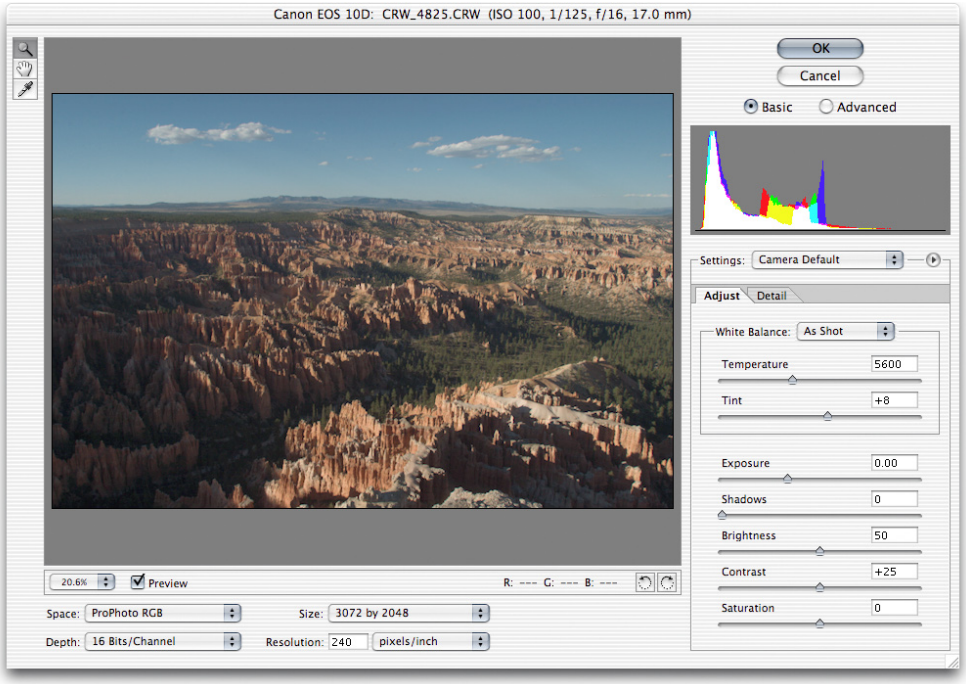
A Digital Workflow for Raw Processing Part Two: Camera Raw



Basic mode of Camera Raw

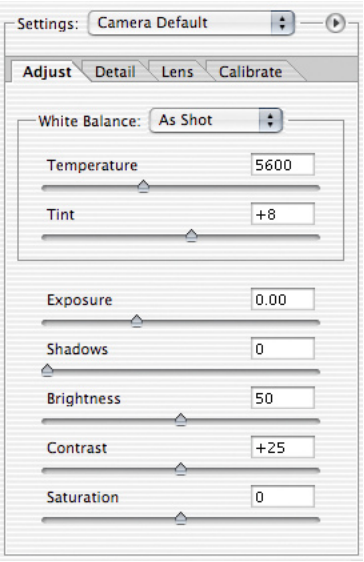
Camera Raw is a powerful plug-in, but it can be confusing if you don't know what the controls do and how you are supposed to use them. Even in the Basic mode shown above, there are a lot of sliders and numbers, and the power to control your image can be intimidating. The manual doesn't help much on the *how*; it only provides a modest amount of the *what*.

I was an alpha and beta tester for Camera Raw, so I have some background with it. When Adobe first sent a beta version of the plug-in, I realized that it was far faster than the camera software and offered a brilliant method of adjusting the white balance of a raw capture.

The white balance is arguably the most important first correction for any raw conversion. Until you determine that aspect, you really can't reliably do any other correction. The Camera Raw interface places White Balance first on the Adjust tab to help guide users to adjust white balance before anything else.

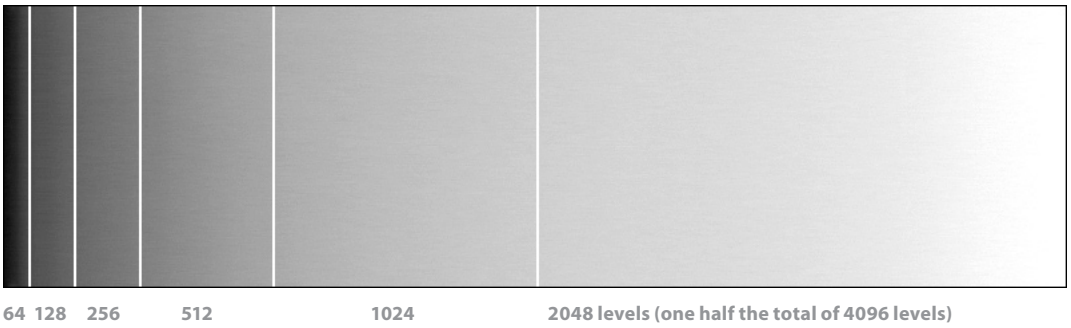
The way Camera Raw is designed, the Temperature control moves the color temperature of the image between blue and yellow along the Kelvin scale. The supported cameras were sampled for spectral responses at two points on the scale, Standard Illuminate "A" (2856° K) and D65 (6500° K). To alter the color temperature between those two points, Camera Raw has a slider-based adjustment that is accurate to 50° K. To accurately adjust the white balance, you also need to use the Tint slider, which offers a green/magenta adjustment. Using these two adjustments, you can properly adjust the white balance of nearly any shot—regardless of the color temperature under which it was shot. White balance is absolutely critical and can't be duplicated by any Photoshop tools after conversion. (For more information about white balance, see the "Part Three: White Balance" section of this paper.)

