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Sharpening and Noise Reduction in Adobe Photoshop

One of the limitations of digital capture devices and digital chips is that the resulting images lack critical sharpness. We need to sharpen for several reasons, each of which imposes its own demands.

Whenever we turn photons into pixels, we lose some sharpness, because no matter how high the resolution of our capture devices, they sample a fixed grid of pixels, turning the continuous gradations of tone and color that exist in the real world into discrete pixels. When we turn pixels into halftone dots or stochastic dithers of inks, or even into continuous-tone dots on dye-sublimation printers or film recorders, we lose sharpness again. So our output devices also introduce some softness.

Sharpening can be a creative tool. Sometimes we want to make the image sharper than it really was, to tell a story, make a point, or emphasize an area of interest.

We need to apply sharpening to counteract the softness introduced by both capture and output, and to satisfy our creative goals.

Remember. Sharpening an image is sharpening the pixels. An extremely out-of-focus or blurred image cannot be made sharp in Photoshop. An image that is slightly blurred from camera motion or slightly out-of-focus can be helped with the sharpening tools in Photoshop. But all images made with digital capture chips generally need some degree of sharpening.

1. Sharpening is typically done in a two-pass approach, generally referred to as *input* sharpening and *output* sharpening.

Input sharpening is only relevant when you photograph in Camera RAW. Most in-

camera jpg algorithms add varying degrees of sharpness. It is only when sharpness is not added in the camera, as in the Camera RAW format where you need to add input sharpening.

To add input sharpening, go to the Detail panel on Adobe Camera RAW (page 3).

The default settings are:
Amount = 25
Radius=1.0
Detail=25
Maskin = 0

For high-quality lenses, such as Canon L series, use the default settings.
For lower quality, and kit lenses, use an amount of 50.

These settings should suffice for input sharpening, where the intent is merely to sharpen the pixels prior to image editing. The primary sharpening step takes place in the second step, the output sharpening pass.

Output Sharpening is the final step in the digital imaging workflow. Image editing controls, as well as other manipulations such as resizing, can affect the image sharpness. Therefore, sharpening is done AFTER all editing changes are made, including color and tonal correction, retouching, and resizing for print or web.

Methods of Output Sharpening

Output sharpening is designed to provide the illusion of greater sharpness by increasing the contrast of the pixels along the edges in your image. Pixels that differ in tonality and color are considered edges.

The primary sharpening tool is Filter>Sharpen>Unsharp Mask.

Sharpening is inherently destructive, which means that it cannot be undone or changed once applied. To apply sharpening in a manner that is dynamic, that can be adjusted over time, use a Smart Filter.

To Sharpen: You should sharpen on your background copy layer. Select the

background copy layer and go to the main Photoshop menu: Filter>Convert for Smart Filter. By sharpening on a smart filter, it is dynamic, which means that, similar to an adjustment layer, you can go back and change or refine the sharpening at any time. After converting for Smart Filters, Go to the main Photoshop menu filter>sharpen>unsharp mask.
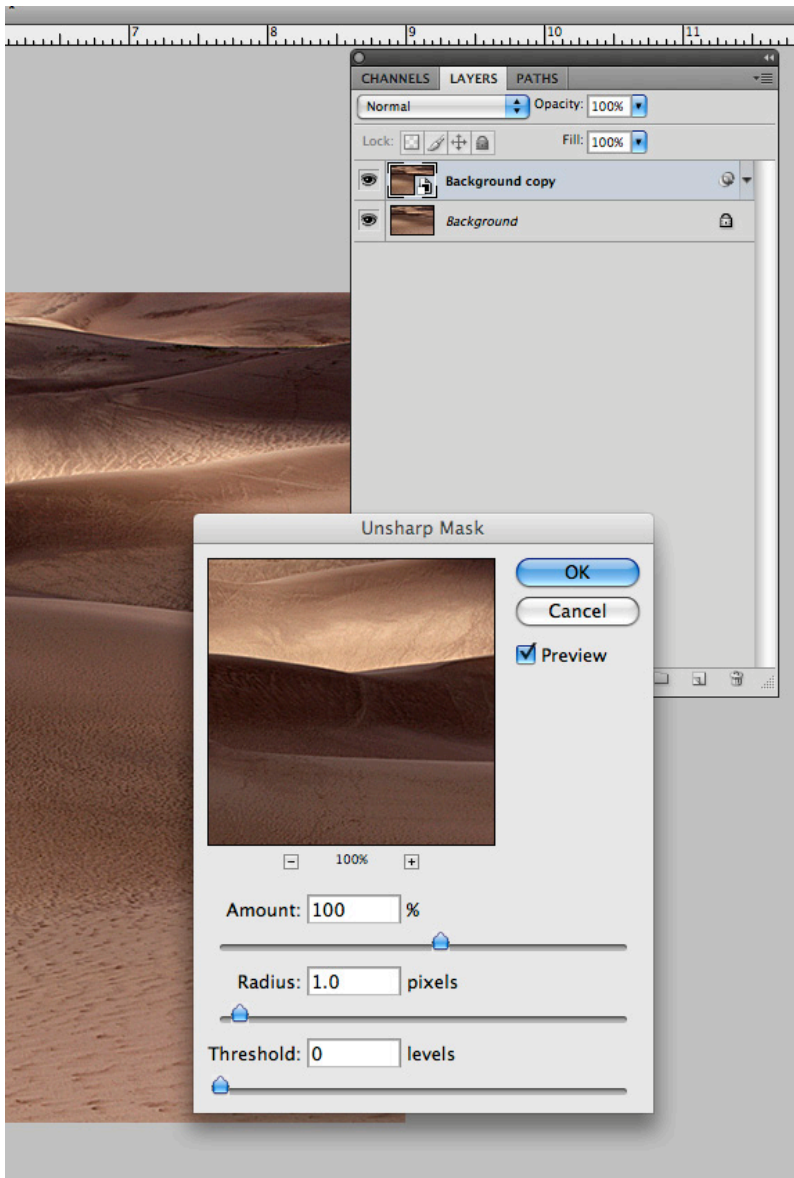
You'll see a dialogue box with three controls: Amount, Radius, and Threshold.

