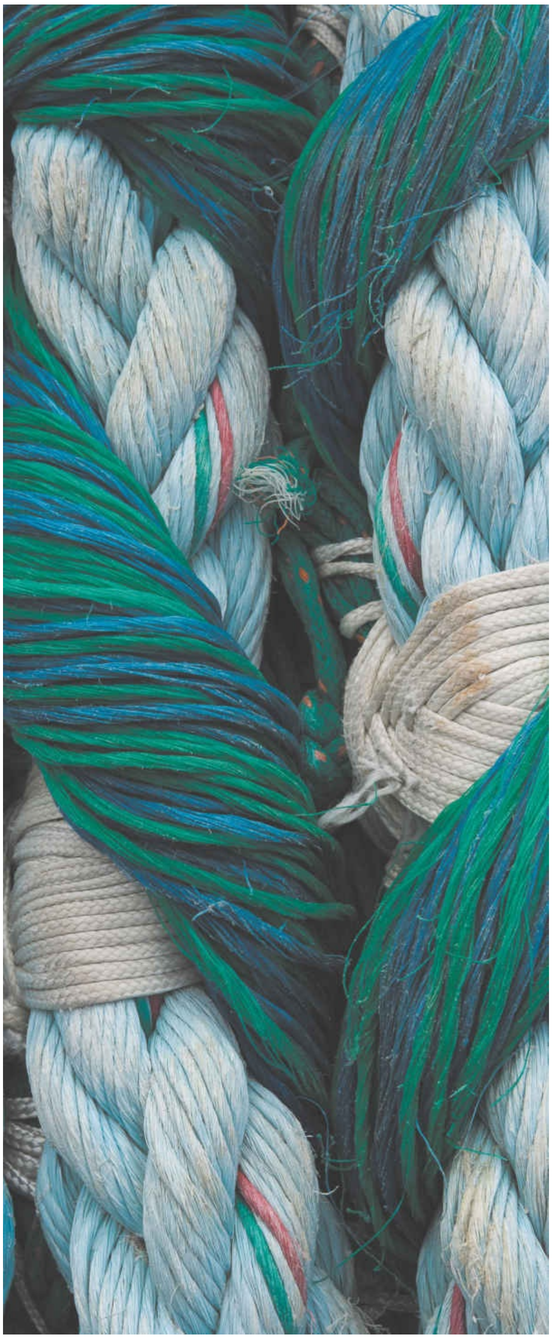
The bad news for Nikon shooters is that the Kenko tubes slightly vignette the image on a full-frame Nikon body, depending on the focal length/tube combination. For example, I can use the 20mm tube on my Nikon 500mm lens with almost no vignetting, but any longer tube, or tubes, definitely vignette the image corners. An easy solution, given the high-megapixel cameras we use, is to frame loosely and crop the image afterward. Or use a Nikon crop body; the D800 full-frame camera, in its 1.2 crop mode, shows no vignetting at all, no matter the tube combination.

Whenever you add extension, two things happen: you can no longer focus to infinity, and you have to get physically closer to your subject. Hey, both of these happen when using any lens focused up close, even when no tubes are added. Rack the lens out to its closest focusing position and you’re no longer in focus at infinity; and to bring the subject into focus, you have to move closer to it.

The total amount of extension you need in order to get to any given magnification depends on the focal length of the lens you’re using. Notice that I said the “total” amount of extension; it doesn’t matter how you gain the extension, since only the entire amount is important. A simple formula will give a rough approximation of the magnification rate:

Magnification rate = total amount of extension / focal length used

Current lenses, particularly zoom lenses, are so optically complex that this formula should be taken only as a rough guide. Still, you should find it rather useful. Suppose you want to photograph at half life size (1/2X) using a 50mm lens. The formula says you’ll need 25mm of total extension to get this magnification. But if you take that same 25mm of extension and add it to a 100mm lens, it only yields 1/4X. On a 200mm lens, it yields 1/8X. Any given amount of extension yields less magnification when used on a longer-focal-length lens.



Commercial fishing net on dock, Oregon. Nikon D2x, Nikon 70−200mm lens, Canon 500D close-up diopter, 1/60 sec., *f*/16, ISO 100

Flowers floating on water, Oregon. For this I added a Canon close-up diopter to my Nikon 70−200mm lens. Nikon D2x, Nikon 70−200mm lens, Canon 500D close-up diopter, 1/90 sec., *f*/8, ISO 100

You can see the problem of working at higher magnifications using extension on a very long focal length; the equipment quickly becomes physically unwieldy. Suppose you're photographing at the long end of your 70−200mm zoom. To get to 1X, you need to add 200mm (about 8 inches for those who are metrically challenged) of extension between the camera and lens. Don't try to work this way. Just picking up the equipment will most likely cause it to bend in the middle (and don't say I didn't warn you). Getting to 2X magnification using extension on a 500mm lens means adding a full meter of tubes, and that combination will definitely break in the middle.

All extension decreases the amount of light reaching the sensor, as the light must travel farther when the lens is moved away from the camera body. The exact amount of light lost to extension isn't a set amount per tube but depends on the focal length of the lens in use. This is obvious if you remember that any given amount of extension has less effect on a longer lens than on a shorter lens. Add a 12mm tube to a 600mm lens, and you have hardly changed the magnification, but put that 12mm tube on a 24mm lens, and you're immediately at 1/2X magnification. But not to worry, your camera meter will automatically take this light loss into account. Just meter and shoot as normal.

I would strongly recommend owning at least one extension tube, to use on your longest lens if on no other. Non-photographers often think we use long lenses to take pictures of far-off subjects. While this is true at times, we more often use long lenses to take tight shots of close-by subjects, especially when we're photographing small birds and mammals. Consider photographing a chipmunk. The fact that my 600mm lens focuses to infinity has no bearing on the situation; I only care about how tight the lens focuses. It's meaningless if the chipmunk runs away from me, as I wouldn't take the picture anyway, but what if it scampers toward me? I want close-focusing ability.

ZOOM LENSES WITH EXTENSION

Extension added to any lens permits that lens to focus closer. This is as true with zooms as it is with other lenses, but using a zoom with extension isn't always the easiest way to work. Here's the problem. The joy of a zoom lens is that you can zoom and stay in focus, simultaneously. What you're actually doing when you zoom is changing the focal length in use without changing the point of focus. If you add an extension tube, this relationship no longer holds true, because some other factors come into play.

Bunchberry, Oregon. In this photo, I used an extension tube with the same 70−200mm lens in the images of the floating flowers and the commercial fishing net. The choice of whether to use tubes or diopters (or both) basically comes down to what you happen to have with you at any moment. Nikon D2x, Nikon 70−200mm lens, 20mm extension tube, 0.4 sec., *f*/16, ISO 100

As noted previously, a given amount of extension added to a given focal length results in a given magnification. Let's say you have a 20mm tube mounted on an 80−400mm zoom lens. At the 80mm end, you're at 1/4X magnification. But zoom out to 400mm and now you're at 1/20X magnification. Since working distance is proportional to focal length, with a zoom lens on extension you must either refocus every time you zoom or physically move the camera position closer to or farther from your subject to maintain image size, or a combination of these.

This isn't always as hard as it sounds. If you're working on a nonmoving subject, using extension added to a zoom isn't a big problem; however, if you're working any sort of moving subject, trying to zoom and change focus simultaneously can be difficult if for some reason you can't use autofocus.

A second problem arises if you use a zoom without a tripod collar. If the camera body itself must be attached to the tripod with the lens, plus extension, hanging out in the front, be prepared for vibration problems. Flopping your camera for a vertical composition becomes difficult, as all that weight wants to twist downward on the tripod head. A partial solution lies in using an Arca-style quick-release tripod head with the anti-twist custom plates from Really Right Stuff or Kirk Enterprises.

SUPPLEMENTARY LENSES

Another way to make a lens focus closer is to add a supplementary lens. Supplementary lenses—also known as *diopter lenses*, *close-up lenses*, and *plus lenses*—look like filters, are available in standard filter sizes, and screw onto the front of a lens just like filters do. When attached, they allow any lens, zoom or fixed-focal-length, to focus in the close-up range. Of course, they must be removed for any non-close-up work. The actual working distance you have, and the subject coverage you end up with, depends on the power of the supplementary lens you're using, the focal length of the lens you add it to, and the close-focusing ability of the lens itself.

Supplementary lenses are available in various strengths that are measured in diopter powers (+1, +2, +3, etc.), which is why the lenses are often referred to as diopter lenses. The higher the diopter number, the greater the lens's strength and the more magnification it yields.

Close-up diopters have some good points and some bad points. Their relatively low cost, small size, and ease of use are big advantages. Adding a close-up diopter doesn't change the amount of light coming through the lens. Since you haven't lost any light, there is no exposure change and no loss of focusing light. Consequently, you end up with the brightest viewfinder image and the most light possible, which is great for faster shutter speeds. By the way, you can add a close-up diopter to any lens that has the appropriate filter thread size, including the lens on a video camera. Adding a close-up diopter to a video camera is the easiest way to work macro subjects with video.