Adobe

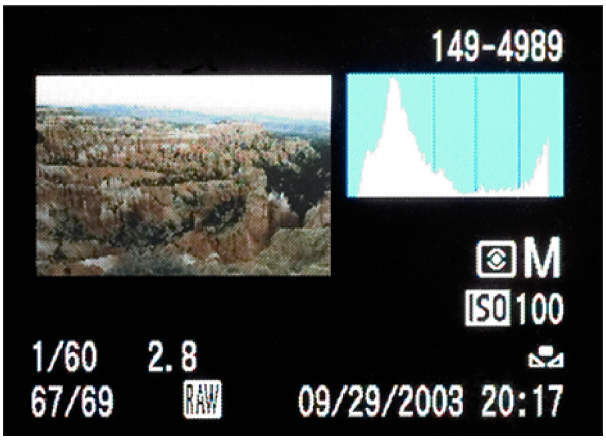


Adjust tab

The next-most important adjustment in Camera Raw is exposure. This adjustment is not merely a duplicate of the Input Levels white point adjustment in Photoshop. Because the raw file is in linear rather than gamma-adjusted space, the Exposure control allows for some wide-ranging exposure adjustments. The original captures from some cameras have over six stops of dynamic range, but the majority of the data in a raw file is in the lightest two stops. One half of the data of a 12-bit capture (4096 levels) or 2048 levels reside in the brightest stop, 1024 in the next stop, and so on. The lowest stop, the shadows, contain only 64 levels.

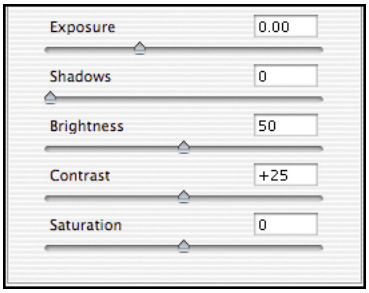


Distribution of levels in six stops



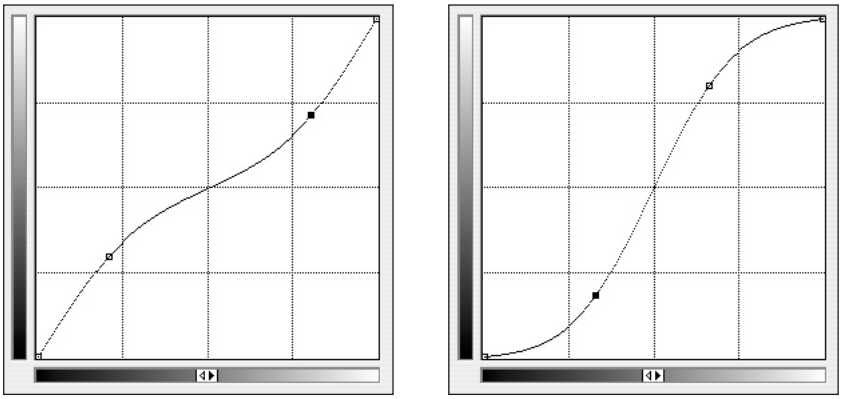
Digital capture and histogram

Because of the distribution of levels, it's critical to both expose correctly for the scene and properly process the exposure in the raw processing. Once processing encodes gamma, you lose the ability to manipulate the data in the same manner as in the raw conversion. Wherever possible, you should expose a digital capture so that the usable range of the scene is as far to the right of the middle (in a histogram) as you can without risking blowing out your highlights. Underexposing and then trying to use the Exposure control to bring back details results in lighter images, but at the expense of wasted bits and at the risk of substantially increased noise in the middle and shadow tones.