Amount is the degree of sharpening. **Radius** is the number of pixels on a contrast edge that will be sharpened **Threshold** is the degree of contrast between pixels that consitute a "sharpenable" edge.

Each image demands its own solution based on the lens used, the degree of sharpness desired, the final output, and the need to enhance or suppress certain details.

The following principles can be used:

1. The amount of sharpness necessary is proportional to the file size. Images with more pixels will require greater sharpening amounts than small files with fewer pixels.

2. The amount slider can be adjusted in large number increments. The radius slider is extremely sensitive. Generally, a low radius of .5 - 1.5 pixels will work for most images. Some photographers prefer to set the radius slider consistently at .08-1.5 and use the amount slider to control sharpening. Others—taking a more aggressive approach—prefer to set the amount consistently to 300% and use the radius slider responsively to control sharpening. Either way, you want to sharpen below the point where halos around edges or posterization, giving a "crunchy" look, is introduced.

3. For "high frequency" images (many jumps in subtle tonal values over a small area; many subtle details), use a lower radius to reduce haloes and the oversharpened affect. For "low frequency" images (fewer subtle details, broad areas of tonal and color differences), you can use a higher radius setting to maximize sharpness.

Low frequency   High Frequency

4. For landscapes or urbanscapes, where you want everything sharpened equally, use a low threshold setting (0-3). This means that any degree of a color or tonal edge is considered an edge to be sharpened. For portraits, or areas where you want to suppress fine details such as blemishes and wrinkles, use a higher threshold setting (3-12). This means that fine edges and very subtle degrees of contrast will be "masked" from sharpening.

For most images, you can safely use an amount of 75-1150%, a radius of .08-2, and a threshold of 1-4. The higher the resolution of the image, the greater your sharpening needs to be. For higher resolution images, use greater numbers on the controls.

Many photographers have their own favorite methods and formulas for sharpening. Experiment and find what works for you. My own preference is to under-sharpen rather

than over sharpen. I usually begin at an amount of 100% - 150% and a Radius setting of .75-1.2. Too much sharpening creates a "posterized" effect and reduces the subtleties of tonal gradation and color relationships in the image.

Smart Sharpen Filter

Smart Sharpen was introduced in Photoshop CS2. It functions similarly to Unsharp Mask, but has additional functionality. It allows you to select the type of blur that you wish to sharpen—gaussian blur (standard pixel blur; the default for the unsharp mask filter), lens blur, or motion blur. This is useful for lenses that are not of the highest quality, or if there is subtle motion blur. Note: it cannot sharpen extreme motion blur or out-of-focus images. Smart sharpen is effectively used with the lens blur setting for most images. It allows slightly greater sharpening than the Unsharp Mask filter before haloes are introduced.

Again, create a Smart Filter layer on your background copy. Access Smart Sharpen through Filter>Sharpen>Smart Sharpen.