But there are some disadvantages. Close-up diopters are only available in standard filter sizes, up to 77mm diameter, so it's impossible to add one to a 500mm or 600mm lens. The most commonly available close-up diopters (generally sold as a set of +1, +2, and +4 lenses) yield poor quality at best. There are some +10 supplementaries available; don't even think about getting one of these. And all close-up diopters make whatever lens they’re added to focus at the same working distance if these lenses are set to the same focusing distance. In other words, if you set a 50mm, a 100mm, and a 200mm lens at infinity focus, and add the same diopter to each, they will all focus at the exact same working distance. At infinity focus on the prime lens, the working distance will be roughly 1 meter divided by the diopter power of the supplementary lens. A +4 close-up diopter used on any lens means that your lens cannot be more than a quarter meter (250mm) from your subject. This lack of working distance can often be a major problem. No matter what, you’re going to be fairly close to your subject.

If all lenses will be in focus at the same working distance, it follows that the longer the prime focal length, the greater the magnification you’ll get. But most of the common close-up diopters are optically designed to be added to 50mm lenses; if you add one to a long-focal-length lens, the quality really goes down. What we need is a high-quality, multi-element close-up diopter designed to be used on longer focal lengths.

Well, lucky us. Canon makes a close-up diopter, the 500D, designed for 70mm to 300mm lenses. Note that while it “designed” for these focal lengths, there’s nothing stopping you from adding it to longer or shorter lenses. It’s available in 52mm, 58mm, 72mm, and 77mm filter sizes. My advice: get the largest size you think you’ll ever need and use step-up rings (readily available online) to mount the 500D on lenses with smaller filter sizes. Keep in mind that this is just a filter, so it doesn’t matter in the least if your camera is a Canon or a Nikon or a Sony. The 500D is a +2 diopter, so at infinity focus your maximum working distance will be a half meter.

The 500D is a very high-quality piece of glass and right now is the only close-up diopter I would recommend. Nikon used to make +1.5 and +3 close-up diopters in both 52mm (called 3T and 4T, respectively) and 62mm (5T and 6T, respectively) filter sizes; while these are discontinued, they can be found on eBay, although generally at grossly inflated prices. When last marketed by Nikon, they were about $50 each, but the current prices on eBay are hovering around $200. Get the Canon 500D.

A 77mm Canon 500D close-up diopter mounted on a Nikon 70−200mm f/4 lens. Since the lens takes smaller-diameter filters, I’ve used a 67mm to 77mm step-up ring. When I use this combination, I normally add a rubber lens hood.

A set of Kenko extension tubes (in Nikon mount).

ZOOM LENSES WITH CLOSE-UP SUPPLEMENTARIES

Close-up diopters really come into their own when paired with a longer-focal-length zoom lens. Most nature photographers own a 70−200mm or 70−300mm lens, and if you have such a lens, adding a 500D would be my number one suggestion for getting started in close-up work. In fact, on many of my international travels, especially in consideration of airline weight restrictions, the 500D is all I carry for close-ups. I've published a lot of photos using this, including several magazine and book cover shots.

The beauty of adding a diopter to a zoom lens is that you can change focal length by zooming the lens while maintaining your point of focus. Indeed, this is one of the best features of a zoom lens. You can zoom in and out, changing cropping by varying the focal length, without moving your shooting location. Adding a close-up diopter to the front of your zoom lens means you can also work close-ups in this manner. For practical purposes you now have a zoom macro lens.

Some zoom lenses have a special Macro feature. Adding a close-up diopter to a good-quality zoom offers far more flexibility and better resolution. Good photographic technique, however, is still imperative if you want good results. The best lens, fitted with a high-quality diopter, is still no better than how you handle the system. This is especially true for close-ups, since magnifying the image also means magnifying all potential problems. You must choose your shooting position carefully, you must use a remote release, and you must have the most stable tripod and head.

HIGHER MAGNIFICATIONS

If you want to work past 1X magnification, there are very few choices for fieldwork. As far as I know, there's only one lens on the market designed strictly for higher-magnification work, and that's the Canon MP-E 65mm f/2.8. This is an extremely special-purpose lens, as it can be used only in the 1X to 5X magnification range. Of course, you need a Canon camera body to use it, which increases costs for Nikon and Sony shooters. Let me repeat: this is a special-purpose lens, and I would not recommend getting it if you're a beginning close-up photographer. In fact, unless you're a high-magnification fanatic, I would think twice—and then twice more—before purchasing it. It's a great lens, but only if you truly have a reason to own it.

So what other choices are there? Well, to be honest, the more common solutions tend to be sort of jury-rigged combinations of gear. With any of these options, working distance will be just a few inches at best. This is true for the Canon MP-E also.

Reversing a Lens

An old technique for attaining high magnification is to mount a lens in reverse on your camera. You'll need a *lens reversal ring*, which has a rear lens mount on one side and filter threads on the other. Since you've turned the lens around backward, you lose all the electronic connections. And unless you have an older lens on which you can set the aperture manually, you cannot change the *f*-stops. Many modern lenses default to their smallest aperture when off-camera, so mounting one of these backward is pointless; however, you can often pick up old manual lenses that can be reverse-mounted for just a few dollars.

Stacking Lenses

If you do have a normal lens where the diaphragm can be fully open while in reverse, try reverse-mounting it on the front of a longer lens. In other words, use the shorter focal length as a very large supplementary lens. There is neither rhyme nor reason to what combination of lenses works or doesn't work. Hold the two lenses together, and take a look through the camera. As far as I know, no two zooms can be combined this way. You will need a male-to-male adapter ring (one with male filter threads on both sides) to mount the lenses together. Try leaving the reversed lens wide open and using the aperture of the lens connected to the camera body. If this doesn't work, leave the camera-mounted lens wide open and set the aperture on the reversed lens. Most likely you'll get some severe vignetting, but you could crop the central part of the image.

Use a Macro Lens with Accessories

Set the macro lens at its maximum magnification and try the following:

- Use some extension tubes with the macro lens or add a close-up diopter to the lens or a combination of tubes plus a diopter.
- Add a second close-up diopter. If these are different strengths, put the stronger one on first.
- Add a 2X teleconverter to double the magnification.
- Add some extension tubes between the lens and the 2X teleconverter. If you put the tubes between the teleconverter and the camera, you'll discover you need a lot more extension.
- Try extension tubes, teleconverter, and close-up diopter.
- Go crazy and try tubes, teleconverter, and two diopters.

What I'm suggesting is to play with your camera equipment. Dig out everything you own and try every combination, no matter how weird it seems. Add a TTL flash and pop off a few test frames. After all, pixels are free, so what do you have to lose? You'll probably discover that some of these combinations are optically terrible, but you'll never know until you try.

If you're really serious about high-magnification work, then you'll need to go to more specialized equipment and procedures. The best resources I know are the forums and galleries on www.photomacrography.net.

This photo of a postage stamp was taken at 1X, using a 105mm macro lens. The subject size is 1 × 1½ inches.

Willow leaves and rocks, Arizona. Working distance wasn’t a problem in this situation, as a large area around the willows was covered with fallen leaves. Nikon D3x, Nikon 24−70mm lens, 1/3 sec., *f*/13, ISO 100

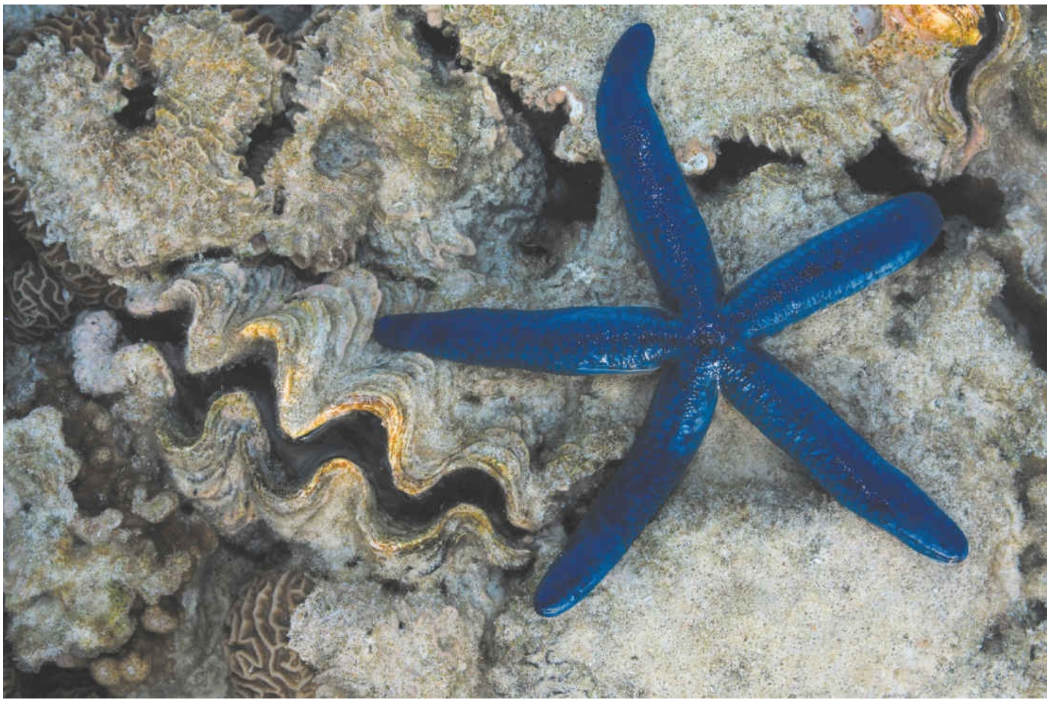
Macro Lenses

Many beginning photographers are under the impression that in order to do close-up work they must purchase a special macro lens. They've been led to believe that macros are the only lenses that will work well up close. This is not exactly correct; as I discussed in the previous section, there are a number of ways to take good close-ups.