Controls other than White Space on the Adjust tab

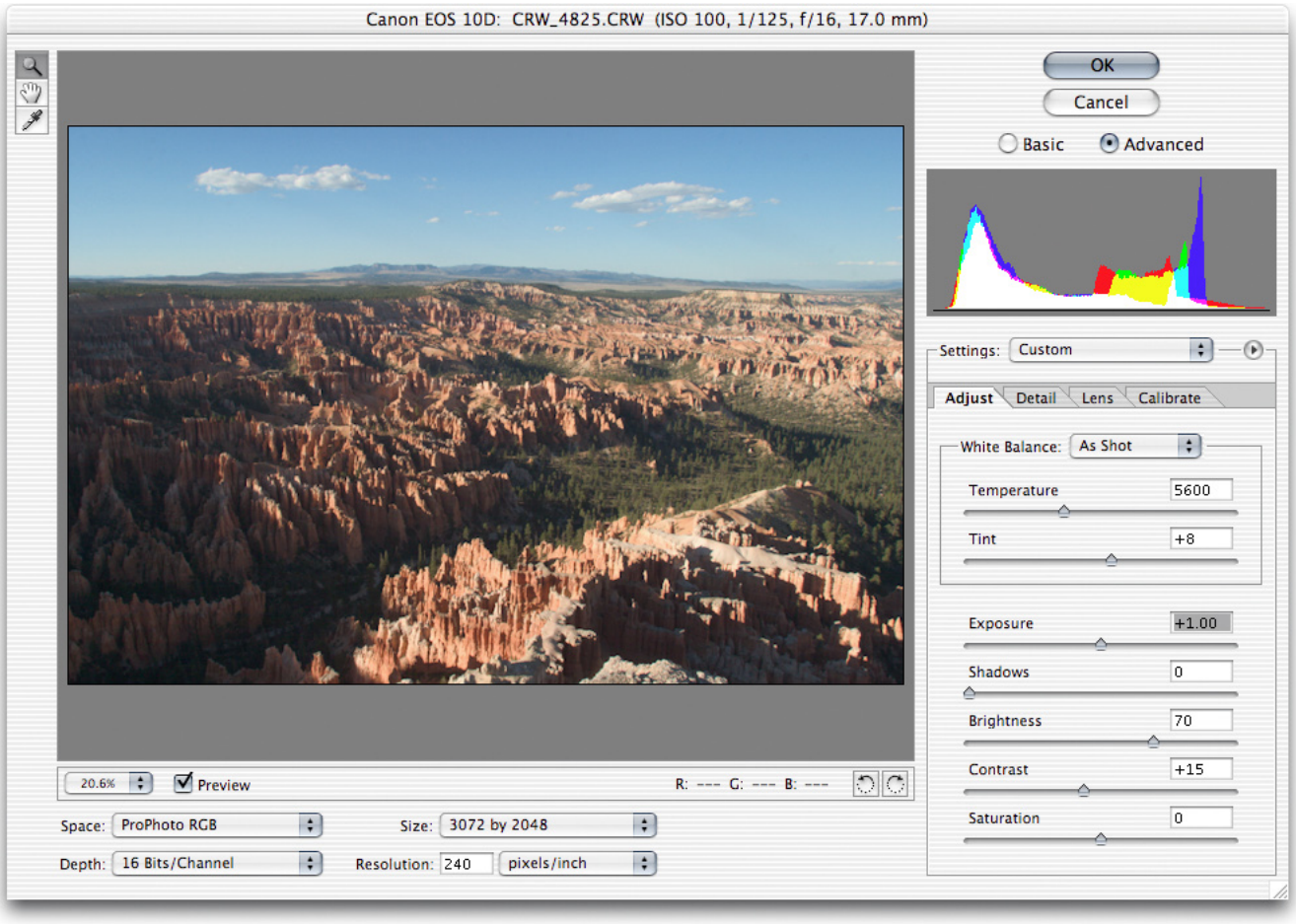
While the Camera Raw white balance and exposure adjustments simply cannot be duplicated in Photoshop, the remaining tone and color adjustments generally can. The Shadows adjustment is a black point clipping, just like the black point in the Photoshop Input Levels adjustment. The Brightness adjustment is like the middle slider (gamma) of Levels. The Contrast control in Camera Raw is a simplified *S* curve that you apply to increase or decrease contrast. On the curve graphs below, the curve on the left shows decreased contrast, while the curve on the right shows increased contrast.



Decreased contrast (left), Increased contrast (right)

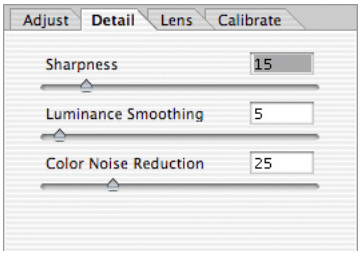
While some people may wish Camera Raw had a full curve function, there is little reason to duplicate the exact functionality of Photoshop in the raw conversion. A Camera Raw curve produces essentially the same results as a Photoshop curve; therefore only a simplified curve function is truly needed.

The Saturation adjustment is the same basic functionality available in the Photoshop Hue/Saturation adjustment, and there's no substantial difference whether you do it in Photoshop or Camera Raw. The only potential for difference is if you're converting from raw into an 8-bit/channel conversion. In that case, it becomes critical to do as many adjustments as possible in the raw conversion instead of making 8-bit adjustments after the conversion. However, Camera Raw is designed to complement the increased high-bit-depth functionality in Photoshop CS; its designers expect you to do the conversion in 16 bit and do any other adjustments after the fact in Photoshop, where you gain the added ability to localize the adjustments. This is the critical factor when you work in 16 bit. Because every control in Camera Raw is global by nature, you often need to use the local correction capability found in Photoshop—particularly with adjustment layers.



Additional tabs are available in Advanced mode of Camera Raw

To explore more adjustments, click the Advanced option at the top of the interface.



The Detail tab

In the Detail tab you can adjust the amount of sharpness, luminance smoothing, and color noise reduction that is applied during conversion. The sharpening is an edge-based sharpening that attempts to sharpen high-frequency detail while leaving low-frequency areas unsharpened. The drawback to sharpening in Camera Raw is that even though the sharpening is edge based, it's still applied globally. While the sharpening may help some areas, it may have unintended consequences for other areas. My personal preference is to apply little or no sharpening upon conversion but apply sharpening after the conversion, when I have local control over where its effects will be applied. However, the noise reduction in Camera Raw can be useful globally. When shooting at higher ISOs, some cameras produce color noise artifacts that Camera Raw can reduce. The Camera Raw preview does not preview changes made to the Detail tab controls in zooms below 100% for performance and screen accuracy reasons. To see the effect of any of your adjustments on the Detail tab, you must be at a zoom ratio of at least 100%. You shouldn't change Detail settings if you are at less than 100% because you simply won't see the results.