Use the Amount and Radius sliders similar to Unsharp Mask. It does not have a Threshold slider.
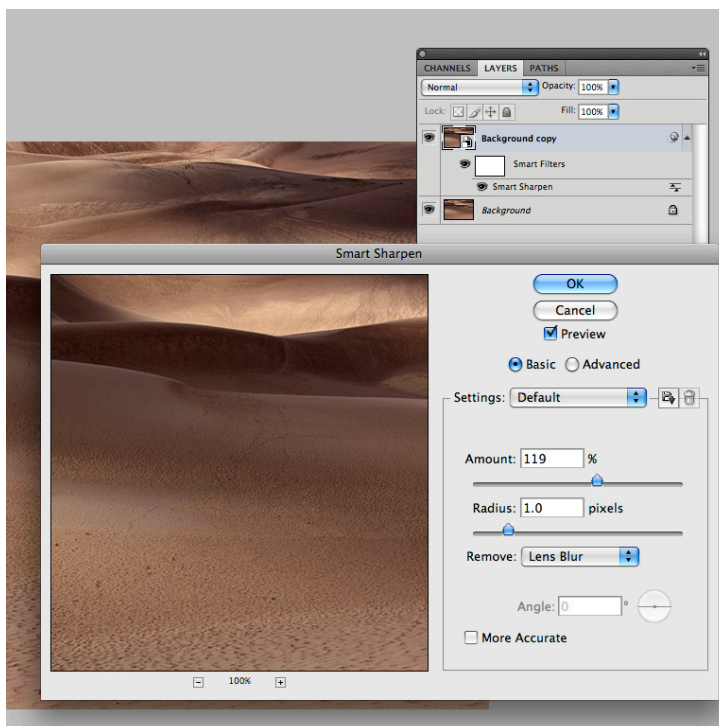
The *huge* advantage of Smart Sharpen is found by clicking on the **Advanced tab.** This allows you to control sharpening separately for the shadows and the highlights.

The Fade command can be moved forward, to a higher number, thereby reducing the sharpening in either the shadows or the highlights. Sometimes, with a desired degree of sharpening for the entire image, you will find

5

too much edge contrast in either the shadows or the highlights due to the sharpening, and this can be controlled with Smart Sharpen.

Ever since its introduction in PS CS2, controversy abounds about which tool is preferable and more powerful, Unsharp Mask or Smart Sharpen. The fact is, they are slightly different and one may be more suitable for one image, the other more suitable for another image. The key is to experiment and find what works for you and your work.

The High Pass Filter

A popular sharpening method, the high pass filter, has the advantage of using an edge mask to affect sharpening. Many images, exposed with long shutter speeds or in low light, contain digital noise which is further amplified by traditional sharpening methods. The high pass filter is an aggressive sharpening method, that can achieve varying degrees of optical sharpness and that does not enhance noise, due to the edge mask, but merely sharpens the edges within an image.

To use High Pass sharpening.

Create a duplicate of the background layer and convert to Smart Filters. Change the layer blending mode to Overlay. This will increase the contrast, but is temporary until you run the High Pass filter.

With this Background copy layer highlighted select Filter>Other>High Pass. Set the Radius to 3-10, depending on the sharpness desired and click OK. It is best to sharpen just a little more than desired. The next step is where the final refinement takes place.

To refine your sharpening, go to the Opacity Slider of the layer palette and lower the layer opacity. Lowering the layer opacity will reduce the amount of sharpening until you find a level that works for your image

Noise Reduction in Adobe Camera RAW 6

One of the consistent limitations of digital chips is the introduction of digital noise in low light situations, with underexposure, and with higher ISO's. The native of ISO of

most digital sensor chips is 100. With in-camera settings, it can be pushed, often up to ISO 1600. When using ISO speeds of 400 or greater, some digital noise is introduced, growing proportionally higher as the ISO is increased. Certain camera models are better, some worse, in terms of the introduction of noise.

There are two types of digital noise: color noise and luminance noise. Color noise takes place in the color channels and results in red, blue, and green "speckled" pixels. Luminance noise takes place in the tonal channel and results in grain-like monochromatic specks. Luminance noise is usually less objectionable than color noise.

All noise reduction algorithms work by softening the pixels. The challenge is to get rid of the noise, while preserving the sharpess and details. The Camera RAW 6 tool palette, if used sensitively, does a remarkable job at removing noise, both color and luminance, without losing essential sharpness. NOTE: The powerful noise reduction algorithm is new in Adobve Camera RAW 6 and Adobe Lightroom 3. These are the only software versions that contain this new feature. Older verions are not nearly as effective.