Let me begin by defining the term *macro lens*. Basically, it's a lens that close-focuses all by itself to a 1X magnification, without needing any added accessories. While it is true that macro lenses are optically optimized for maximum sharpness and flatness of the field of view in the close-up range, in practical field terms, all lenses will work fine for close-ups if your photographic technique is good. Most modern lenses are optically superb, and in nature photography, you normally photograph three-dimensional subjects rather than flat-field subjects. Still, if you do a lot of close-up work, there are many reasons to own a macro lens.

Macro lenses are available in three focal length ranges: 50−60mm, 85−105mm, and 150−200mm. Canon, Nikon, and Sigma are currently the only manufacturers that I know of who make lenses in that last group. Note that Nikon calls its macro lenses "micro" lenses, but there is no real difference except spelling.

Don't confuse fixed-focal-length macro lenses with the so-called macro zooms touted by many manufacturers. The Macro mode on a zoom lens may allow focusing closer, but both the image size and the optical quality at the Macro setting don't usually compare to what you can get with a standard macro lens. In fact, most zooms will produce better images with a good two-element diopter than when used in the Macro mode. A number of years ago, Nikon did make a unique zoom that actually was designed as a macro lens, although it only went to 1/2X. This was the 70−180mm *f*/4.5−5.6, a one-of-a-kind lens that can sometimes be found on the used market. Although it's optically a good lens, it's not the best choice for close-up work, as it drastically loses working distance as it is zoomed closer.



Blue sea star in shallow water, Lady Elliot Island, Great Barrier Reef, Australia. I actually needed to shorten my working distance, as I was wading in the shallow waters, and could not use a tripod. I borrowed a 55mm macro and operated the camera with one hand while holding my flash with the other, all the time hoping I didn’t slip and dunk the gear in the saltwater. Nikon D2x, Nikon 55mm macro lens, fill flash, 1/80 sec., f/8, ISO 200

Horned lizard, California. A longer lens would have made taking this photo a lot easier, but you use whatever equipment you have with you at the time. Nikon D3, Nikon 105mm macro lens, 1/10 sec., *f*/19, ISO 100

A photo shot with a macro lens won't look different from one shot with a regular lens of the same focal length. Focal length is what determines a photo's "look." Photos taken with a 100mm macro lens, a 100mm fixed prime lens, and a zoom lens at 100mm will all look the same. The optical quality, and how the each lens handles the out-of-focus background, will probably be different, but the overall "look" will be the same.

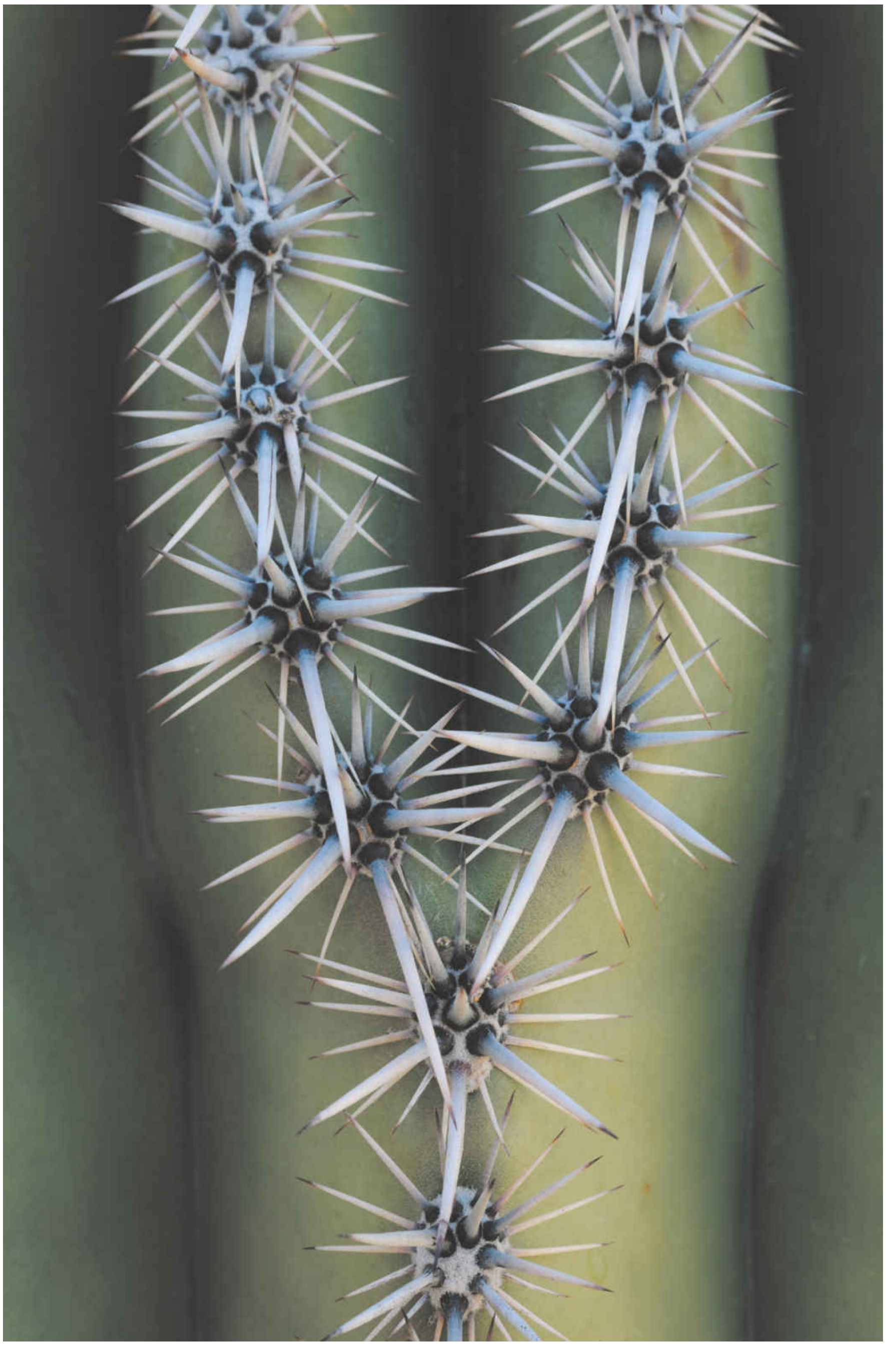
I've read debates on Web forums about how using a macro lens affects depth of field. Let me state this clearly: depth of field has nothing to do with focal length or whether or not a lens is a macro or a zoom or a prime lens. It has everything to do with image size (that is, magnification rate). All lenses, when shot at the same image size and aperture yield the same depth of field. Yes, pictures taken with a wide-angle lens and a telephoto lens, at either a close or a normal subject distance, will have the same depth of field so long as both lenses are at the same aperture and have the same image size (in other words, the main subject is the same size in both images). Perspective is governed by shooting location, and using that wide-angle means you're going to be a lot closer to the subject for the same magnification, the same image coverage, than with the telephoto. Consequently, the perspective of the photos will not be the same. Background coverage depends on the angle of view of the lens, so the wide-angle will take in more area behind the subject. But at the same magnification, where the subject is the same size in both frames, there will be no difference in the depth of field if the lenses are used at the same aperture. This is true for landscape photos, for close-ups photos, and for everything in between.