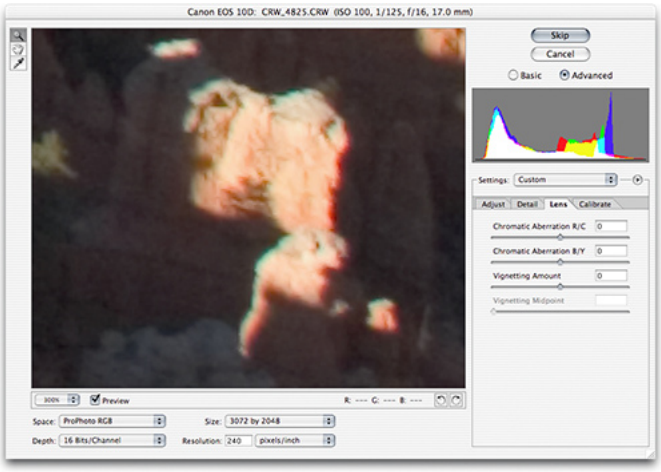
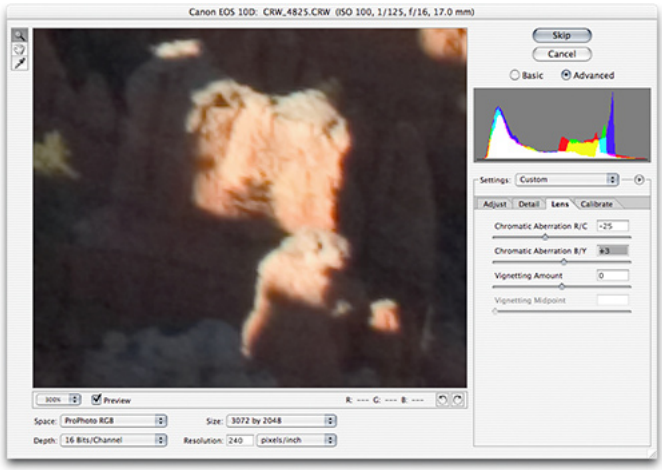


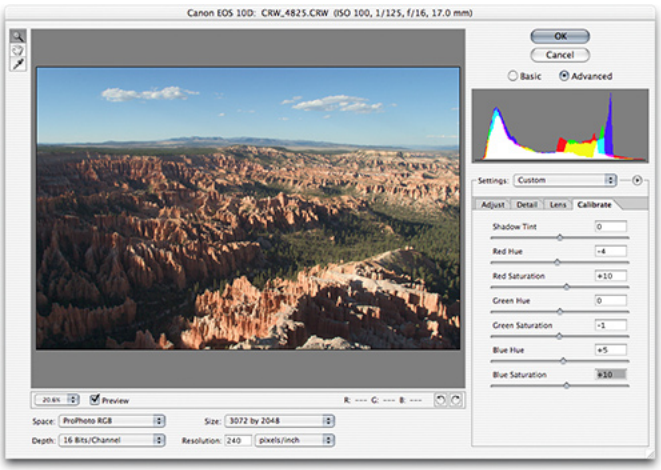
Image on the Lens tab without adjustments



Adjusting for incorrect color-sized channels

The next tab is the Lens adjustments. The Lens adjustments in Camera Raw can adjust only one type of chromatic aberration: the inability of a lens to focus colors of light at the same size. It can't do anything for a lens's inability to accurately focus colors of light at the same plane. On the Lens tab, the Chromatic Aberration R/C (red/cyan) and Chromatic Aberration B/Y (blue/yellow) sliders enable you to adjust for incorrect color-sized channels. The adjustment makes the red channel either slightly larger or smaller along a nonlinear adjustment. By adjusting for both the red and blue channels, you can remove color fringing caused by this lens defect. One tip is to hold the Option/Alt key to isolate that channel's fringing. I have found that all my lenses in the super-wide to medium-wide range produce chromatic aberration, and this adjustment does a remarkable job of helping the corner sharpness and removing the color fringing of images.

Also included in Camera Raw is the ability to adjust for some lenses' tendencies to have vignetting or dark corners. Particularly a problem with super-wide lenses, you can adjust a tone balance and the vignetting midpoint. Used carefully, you can do subtle correction or add a creative artificial corner darkening for effect.



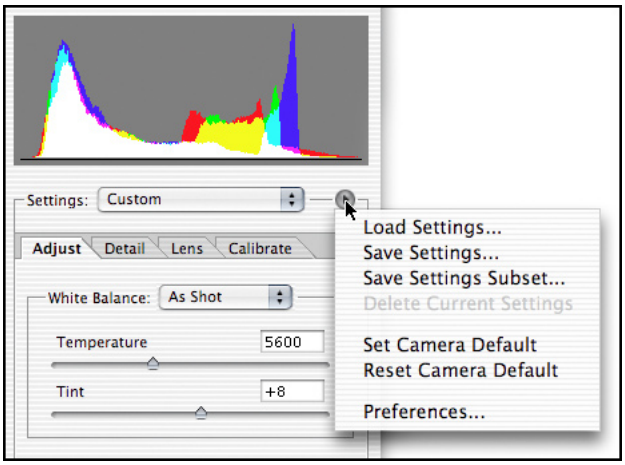
Adjusting saturation on the Calibrate tab

One issue in the original Camera Raw was the lack of the ability to use custom profiles for those cases where cameras didn't match the color mixing function of those tested by Adobe. Some cameras produce images that the original Camera Raw rendered with hue torque. To better understand this phenomenon, imagine a fire engine red. By adjusting the hue of the red, you can make it more yellow or more magenta. Making it more magenta produces a cooler red, while moving toward yellow makes it hotter. In the original Camera Raw, if a camera's sensor had a hue bias, there wasn't anything you could do about it in the raw conversion. You could do a Hue/Saturation adjustment after the fact in Photoshop, but that was less optimal.