To use Adobe Camera RAW Noise Reduction, you will find the Noise Reduction sliders located in the Detail panel, the third panel from left to right.
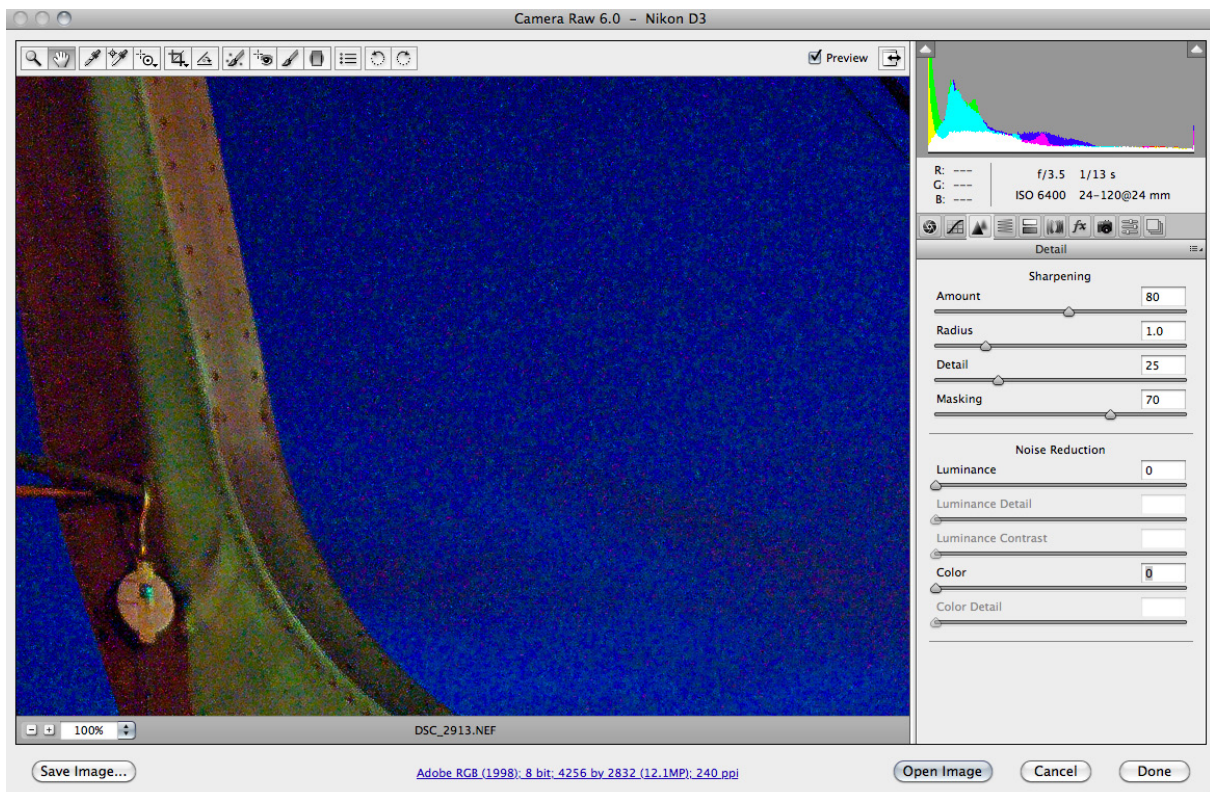
The first thing I like to do is zoom in to 100% and then adjust my image sharpening by using the Amount slider and then using the Masking slider to apply the sharpening to just the edges, in this case at unit #70.

Then I start getting rid of the noise by first removing any color noise. There is a default amount set for color of 25 and I find that it works pretty well but I still like to move the Color slider to zero and then back to a higher number just to make sure that the color noise is gone. This adjustment works great but the real culprit in most images is usually from luminance noise.

So logically that's the next step and really where the magic happens. The easiest way to set the luminance is to just move the Luminance slider to the right until all the noise is gone. When it looks good, stop. It's really that easy. The one thing you might find is that the noise reduction has softened some of the details a little but you can bring those back pretty well by using the Luminance Detail slider. You can also increase the Luminance Contrast slider setting to add a little snap back to the image.

Remember, noise reduction and sharpness work at cross-purposes. Removing noise will always reduce some subtle detail and sharpness. It is a balancing act between the Luminance slider to reduce the noise, the detail slider to bring back some of the lost detail due to the noise reduction, and the contrast slider to further enhance the details. I try to move the luminance and color sliders JUST to the point where the noise is reduced to avoid the loss of detail. Moving the detail slider may necessitate going back to the luminance slider and the sharpness slider in the upper part of the box, until you find the right balance.

This is the first time that Photoshop (and Lightroom) has implemented powerful noise reduction features. Many photographers, myself included, used third-party noise reduction software in the past. No longer. ACR 6 and Lightroom 3, I believe, represent the most powerful noise reductions algorithms on the market.