Hoarfrost on rose hips, Oregon. Nikon D800E, Nikon 200mm macro lens, 1/30 sec., *f*/11, ISO 100

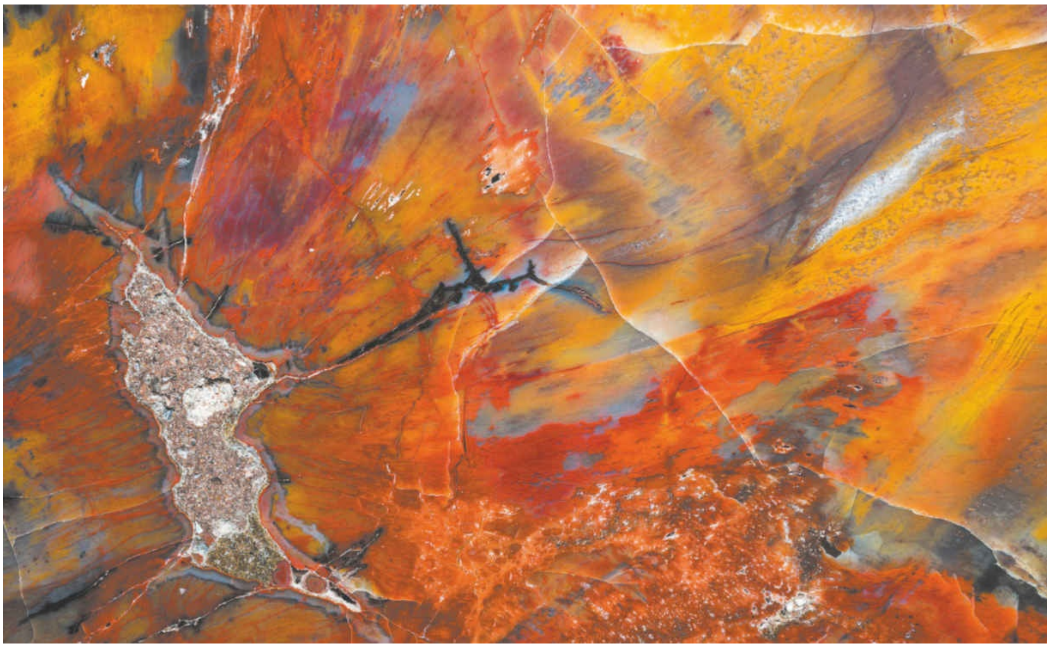
Why, then, even consider purchasing a macro lens? They are far more convenient to use in the field. You don't have to add or remove extension tubes or diopters or do anything else to go from infinity focus to 1X magnification or any point in between. You just turn the focusing mount and shoot. If you do a lot of close-up work, macro lenses are the easiest way to work. And macros are optically designed for close-up work, so theoretically, they will produce better results. I say “theoretically” because the quality of most close-up work hinges more on photographic technique than on lens choice.

I still occasionally hear that macro lenses are only useful for close-ups and that to photograph at normal distances a standard lens is needed. Not true at all. Macros can be used to photograph subjects at any distance. I think the real question to ask before you purchase a macro lens is whether or not you already have a good-quality lens in the same focal length. If you do, then try using it with extension tubes or supplementary lenses and evaluate the results. Are the images satisfactory? To be honest, I wouldn’t recommend that you purchase any macro lens unless you plan on shooting a lot of close-ups. The money would be better spent upgrading your tripod or taking a photo trip; however, if you like close-up photography, the convenience of a macro lens might be well worth the expense.

I would suggest skipping over the macros in the 50−60mm range. For most nature fieldwork, these short focal lengths don’t allow enough working distance between lens and subject. While I actually still own a very old Nikon 55mm *f*/2.8 macro, I can’t remember the last time I ever used it for any reason whatsoever. For general field photography, the 85−105mm group includes some very fine optics, particularly when photographing down to around 1/2X magnification. Check the minimum working distance for 1X, as some of these lenses lose focal length as they focus closer, resulting in an abrupt lack of working distance. If you’re serious about field close-up photography, consider the long-focal-length macro lenses: the 150−200mm group. These all focus from infinity to 1X and are very sharp throughout the range. While they are physically larger and heavier than the shorter macros, and more expensive, the increased focal lengths offer two big advantages: increased working distance and a narrowed angle of view. Just as important, these lenses have tripod collars that allow switching from vertical to horizontal or allow minute rotation of the image frame without flopping the lens on the tripod head. This is an incredible advantage in close-up photography, where precise camera placement is so important.



Saguaro cactus spines, Arizona. I was happy to have the extra working distance of the 200mm macro lens. Nikon D3x, Nikon 200mm macro lens, 1/6 sec., *f*/13, ISO 100



Tight section of polished slab of petrified wood, photographed with the only macro zoom lens ever made: the Nikon 70−180mm. Nikon D800E, Nikon 70−180mm macro lens, 1/60 sec., *f*/20, ISO 100

Current long macros include the Nikon 200mm *f*/4 ED and the Canon 180mm *f*/3.5 L, plus two from Sigma, in mounts for Sigma, Nikon, Canon, and Sony: 180mm *f*/2.8 (this takes 86mm filters, not a common size) and 150mm *f*/2.8 APO (an excellent compromise between size, weight, speed, and price).

One way to get a great macro lens at a good price is to look for older manual-focus models. With close-up work, you'll rarely use autofocus or IS/VR, so why pay for these features? The optics are often the same as in the newer versions, while the older lenses are generally slightly smaller and lighter … and available for a lot less money.

Close-up Flash

I would urge you to shoot close-ups with natural light as often as possible; however, with small, animated subjects, such as insects or lizards, you'll discover a combination of problems. It's extremely difficult to work from a tripod if your subject is moving all over the place, going nearer and farther, higher and lower. Handholding the camera is the solution, as it allows the needed mobility and ease of camera placement. This in turn means that you need a way to freeze any motion problems, both your own movement and that of the subject. A fast shutter speed is mandatory, so use of a high ISO would seem like a good solution; but you need to stop the lens down to a small aperture since you lose depth of field as you gain magnification, and working at those small apertures will push the ISO into the stratosphere. Using flash to light the subject, rather than natural light, solves the problems. You basically have two choices—opposites of each other—when using flash:

- You can expose for the ambient light and use flash to fill in the shadows.
- You can light the subject with flash and use the ambient light as a fill-light source.

If you're not sure about these concepts, please go back and reread the earlier section on flash.

To photograph small moving creatures in the field, you'll want to start with a mobile, easy-to-carry handheld outfit based around a close-focusing lens. Try to use a lens in the 100mm to 200mm range. Any shorter and the lack of working distance means you'll be scaring off most of your subjects. Any longer and the camera/lens/flash combination is going to be awfully heavy to lug around—and difficult to handhold for any length of time. A 50mm macro lens is too short; a 70−200mm *f*/2.8 is too big. Check out the size and weight of Nikon's 200mm *f*/4 macro lens; this is about as big and heavy as you want to go. You want some combination—extension tubes, close-up diopters, macro lens, whatever works—so that you can cover a subject size from about 4 × 6 inches on down to 1 × 1½ inches (1/4X to 1X magnification). Ideally you'll end up with a lens that gives you roughly 12 inches of working distance at 1/2X magnification.

Crab spider on blackberry, Oregon. Nikon D800E, Nikon 200mm macro lens, diffused flash, 1/250 sec., *f*/22, ISO 100

Now you need a flash unit. The little pop-up flash on your camera really won't work well. Get a separate TTL flash and a TTL cord so that the flash can be used off-camera. On some cameras the pop-up flash can be used to control off-camera flashes wirelessly, but a TTL cord is a more positive connection. The flashes I use for my close-up work (the Nikon SB-700 and older SB-800) are the same ones I use for all my flash work, including fill flash on birds and mammals.

You can position a TTL flash anywhere at a reasonable distance from your subject and it will automatically provide the right amount of light. Move it closer to the subject and it extinguishes itself faster, giving less light. Move it away from the subject and it puts out more light. The flash-to-subject distance in itself is not as important here as is the relative size of the flash head compared to your subject. When you're handholding a camera, the flash will be moving around with you; consequently, it will be roughly the same distance from the subject as the camera. If you're using a focal length that keeps the camera several feet from the subject, the flash head becomes a point source of light, and you end up with black shadow areas. If you move that same single flash unit closer to the subject, the flash now effectively becomes large compared to the subject. You get softer shadows just by positioning the flash closer.

For even softer light, add a diffuser over the flash, which in effect makes the light source even larger in area. Two that I carry are the Vello Mini Softbox (very inexpensive and sold under about a dozen different names) and the LumiQuest Softbox (the smallest of this series and my preferred close-up diffuser). Don't bother trying the plastic "diffusion dome" that most likely came with your flash unit; for close-up work, it just spreads out the light but doesn't really soften it.

Here's the outfit I used for the crab spider photo. The bracket is simply a short piece of aluminum strap attached to the rotating collar of my 200mm macro lens. Rotating from horizontal to vertical is quick and easy; however, the weight and size of this lens/camera/flash combination makes it very awkward and tiring. The TTL cord connects to the hot shoe on my camera.

Your flash instruction manual might tell you that the flash won't work TTL when it's placed very close to the subject. This is not exactly true. When a flash is positioned quite close to a subject, TTL flash metering won't work correctly *if* the lens is set at a wide-open aperture, such as *f*/2.8. The flash simply cannot turn itself off fast enough. No big deal for nature photographers, since we normally stop down the lens to gain what little depth of field is available. If you set the lens to around *f*/16, there is no problem.

Remember, you're lighting the subject with flash, not doing fill flash, which allows you to handhold the camera and still get sharp photographs. If the flash is the main light source, the effective shutter speed becomes the duration of the flash. Using any current TTL flash up close means your effective shutter speed is well above 1/1000sec.

Set the camera to the manual exposure mode and the shutter speed 1/250 sec. Keep the ISO low, around ISO 100 or lower. With the lens at *f*/16, flash pointed at the subject, shoot a test image. If you slow the shutter speed a bit, you'll let some daylight act as a weak fill light, but you don't want a daylight ghost image to record. Check the histogram and adjust the flash output accordingly.

If you’re working a static close-up subject with the camera on a tripod, you can position the flash anywhere you want using the TTL off-camera cord. For animated subjects, trying to handhold the flash while at the same time handholding the camera is a quick lesson in finding your frustration tolerance limit. Mounting the flash in the hot shoe atop the camera isn’t a good idea, as, first, you’ll have a parallax problem where the lens is aimed at one spot but the flash is aimed at another; and, second, mounting the flash in the hot shoe means that you’re directly sidelighting any vertical composition. If your subject is a living creature, there’s a good chance it will turn and you’ll end up lighting its posterior end. Not good.