In the CS version of Camera Raw, you can control not only the hue but also the saturation of red, green, and blue on the Calibrate tab. So, if your camera consistently renders red as too cherry, you can render it with a more yellow bias. Additionally, some cameras produce captures whose deep shadow areas have a slight tint—even when all other colors are correct. The Shadow Tint adjustment (basically a black point color adjustment) enables you to adjust for a warm or cool cast to the shadows and to cause deep shadows to be more neutral. One caution: The Calibrate controls are not intended to compensate for an incorrect white balance. They are intended to fine-tune the hues of the colors your camera captures and produces through Camera Raw. (Of course, you can experiment with the sliders for creative effects.) Additionally, the Calibrate controls are not the same as the Photoshop Hue/Saturation adjustment, so it's optimal to make these adjustments in Camera Raw.

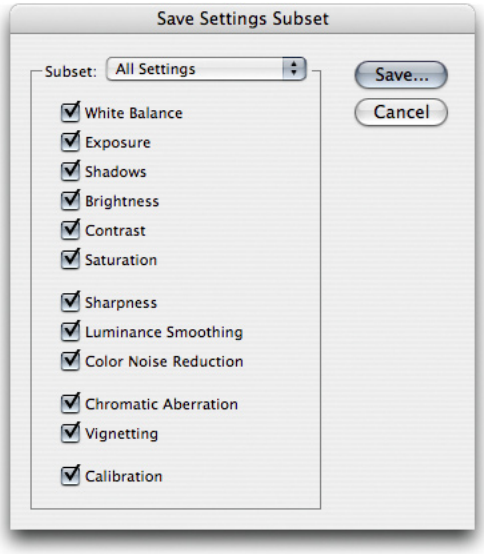
If you wish to use the Calibrate function more accurately and employ a GretagMacbeth Color Checker, I suggest visiting Bruce Lindbloom's website (http://www.brucelindbloom.com). The site has Color Checker readouts for a variety of RGB color spaces, including all of the color spaces included in Camera Raw. You can use the reference numbers to better tune the color rendering of the various patches, and you can achieve an even higher degree of accuracy by using the Eyedropper tool to check the patch colors. Note that the only way to use the numbers is when you have an absolutely perfect white-balanced image with absolutely minimal exposure, shadow, brightness, contrast, or saturation corrections. The shot of the Color Checker must be perfectly lit so that no anomalies occur regarding fall-off of light. It can be a useful exercise to accurately adjust your color rendering. On the other hand, it can also be frustrating to try to achieve perfection because you never will. The lens you shoot with, the lighting color, and the sensor you use will, in all likelihood, have a color mixing function that precludes exact duplication of the numbers that result in measuring the color patches with a spectrophotometer. Because of metamerism, the colors of the patches may not be reproducible to a precise degree with your camera. This same limitation is apparent when you try to make accurate color profiles of digital cameras and is what led to the scheme for making raw conversions in Camera Raw. The design is intended for visual adjustment, not adjustments based on numbers or values.

You may need to make these adjustments on a camera-by-camera basis and fine-tune them when you change ISO. As you might expect, this work would be difficult if you had to repeat it every time you set up to process a series of shots. This issue leads to another critical aspect of efficient use of Camera Raw—saving custom settings.



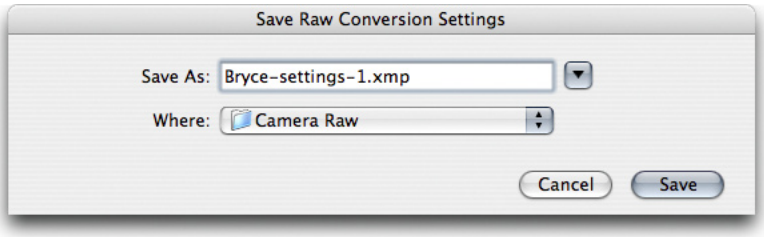
Commands for saving settings

If you haven't explored the ability to create custom settings in Camera Raw, I suggest you do so. It will reduce the amount of time you spend trying to correct images. When you go through all of the Camera Raw options, you can choose to save those corrections in a named Camera Raw XMP metadata file and have it appear in the settings pop-up menu for easy retrieval. If you choose Save Settings, all the current settings are locked together in the custom settings file.



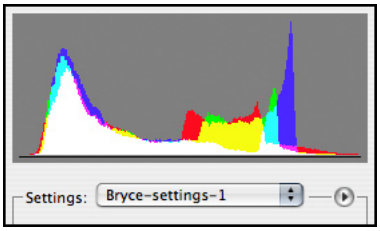
Save Settings Subset dialog box

However, based on the needs of your workflow, you may wish to choose Save Settings Subset to save only some of the settings that Camera Raw uses. Suppose, for example, that on one particular lens, you know you'll always want to use a Chromatic Aberration adjustment. You could save that setting and choose it from the pop-up menu. You would then be free to adjust all the other settings and know that a Chromatic Aberration adjustment will always be applied at a certain level. Alternatively, if you're shooting in a studio where the color of light is consistent and reproducible, you may wish to spend the time creating a setting that produces optimum white balance and hue corrections in Calibrate. In that case, you would select only the White Balance and Calibration options.