This flash bracket is a simple solution, made from parts I’ve cannibalized from other projects. A long arm is bolted to an Arca-Swiss clamp (I happened to have this slotted arm, but a piece of aluminum strap with a hole drilled at either end would work just as well). The clamp is attached directly to the L bracket on my camera. To switch from horizontal to vertical orientation, I simply remove the bracket and then reattach it to the other side of the L bracket. The TTL cord connects flash and camera.

Skipper on lemon sage, Oregon. With close-up flash, you don't have to travel far to find subjects. We have a small herb garden next to our deck, and skippers seem to like the lemon sage. I was actually kneeling on the deck when I took this shot. Nikon D800E, Nikon 105mm macro lens, diffused flash, 1/160 sec., *f*/16, ISO 100

The solution is to make or buy a "third hand" bracket to hold the flash. The ideal position for the flash is just above the end of the lens, pointed slightly down at your subject. You want some way to keep the flash in this same relative position even when the camera is rotated for a vertical shot. A bracket is just a flash holder, nothing more, so if you're handy, you can certainly make your own. It doesn't have to be pretty when you finish, but it does have to be practical.

To be honest, I have yet to find any ready-made flash bracket that works really well for my style of close-up work. To me, most seem overly complicated, have the flash too high, and don't allow total repositioning of the flash. The brackets I use are mainly parts and pieces I've cannibalized over the years from other sources. You can get ideas for making a bracket by doing a search for "macro flash bracket" on Google Images. A quick suggestion for the do-it-yourself person who wants to make a flash bracket: a 1-inch-wide, $^{1}/_{8}$-inch-thick aluminum strap can be found at any hardware or home improvement store and is easily bent or drilled.

For a handheld flash rig, I would suggest working with one flash as the primary light source as often as possible. Two flashes create some immediate physical problems with their added bulk and size. How do you carry this outfit? What sort of bracket do you make to hold two flash units, especially if you're using fairly large flashes? How do you shoot a vertical?

To use a handheld flash outfit in the field, set the rough magnification you need, make sure the camera and flash are turned on and the lens is at the correct *f*-stop, and then lean in and out to achieve perfect focus. Autofocus isn't much help, as every small movement on your part will have the AF system hunting. Turn AF off, hold the camera with one hand while supporting the lens with the other, and then physically move in and out until the image comes into focus. Brace yourself as much as possible before you press the shutter. Depth of field is so limited when you're shooting small subjects that a slight accidental shift of the camera can ruin a photograph. Pay extra attention to camera positioning, as it is much more difficult when you're handholding a camera at high magnifications. A photo with the principal plane of focus slightly off the subject, or off the eyes of a small creature, will appear unacceptably out of focus. Overall, the process of taking pictures of small, animated subjects using handheld gear is an extremely physical and involved form of photography.

Chapter 6

THE PHOTOGRAPHER AT WORK

My Personal Field Gear

I'm often asked about what specific equipment I carry. In some ways, this is a pointless question, as equipment in and of itself does not take pictures—photographers do that. The very best equipment used poorly can produce bad images, while mediocre equipment used well can produce exquisite ones. I've joked for years about the fact that a comment I often hear is "Gee, you must have a good lens," as if some lens went out all by itself and took pictures. You know, every morning I tell my lenses to go do some work while I relax with another latte. But they never do! Quality equipment certainly does make life easier in the field, but the fact that you own good equipment only means that you've invested some of your money in your photographic outfit.

On the other hand, I will acknowledge that I'm an equipment junkie. Most photographers fall into this category, and I'm probably leading the pack. The following lists won't be correct for long, as I will undoubtedly switch my gear around as new lenses and cameras become available. Shooting digitally, I'll no doubt be upgrading camera bodies as new ones come to market, particularly if they offer more dynamic range along with less noise at higher ISOs.

I don't want to present these lists as endorsements per se of any equipment. These equipment choices work for me. Don't copy my gear; instead, develop your own outfit tailored exactly to your needs, your subject matter, your expense account, and your preferences. I do own a lot of camera gear, but photography is how I make my living. It's my one and only business and has been such for over forty years now. But here's an honest warning from one who knows: it's just as easy to have too much equipment as it is to have too little.

I use Nikon equipment and have for my entire professional career. I'm very happy with Nikon gear, but you can certainly take good pictures with any brand. I'll mention right here that I do not work for Nikon, nor am I on any sort of financial retainer from the company. I buy my camera equipment with my own money, just as you do. And just to be clear, I certainly don't carry all of this equipment with me at any one time; I tailor what I carry depending on what my expected subject matter will be.

Red-crowned cranes in snowstorm, Japan. I’ve been lucky enough to photograph red-crowned cranes several times, and the photos I like the best have all been taken in heavy snowstorms. Nikon D2x, Nikon 200−400mm lens, 1/1250 sec., *f*/5, ISO 400

Coyote in snowstorm, Hiawatha National Forest, Michigan. If the camera gear has cooled to the ambient temperature, dry snow is no problem. It just easily brushes off. Wet snow is a different matter, and camera protection is necessary if you’re out for any length of time. Nikon D3, Nikon 200−400mm lens, 1/500 sec., *f*/8, ISO 800

CAMERA BODIES

Currently I use a Nikon D4 (my “fast-action” body) and a Nikon D800E (my “landscape” body). Both are equipped with Really Right Stuff L brackets. I don’t have the extra battery grip for the D800E, as I wanted to keep the camera as small and lightweight as possible.

LENSES (ALL NIKON)

- *14−24mm f/2.8 AF-S and 16−35mm f/4 AF-S*. While I love the 14−24mm, it's bulky, heavy, and doesn't take filters. If I know any of those factors are restrictive, I substitute the 16−35mm *f*/4.
- *24−70mm f/2.8 AF-S and 24−120mm f/4 AF-S*. The 24−70mm is a bit sharper, but the 24−120mm, with its wider zoom range, is a bit more convenient. Basically, I carry the 24−70mm for landscape work and the 24−120mm for travel. The 24−120mm also has VR (vibration reduction), while the 24−70mm does not—important if I know I'll be in a handholding situation.
- *70−200mm f/4 AF-S*. I did own the 70−200mm f/2.8 version, but I much prefer the smaller size of the f/4 lens. I don't think I ever shot the f/2.8 lens wide open.
- *80−400mm f/4.5−5.6 AF-S*. The more I use this lens, the more I like it. I carry it, rather than the 70−200mm, when I suspect I might need the extra focal length.
- *500mm f/4 AF-S and 600mm f/4 AF-S*. Yes, I have both of these lenses. While I've had the 500mm for some time, I recently picked up a used, mint-condition 600mm, rationalizing that I was a decent guy and deserved such a lens and, besides, it was too good of a deal to pass up. Good thing I'm not a car fanatic, or I would be using that same rationalization for a Lamborghini.

SPECIAL-PURPOSE LENSES (ALL NIKON)

- *24mm f/3.5 PC-E tilt/shift*
- *45mm f/2.8 PC-E tilt/shift*
- *85mm f/2.8 PC-E tilt/shift*
- *200mm f/4 micro*

FLASHES

- *Nikon SB-800 and SB-700 flashes, plus off-camera cords*. I have several of the old SB-800 flashes and see no reason to replace them.

ACCESSORIES

- *Nikon 1.4X teleconverter*
- *Kenko extension tube set*
- *Nikon MC-30 and MC-36 remote releases*. The MC-36 incorporates an intervalometer and timer for long exposures.
- *Nikon thin polarizing filters to fit all lenses*
- *Tiffen IRND 2.1, and Kenko ND-8 and ND-400 neutral-density filters*
- *Canon 500D supplementary close-up filter*

TRIPODS AND HEADS

- *Gitzo 3540XLS with Gitzo leveling base and RRS BH-55 ball head*
- *Really Right Stuff 24L Versa, with RRS Series 2 leveling base and BH-55 ball head*. I basically think of the above two tripods as interchangeable. When I'm driving to a location, I take both in case I want to work two cameras simultaneously. When flying to a location, I generally choose the 24L, as it's a bit more compact when closed, hence easier to pack.
- *Really Right Stuff 33 Versa, with RRS Series 3 leveling base and Wimberley gimbal head.* My "big glass" tripod and head.

BAGS AND BACKPACKS

I have several Think Tank Photo roller bags and packs, and highly recommend their products:

- *Airport Accelerator*. My most used-backpack.
- *Urban Disguise 60*. This is a combination shoulder bag and briefcase, and goes with me everywhere. It holds my laptop, chargers for both cameras and computer, and small external hard drives and still offers room for an extra lens if need be.