Saving conversion settings

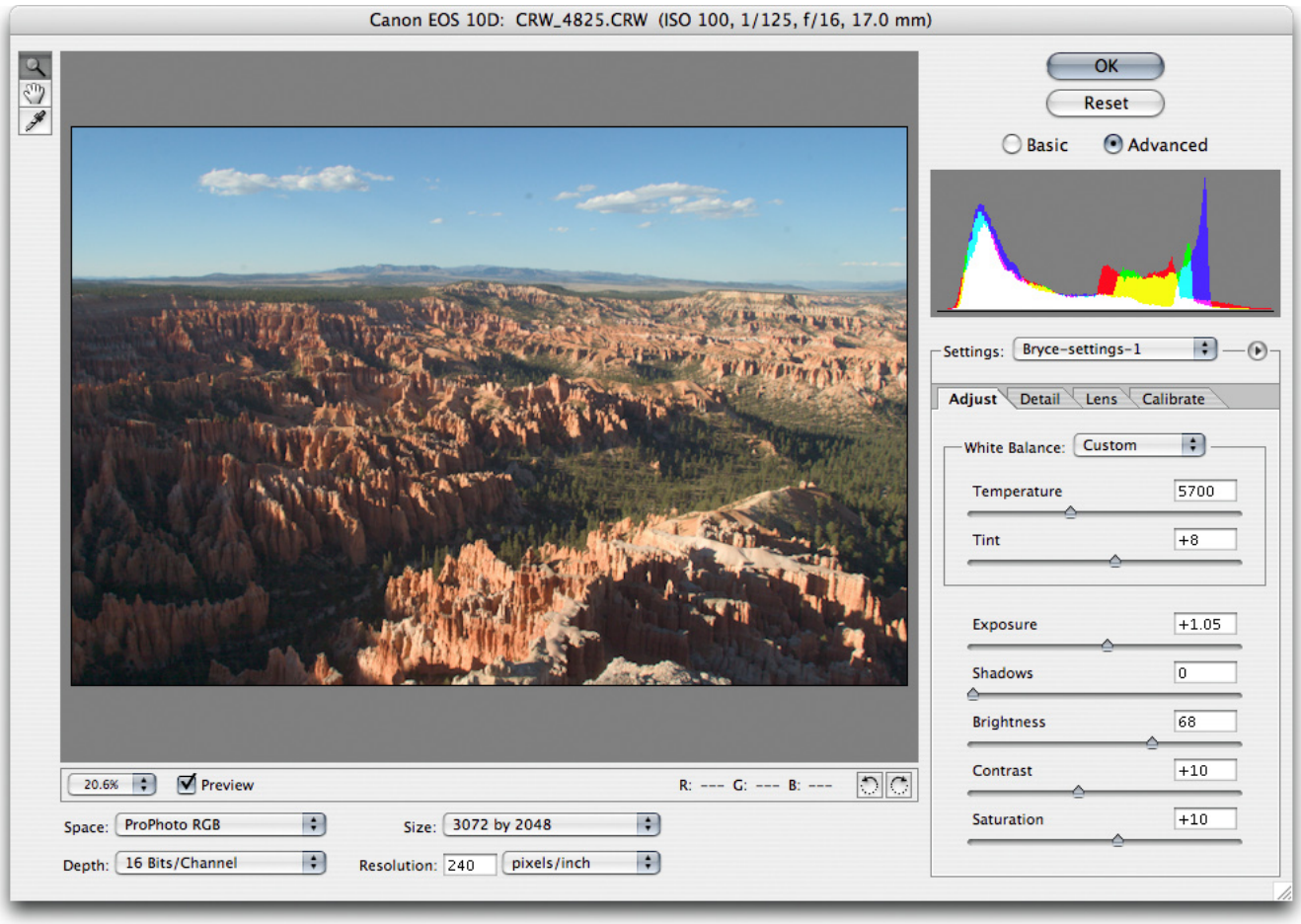
In this manner, you can create a variety of your own saved settings and do your corrections in Camera Raw by simply selecting a saved setting and doing minor adjustments for things such as exposure or contrast.



Menu where you select saved settings

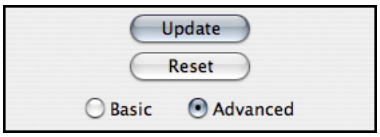
By spending a little upfront time organizing, you can easily create a variety of custom settings that are fine-tuned to your shooting or processing style and that produce exacting and reproducible results. That is time well spent if your shooting often falls into repeatable situations.

Also remember that even with the custom settings, you're always free to adjust the images as needed. Saving a custom setting doesn't lock you into anything. It only simplifies getting to a consistent point in the Camera Raw settings.