SCATTERED IN THE BACKPACK

- *Two extra 32GB flash cards.* Both of my cameras can take two cards, and I keep a total of 48GB in each body.
- *A small tool/repair kit*, including an Allen wrench that fits the lens and body quick-release plates, a tiny screwdriver (actually meant for eyeglass repair, with a straight blade on one end and a Phillips head on the other), and an extra rubber ring that goes around the camera eyepiece, which prevents getting my eyeglasses scratched (anyone else ever lose one of these things?).
- *A couple of mini-carabiners*
- *A bright-red Giotto Rocket Air Blower*, the best blower bulb available.
- *Several microfiber cleaning cloths*
- *An old toothbrush* (to remove sand and grit from tripod legs, filter threads, etc.)
- *FotoSharp rain covers* (one for my long lenses and one for shorter focal lengths)
- *A trash compactor bag* (much stronger than standard plastic garbage bags)
- *A tiny LED pinch light* (the kind often found on a key ring)
- *Multiple strips of gaffer tape* (good for all sorts of uses), stuck on the inside lid of the pack

Changing My Camera Settings

When I'm working in the field, I'm constantly changing the settings on my cameras. Of course I select the apertures and shutter speeds I want to use, but here I'm referring to how my cameras actually operate. I'm constantly changing a number of features:

- ISO. Either for a faster shutter speed to stop subject motion or to photograph in low-light situations. The exposure setting I want to use—the aperture/shutter speed combination—dictates my ISO. Sometimes I select Auto ISO, particularly when the light is quickly shifting or an animal is moving from highlight to shadow.
- Motor drive rate. I select the fastest frame rate when I'm photographing birds and mammals, and single shot for landscapes and close-ups.
- Mirror lock-up. I choose No for action work, Yes for all other subjects.
- The in-camera time and date. I always set my cameras to local time so that the recorded metadata matches my itinerary.
- Metering pattern. I use matrix (evaluative) most of the time, spot metering occasionally.
- LCD brightness. I set this to High in bright sunlit situations, making the LCD easier to view, and Low in dim lighting conditions.
- Exposure-delay mode. While I use a remote release whenever possible, at times I go to the 3-second delay mode for static subjects unaffected by wind.
- Exposure mode. Most of the time I work with Aperture Priority, changing to manual exposure mode when I need to maintain a constant given exposure value.
- AF mode. I can't imagine myself using the same autofocus mode for all my work. I use single-point AF for landscapes and static subjects, and toggle which AF point is primary depending on my subject. For active subjects, I generally use 3-D focus tracking, which automatically shifts the primary focus point to follow the movement of the subject. This is my favorite AF mode, as I can concentrate on composition and don't have to keep an AF point centered on the subject. I switch to Auto Area AF (which automatically selects the closest subject) when I know I'm going to have to "point and shoot." Auto Area AF works great with fast-moving subjects against smooth and continuous backgrounds.

Working in the Field

WEATHER CONCERNS

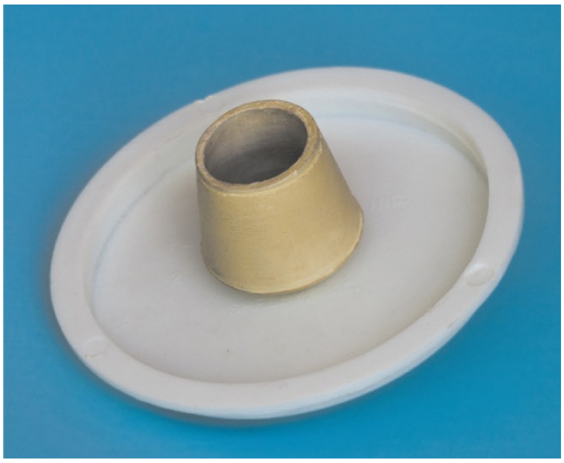
Most camera gear seems to be designed to be used in good weather—fairly mild temperatures and no adverse environmental conditions impacting either equipment or photographer. Cameras and lenses are easy to handle when used indoors, and while you're standing on a flat, hard surface. But as nature photographers, we work in all sorts of weather. In fact, that perfect cloudless blue-sky day is not when we want to be out photographing. For us, bad weather is good weather, because it has mood and emotion.

While there are some good pictures to be made in tough conditions, I'm not thrilled about taking my expensive electronic cameras and lenses out when it's raining or snowing. Rain covers are the answer. The simplest covers are the plastic shower caps found among the bath amenities in most hotels. I have these stashed in every camera bag and backpack and a bunch of extra ones tucked away in my truck. You don't want to photograph through the shower cap, but just use it as a quick camera cover. The elastic band keeps the cap from blowing off, while at the same time the shower cap can be easily removed for a couple of quick frames.

For longer lenses, or when you need to keep shooting despite the rain or snow, the real answer is a waterproof camera cover. I'm partial to those from FotoSharp (www.fotosharp.com), especially their "universal camouflage" ones that have a "blackout" interior. These are inexpensive, very compact, and have a Velcro opening for tripod use. The covers are based on a simple design that works perfectly: a waterproof sleeve with an elastic drawstring at either end.

When photographing in deep snow, both you and your tripod will disappear into the drifts. Just as you can use snowshoes on your feet, you can add snowshoes to your tripod legs. While you can purchase these ready-made, it's quite easy to make your own set for just a few dollars (see this sidebar).

By the way, when you're working in fairly deep snow, start with the tripod legs less than fully spread. As you push the tripod down into the snow, the snow itself will force the legs apart.



A well-used tripod “snowshoe.”

A folding diffuser, partially pulled from its case.

Elephants at waterhole, Botswana. This photo was taken at 28mm. I was photographing from a groundlevel blind at a waterhole, which gave the unique perspective. Nikon D800E, Nikon 24−120mm lens, 1/160 sec., *f*/8, ISO 400

Rothschild's giraffe in heavy rain, Lake Nakuru National Park, Kenya. I kept the shutter speed slow so that the rain would show as streaks. The safari vehicle's top was partially raised, but the rain was blowing directly into the vehicle while I photographed. My FotoSharp cover kept my camera gear dry, but I was quickly soaked. By the way, if you look closely you can see that a group of yellow-billed oxpeckers are clinging to the giraffe's legs for a bit of protection from the rain. And just behind the giraffe's back legs, an impala can be partially seen. Nikon D3x, Nikon 200−400mm lens, 1/20 sec., ISO 400

DIFFUSERS

While modern DSLR cameras can handle contrasty light far better than film ever could, too much contrast is a photographic disaster. This is especially true for close-up work, where we don't want parts of the subject hidden in deep shadows. One good solution is to photograph on overcast days, when the entire sky acts as a giant diffused light source.

But having an overcast day when you want one rarely seems to happen. The answer is to use diffusers and reflectors. In my opinion two brands stand out: the round LiteDisc line from Photoflex (www.photoflex.com) and the triangular TriGrip ones from Lastolite (www.lastolite.com). Both brands are available in a diffusing material or as white, silver, or gold reflectors. All of these can be folded into a more compact size with a twist of the hands. (Hint: Hold with your fingers on opposite sides. Now twist. Being able to fold a large diffuser in one try is a mark of becoming a professional photographer!)

I would suggest getting the largest diffuser you can pack, or perhaps two of them, since you want to control the light falling both on your subject and on the background. Then get one or two small reflectors.

To use a diffuser, position it as close to the subject as you possibly can without it protruding into the picture frame. This will give soft, broad highlights. Held far away from the subject, it simply throws a shadow; move it closer, and the lighting gets better and better.

BLINDS

At least once in a while, you'll want to work from a blind, a hiding place for you and your equipment. Blinds are a great means of getting closer to wary subjects, because you can position the blind right where the subjects are likely to appear. Locations such as bird feeders, watering holes, and well-used game trails are obvious choices. I would strongly urge you to be extremely careful about working birds at their nests, and particularly song birds. Nesting birds have a strong instinct to care for their young, so up-close photographic activity of any sort just adds stress to an already stressful time. No photograph whatsoever is more important than the welfare of the subject.

Rod Planck's N-VISIBAG Blind set up at a local cattail marsh. The Kwik Camo blind is very similar but is a lighter-weight fabric and, consequently, a bit cooler to use in warm temperatures, while packing into a smaller space. Both work well.

Blinds can be as complex or simple, as permanent or temporary, or as Spartan or luxurious as you wish. You already own one: your vehicle. We've all had the experience of driving close to an animal that seemed blissfully ignorant of our presence, only to watch it disappear over the far hill at the first "snick" of the car door opening. Shooting from your car can be particularly productive in parks and refuges where animals have become accustomed to slow-moving and stopped vehicles. When you're ready to photograph, slowly drive up to your subject, and as you get close to where you want to be, turn the engine off and drift into position. You'll never get sharp photos if you leave the engine running.

When shooting from your car, you'll generally be using the longest lens you own. You can't very well handhold it out the window, and laying it directly on the window frame doesn't work well either. While there are a few specialized window mounts, it's easiest to use a large beanbag. You can make your own or buy one. You want something like the SkimmerSack from www.naturescapes.net. Most homemade beanbags I see are far too small and far too light in weight. You need some size and mass for the beanbag to stay in place all by itself and to fully cradle a large lens. If I know I'm going to be photographing from the car for a while, I add some camouflage material to the open window, held in place by self-adhesive Velcro tabs.

MAKING YOUR OWN TRIPOD "SNOWSHOES"

To make "snowshoes" for your tripod legs, head to your local home improvement store and purchase the following:

- Three slip-on crutch tips (the rubber furniture-leg tips) in a size just large enough to slip snugly over your tripod "feet."
- Three ¼- to 20 1-inch-long bolts, the nuts for them, and six flat washers that fit the bolts.
- Three plastic test caps (look in the plastic pipe section). Mine are for 4-inch pipe and cost 50¢ each.

Drill a hole through the center of each crutch tip and the middle of each plastic test cap. Take a bolt, add a washer, and thread it through the crutch tip, then through the test cap; then add a second washer and nut and tighten. That's it—you've got a tripod "snowshoe." Just as you still sink a little into the snow when you're wearing snowshoes, your tripod will also. But it won't go out of sight in powder snow, as it would otherwise.

Of course you can't always use your vehicle as a blind. A quick option is the "throw-over" camouflage bag blind, which is a camouflage material "bag" that you drape over yourself and your gear. Position your tripod and lens wherever you want and toss the bag blind over yourself. This works well when you're shooting low to the ground or along the edges of marsh ponds. Wear waterproof chest waders and simply sit down along the water's edge, preferably adjacent to cattails or other vegetation. When you drape the blind over yourself and your tripod-mounted long lens, you immediately disappear. Throw-over covers are meant to be used from one spot; you don't want to try walking around while covered (although that might be a unique Halloween costume).

Two throw-overs are Rod Planck's N-VISIBAG Blind and the Kwik Camo Photography Blind, both available from www.outdoorphotogear.com and other sources.

A portable blind is a step up from the throw-overs. There are many versions on the market, but I'm partial to the quick-erecting pop-up versions that fold flat and can be carried in a bag. See the Gunner, Doghouse, and Outhouse blinds from Ameristep (www.ameristep.com).

LENSCOAT

LensCoat is a unique product, a custom-designed neoprene sleeve that slides over a lens. While protecting a lens from bumps, nicks, and scratches (helping the lens maintain resale value), it also provides a thermal barrier, making the lens more comfortable to handle.

While these are available for just about every lens on the market, I see them as most valuable for your large and very expensive long-focal-length lenses. After spending several thousands of dollars for a big lens, the expense of a LensCoat is almost meaningless. These are widely available from many outlets; see www.lenscoat.com for more information.

COLOR FINDERS

Some time ago, I accidentally dropped a Nikon remote release while I was traversing a rocky Arizona hillside. I realized I had lost the release when I went to take another shot just a few minutes later. I backtracked and searched and searched but never did find that release. That all-black release is still out there somewhere, lying among black shadows, black rocks, and my black thoughts. An easy solution would have been to (a) always double-check I have my remote release with me and (b) wrap some bright-orange electrical tape around the release to make it easier to find. And yes, the orange tape did help me find my replacement remote release the next time I dropped it, because I wasn't diligent about part (a) of the solution.

While I've never lost my cell phone out in the field, I did get a bright red cover for it. I probably should have gotten fluorescent orange.

FOUR WHEEL CAMPER

I live in the western United States, where distances between locations can be vast. Staying on-site is absolutely necessary in order to work the early and late light, as the nearest lodging might be hours away. Most of the pro nature photographers I know who live in this part of the country have some sort of self-contained vehicle, so they can remain on-site. I'm way too old for tent camping and want some creature comforts, while at the same time, I want back-country accessibility. For me, the answer is a pop-up camper mounted on a four-wheel-drive pickup truck.

Soaptree yucca, sand dunes, and San Andres Mountains at first light, White Sands National Monument, New Mexico. Nikon D800E, Nikon 85mm T/S lens, 0.6 sec., *f*/22, ISO 100

I've owned a Four Wheel Camper for a number of years now and recently upgraded to a new model. As this brand name implies, these campers are designed to handle off-pavement driving and are available in models to fit all trucks, from the smaller Toyotas and Nissans to full-size pickups. I have nothing but good things to say about the campers themselves and also the company (which definitely understands photographers, as the owner is a Nikon shooter himself). I know that quite a few of the professional nature photographers who live out here are driving these rigs.

The truck camper is my base camp, my home on the road, my office in the wilderness … with all of the creature comforts of stove, refrigerator, furnace, 90-watt solar panel, queen-size bed, and lots of storage space. The weather can be awful, but I remain dry and warm, able to work on my laptop, cook a meal or make coffee, or read with a glass of wine at hand. And I can set up camp, or break camp and be on the road, in just a few minutes at most. For information, see www.fourwh.com.

SOME PHOTOGRAPHIC TECHNIQUES TO TRY IN THE FIELD

- *Blurs:* Even back in the olden film days, it was possible to intentionally blur an image. The difference now is that you can see the results immediately in the LCD and delete if you don't like them. There's a big difference between an image that is artistically blurred and one that is simply out of focus. Try intentionally moving the camera during a long exposure or, if there's a moving subject, keeping the camera stable and allowing the movement of the subject to blur.
- *Zoom Blurs:* Another kind of blurred image can be created by zooming the lens during the exposure. For the best results, work with a tripod-mounted camera. You'll get very

different results by zooming from long focal length to short versus from short focal length to long. Generally, I prefer the first method. If your zoom has a tripod collar, try rotating the lens during the zoom.

- *Multiple Exposures:* More and more cameras are now offering a feature for in-camera multiple exposures. You set the number of frames you want to combine, the camera takes that many, and then the camera automatically combines them into one properly exposure image. Really simply.

Working in the Digital Darkroom

Like many nature photographers back in the film days, I used slide film (transparency film) exclusively. You took a shot, sent the film to the lab for processing, and got back a finished photograph. In essence, the creative process stopped at the moment of pushing the shutter release. In my opinion, the period of time when slide film was dominant was an anomalous era in the history of photography. Historically, photographers have always gone into the darkroom to create an image that more perfectly expressed their vision. Remember the famous Ansel Adams quote: “The negative is the score, the print is the performance.” I’m not suggesting that we should all make prints but that we should treat the file we create in the field as the starting point for the final image, not the final image itself. We should break out of old ways of thinking.

In this, it certainly helps to shoot RAW files. JPEG images are processed in-camera, using whatever parameters you have chosen in your camera setup. They can be processed somewhat after the fact, but only to a limited degree. RAW files are just that: the raw information captured by the sensor. What you see first on a computer screen is just a rendering of the file using the default settings in your software as a starting point, nothing more. You can process RAW files as you wish, in as many different ways as you want. You can make as many variations from one RAW file as time permits. Of course, the very fact that you actually have to sit at a computer and process the file is exactly the catch-22 for many people.

Whether you shoot RAW or JPEG, you’ll have to use some software to manage your files. One “problem” with shooting digital images is that we end up drowning in files. Pixels are free, so we keep shooting and shooting. I would strongly urge you to think about an overall organization system for your image files and a file-naming convention that enables you to avoid having duplicate camera-generated file names.

Machine tracks in wheat stubble, Washington. Converted to black and white using Nik's Silver Efex Pro software. Nikon D2x, Nikon 12−24mm lens, 1/45 sec., *f*/11, ISO 100

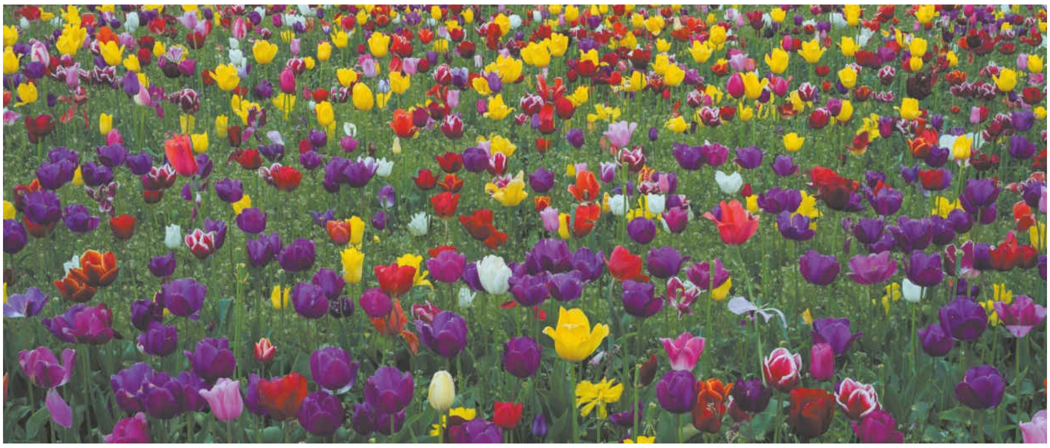
Lenticular clouds, South Georgia Island. Converted to black and white using Nik's Silver Efex Pro software. Nikon D3X, Nikon 24−70mm lens, 1/250 sec., *f*/8, ISO 200

I use Adobe's Lightroom software as the database for my digital files and would strongly urge you to consider this program. Right now I have well over 200,000 images in my master Lightroom database and can find any one file within seconds. I organize my files by year, and then each shoot by month and date. For example, I have a folder for each year. Each shoot is filed in the proper year's folder by month: 04 Oregon coast (04 = April), 05 Redwoods NP (05 = May), etc. For multiple shoots in the same month, I break this down: 04.1, 04.2, 04.3, etc. Nikon allows a three-letter code to be set in-camera to identify that camera body; for example, I've set the code for my Nikon D800E as D8H (*D 8 H*undred). I always set the clock in the camera to the correct date and time zone. As I download, the files from this camera are renamed by the software from their default DCS_1234.nef to YYMMDD_D8H_1234.nef (the *1234* is the file number generated by the camera). (Incorporating YYMMDD and the camera body code into the file name means that I'd have to shoot over 9,999 images in one day with that specific camera body to ever repeat a file name, which isn't very likely.)