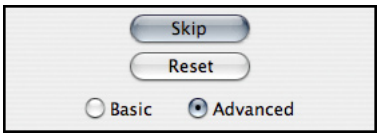


Preview image with saved settings

After you spend the time adjusting all the parameters, you may be ready to process. If you are working on a single image, go ahead and click the OK button to allow Camera Raw to process the image and open it in Photoshop. However, if you are in the middle of editing multiple images, many of which have similar or exactly the same Camera Raw setting requirements, don't click OK. In this case, update those settings into the Camera Raw metadata for that image and then use those settings to apply to other images. Hold down the Option (Alt key on Windows®) and the OK button turns into an Update button that closes the Camera Raw dialog box without processing but adds the Camera Raw settings to the image's metadata. In this way, you can quickly go through a large number of images to adjust the Camera Raw settings and delay the actual raw processing to a later stage in your workflow.

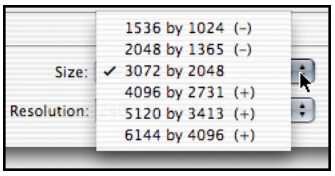


Holding Option (Alt on Windows) turns the OK button into an Update button.



Holding Shift turns the OK button into a Skip button.

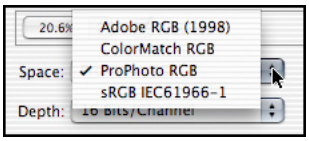
Another option, in the event that you selected a variety of images in the File Browser to open, is to simply skip the current image. Holding down the Shift key changes the OK button to Skip, which closes the current image and opens the next selected image in Camera Raw. Using this option, you can quickly edit the settings for a series of images or choose which images to adjust and which to simply close. This paper discusses more workflow strategies in the "Part Four: Simple Batching" section, but even this simple series of key commands can help ease the burden of raw processing.



Choosing the Size

There are two other processing options in Camera Raw worth serious discussion: the Size and Color Space options. A lot has been discussed in various web forums and e-mail lists about how to up-sample digital captures. Some people spend money to get third-party solutions, while others resort to some exotic routines in Photoshop to up-sample what amounts to small digital capture files for large reproductions or prints. One concept was Step Interpolation. Instead of using the Image Size command in Photoshop to do a single-stage up-sample, you incorporated a series of multiple 110% Bicubic Image Size passes. Many people were surprised that, in the case of digital captures, multiple passes produced smoother and better up-sampled images than a single pass of Image Size. In effect, Bicubic used two (Bi) series of four pixels (cubic) to sample in determining how to add interpolated pixels. By increasing the number of times and at a much lower amount, it effectively increased the sampling for interpolation.

The Photoshop engineers started experimenting with a variety of up-sample algorithms. Using the raw processing in the up-sample scheme, the engineers devised a highly effective up-sample capability in Camera Raw. In my opinion (and after a lot of testing), it's the best method available for up-sampling digital captures. It is somewhat limited. Because the up-sample is tied to the original pixel dimension of the capture, the algorithm produces only a few fixed up-sample sizes. However, if the need is to maximize the usability of final output size and resolution, Camera Raw is the best method available at this time. Even the new algorithms in the Image Size options (Bicubic Smoother) in Photoshop CS don't do quite the same. However, Photoshop and other routines may offer more flexibility to create an exact-sized file; Camera Raw is limited to fixed sizes. But you should test the results with your own camera and see how far your captures can be pushed.



Choosing a color space

Another function of Camera Raw is to specify the color space to which you convert. The color spaces are limited to only working space profiles, which are guaranteed to be gray balanced—meaning that equal amounts of red, green, and blue will be neutral. This limit has caused some controversy, as Camera Raw can't use custom camera profiles and is limited to only those color spaces available in Camera Raw. Some people see this as a severe limitation, while others see this as a designed simplicity. I think it makes a great deal of sense. Custom profiles can offer truly accurate results only when the condition under which the profiles were made are used when shooting. Any variability introduces inaccuracies—some slight and some not so slight. A digital sensor alone can't be profiled. Only a combination of the response of the sensor, the lighting and exposure, and the raw processing can be truly profiled. If any of the variables change, the profile becomes less relevant.

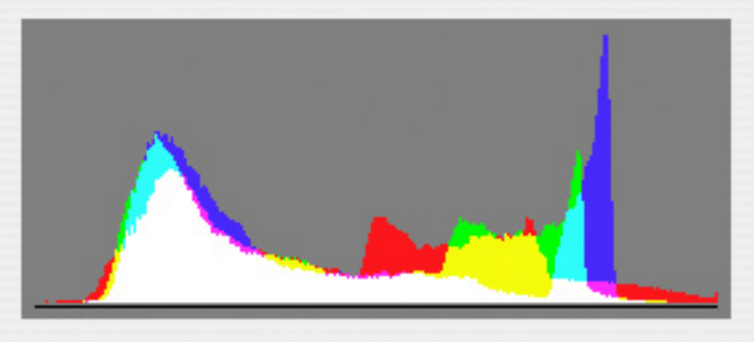
There are some legitimate situations where it does make sense to do a custom profile. Doing a copy shot of artwork under controlled (repeatable) conditions lends itself to produce more accurate results—if a profile can be accurately made. A studio photographer shooting under consistent electronic flash could also benefit. However, a one-size-fits-all approach to profiling a camera will lead to situations where the profile becomes less useful the more you depart from the conditions that prevailed when you made the profile.