Lightroom will do all this organization by itself, once I set up an action template setting what I want. With one click of my mouse, Lightroom renames the files, adds my copyright information, sorts the files by day, and moves them to the proper month and shoot folder in the proper year folder. All my organization is done! Plus, Lightroom is my RAW file converter of choice; I use it to prepare all my files.

You will also need an image-editing program. I use Photoshop and would recommend it, or the simpler but far less powerful Photoshop Elements.

If you're serious about your images, you need to learn a bit about color management. In order to accurately evaluate colors on your monitor, you must first calibrate it to known values. Have you ever walked into an appliance store and looked at a wall of televisions, all tuned to the same program? Did you notice that the colors are all over the place (one set is far too magenta, one is too green, one is too blue) because they're not calibrated to a standard? Without calibration, color evaluation and correction are just guesses. The question is whether you want good color that is consistent however the file is used or color that only looks correct on your monitor.



Tulips at Wooden Shoe Tulip Farm, Oregon. I used my 85mm T/S lens to take three frames. The lens was tilted to reposition the plane of focus and then shifted left, center, and right. The image was stitched in Photoshop. Nikon D4, Nikon 85mm T/S/ lens, 1/320 sec., *f*/11, ISO 800

A colorimeter is a device that you place on the front of your monitor to profile it by reading known color values through an accompanying software package. A profile is a description of how a device interprets the "ones and zeros" that make up computer color values. I strongly recommend that you purchase a monitor calibrating system. My choice is the i1Display 2, an advanced but very affordable package from X-Rite (www.xritephoto.com).

The calibration steps are simple. Install the software package and open the program. Make sure that your office lighting is reasonably subdued. Place the colorimeter sensor on the screen as directed by the program and go through the steps. When the program ends, it will automatically save the profile in the correct location and make that profile the default description of your monitor.

Some photographic techniques you should remember to try:

- *Black and White:* All sensors record color information, but it's very easy to create black-and-white images. You can do this in most editing software (or even with many RAW file converters, such as Lightroom and Photoshop), or you can use Nik's Silver Efex Pro, which I highly recommend. Note that Silver Efex needs a host program to work.
- *Stitched Images:* With the proper software, you can stitch frames together to get larger file sizes or to make panoramic images. Level your camera and tripod head before you shoot. You want the rotational movement—the left/right movement—to be square with the world. Using the manual exposure mode, take as many frames as needed, overlapping them by about 25 percent. You don't need to be precise about the amount of overlap; just eyeball it. Shooting verticals instead of horizontal images will yield a larger file size and more detail in the final image. For the easiest stitching of the frames, shoot with a longer-than-normal lens. Don't use a polarizing filter unless you're using a very long focal length, as uneven polarization across each frame will show up with short lenses. Turn off autofocus and don't refocus between frames. Shoot all the images at the same *f*-stop so that depth of field doesn't change between images. Process all the frames the exact same way.

  You'll need software to do the stitching. I use Photoshop's Photomerge command, but there are special panoramic programs such as Autopano Pro, or the free Image Composite Editor (ICE) from Microsoft (Windows only).
- *Focus Stacking:* Stopping a lens down to its smallest aperture may yield more depth of field, but you'll lose sharpness due to diffraction. Focus stacking is the process of taking multiple frames, focused on different points of the subject, and stacking them together, combining all the in-focus areas and resulting in a single image with deeper and sharper depth of field.

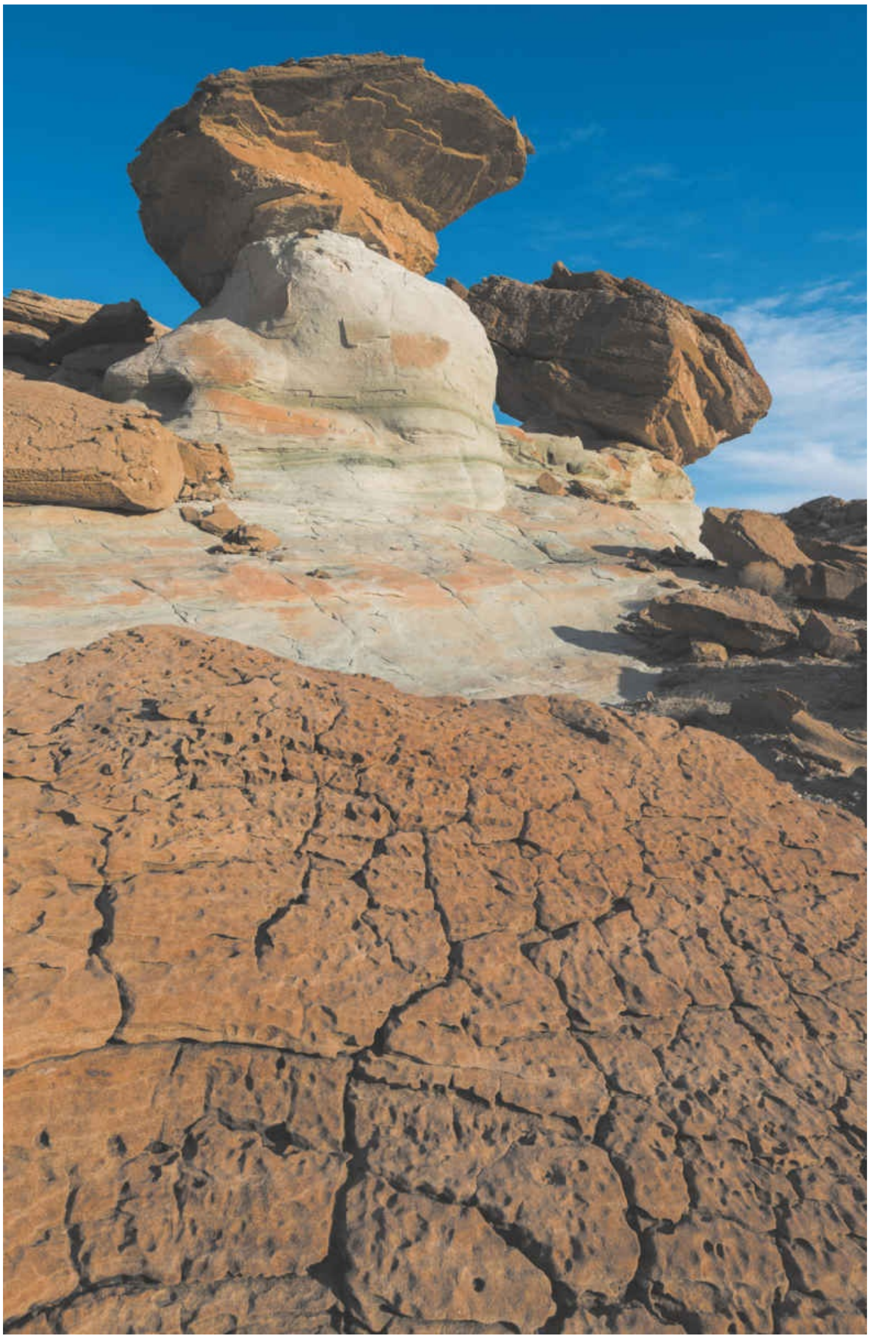
  Don't frame your subject too tightly, as the final stacked image will have to be trimmed a bit. Keep the same exposure for all the images, and turn off autofocus. Select a middle aperture, such as *f*/11. Without moving the camera, take a series of images, shifting the focus point for each frame. The number of frames needed depends on the subject, but too few will yield alternating in-focus and out-of-focus bands.

  Process all the images exactly the same; then open them all in Photoshop as layers in a single image. Highlight all the layers, and then select Edit > Auto-Align Layers. Make sure all the layers are still highlighted, and select Edit > Auto-Blend Layers. Trim the edges of the resulting image, and you're finished.

  Photoshop does reasonably well when stacking subjects that aren't too complex. If you find yourself wanting to blend more intricate subjects, try Helicon Focus (www.heliconsoft.com) or Zerene Stacker (www.zerenesystems.com). Both offer downloadable trials.

The Alvord Desert, Oregon. One frame, mirrored. There are all sorts of games you can play as you process your images in the digital darkroom. Here's one option: duplicate an image, then flop the duplicate and merge the two to create a mirrored image. Nikon D2x, Nikon 12−24mm lens, 1/10 sec., *f*/11, ISO 100

Scotch broom, Oregon. This is a stack of seven images. Nikon D800E, Nikon 200mm macro lens, 1/15 sec., *f*/8, ISO 100



Hoodoos at Stud Horse Point, Arizona. I stacked four images so that all points in the frame would be in sharp focus. Nikon D800E, Nikon 16−35mm lens, 1/30 sec., f/14, ISO 100

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