I understand that this is a controversial issue. My opinion has been formed over a couple of years working with digital files and from my own experience of frustration over trying to make accurate camera profiles. However, the choice of which color space to process your images into with Camera Raw is still a critical decision and should be based on user tests for optimum results. The following screen shots are sample histograms of the image in the previous Camera Raw dialog boxes in different color spaces. They go from top to bottom in the same order listed in the Camera Raw pull-down menu.

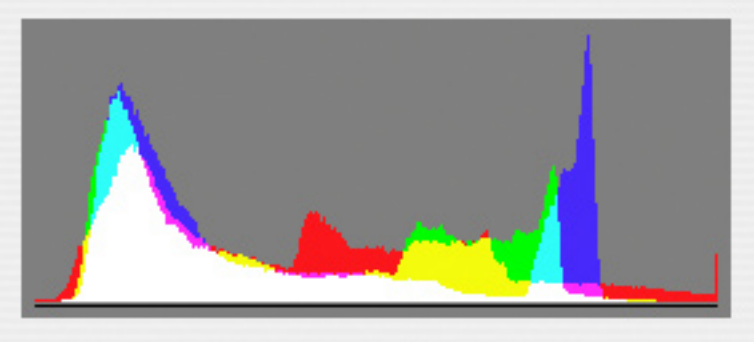
At the top is Adobe RGB.

The next one is ColorMatch RGB. Originally based on the Radius PressView monitors, ColorMatch RGB is a choice often used by people who have a lot of legacy images. Second from the bottom is ProPhoto RGB. Originally designed by Kodak (and called ROMM RGB), ProPhoto RGB is the largest space available in Camera Raw.

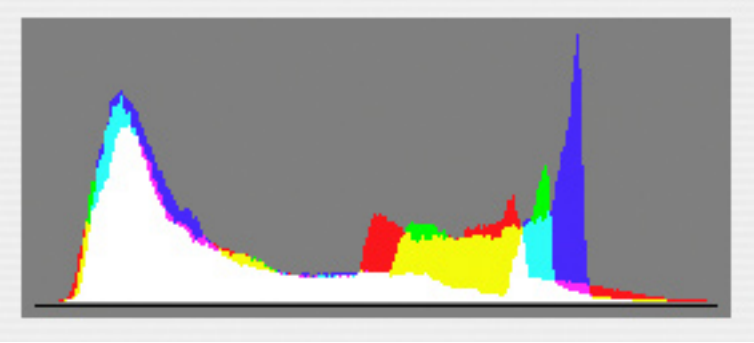
The bottom color space is sRGB.



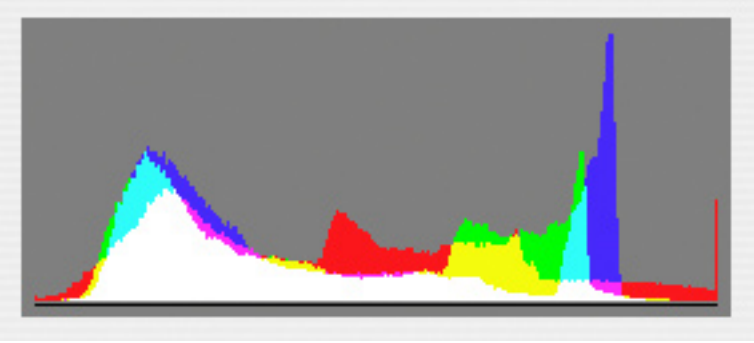
A histogram of the Bryce image, as rendered in the Adobe RGB color space



A histogram of the Bryce image, as rendered in the ColorMatch RGB color space



A histogram of the Bryce image, as rendered in the ProPhoto RGB color space



A histogram of the Bryce image, as rendered in the sRGB color space

Look at the histograms. All the color spaces, except ProPhoto RGB, show channel clipping in the red channel. This means that if you process from raw by using any of the spaces other than ProPhoto RGB, you will lose some data that the sensor captured but that will be clipped upon conversion. Even Adobe RGB clips, although the amount of clipping is slight.

For this reason, I often choose to process from raw into ProPhoto RGB. For those cases where I need to do image combinations with images from other sources, I may need to drop the color space down to Adobe RGB or ColorMatch RGB. However, I still have the flexibility to work in ProPhoto RGB to use as much data that all the channels have for manipulation of color and tone and then convert down into a smaller space.

To see the relative sizes of Adobe RGB and ProPhoto RGB, examine the following screen shots. The images are *gamut maps* produced in a program called ColorThink and are available from Chromix (http://www.chromix.com). On the left is a gamut map of Adobe RGB, and in the middle is ProPhoto RGB. By comparison, ProPhoto RGB is huge. With both gamuts showing (right figure), all of Adobe RGB easily fits within ProPhoto RGB. You can be assured that ProPhoto RGB is a color space container that will hold all of your sensor data. Again, this is a viable option only when you're converting from raw to 16-bit images. The size of ProPhoto RGB is likely to produce banding if any post-conversion processing in Photoshop is done in 8 bits per channel.

Jeff Schewe
Jeff, a summa cum laude graduate of Rochester Institute of Technology, has been an advertising photographer in Chicago for over 25 years. He has been doing digital imaging for over 14 years and is widely known and respected in the digital imaging community as a leading pioneer in the field. Jeff is a feature consultant and alpha tester for Adobe Photoshop.

Adobe RGB gamut map, ProPhoto RGB gamut map, and a comparison of gamuts for both color spaces

The final image processed from Camera Raw is shown below.

Processed image

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