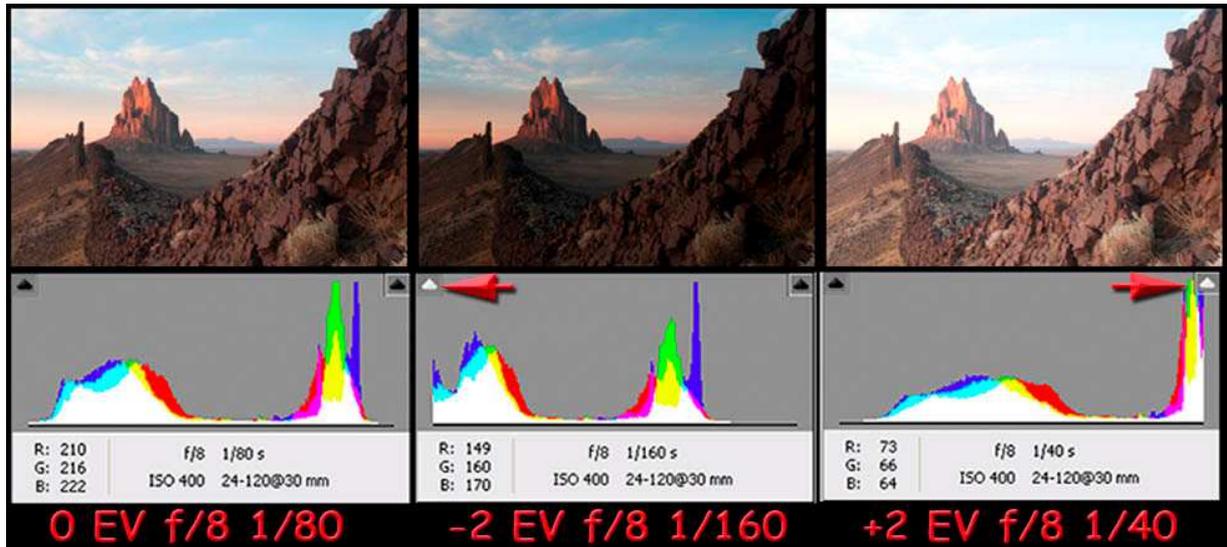# Histograms and Tone Curves

We present an overview to explain Digital photography essentials behind Histograms, Tone Curves, and a powerful new slider feature called the TAT tool (Targeted Assessment Tool) in Lightroom.

Digital HDR photography in a visual nutshell! OK, we can go home now…
But, not before we understand **every** implication in these six images. Gotcha!

Image thumbnails are actual raw captures of Ship Rock. The proper Adobe Camera Raw Histogram occurs beneath each thumbnail.

Let's consider the first Histogram for 0 EV shot. Zero EV represents a manual shot with aperture f/8 and shutter speed 1/80th second.

First, let's note; two triangles at upper left and right part of the Histogram are black. This means our manual capture pretty well set a black point and was slightly below a white point. To define the black point, note, the white portion of the Histogram goes all the way to left edge of horizontal axis, but does not rise vertically. To nearly define the white point, there's perhaps 1/8" without data near the right edge. This is a well-balanced Histogram.

If we underexposed our shot, we might have -2 EV. You promptly note that pesky little flippy triangle on the left - turning white. This means all shadows channels are blown. That's digital lingo for you don't have any information in the shadows in this image.

Exposure Value

Exposure Value (EV) denotes all combinations of a camera's shutter speed and relative aperture that give the same exposure. EV 0 corresponds to an exposure time of 1 s and a relative aperture of f/1.0. 1 EV corresponds to a standard power-of 2 exposure step, commonly called a stop. Each increment of 1 in exposure value corresponds to a change of one "step" (or, more commonly, one "stop") in exposure, i.e., half as much exposure, either by halving exposure *time* or halving *aperture* area, or a combination of both.

If we overexposed, we might have +2 EV. Here, the little triangle on the right is white. All channels are blown for the highlights. Sadly, you're missing subtle changes in the highlights - a very *serious* no-no.
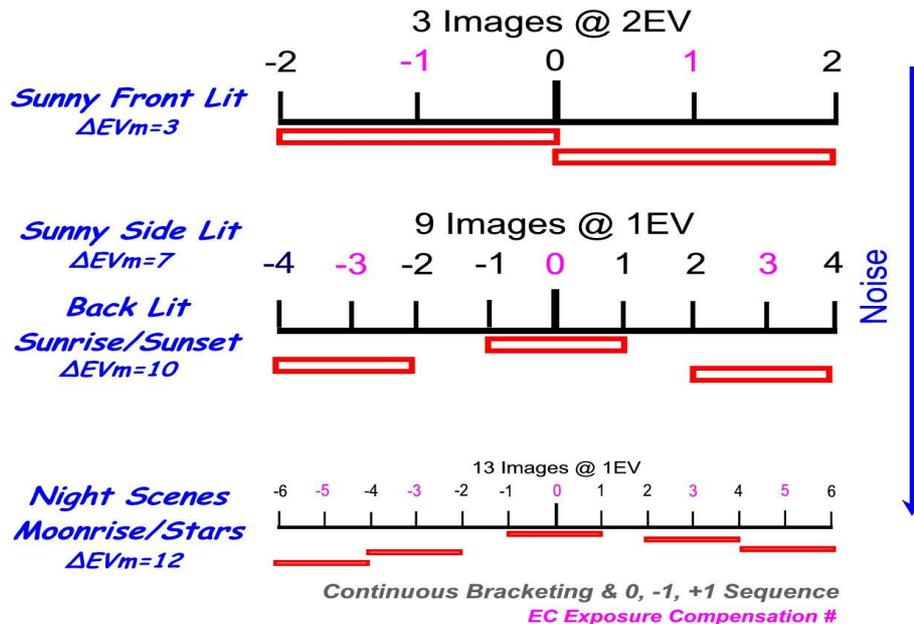
Visual EV Scales

Ferrell McCollough provided an interesting way to visualize an EV scale. Daylight may have an EV range of 3; night may have an EV range of 12. Shooting inside may get to an EV range of 14 when you consider exterior lights.


©McCollough
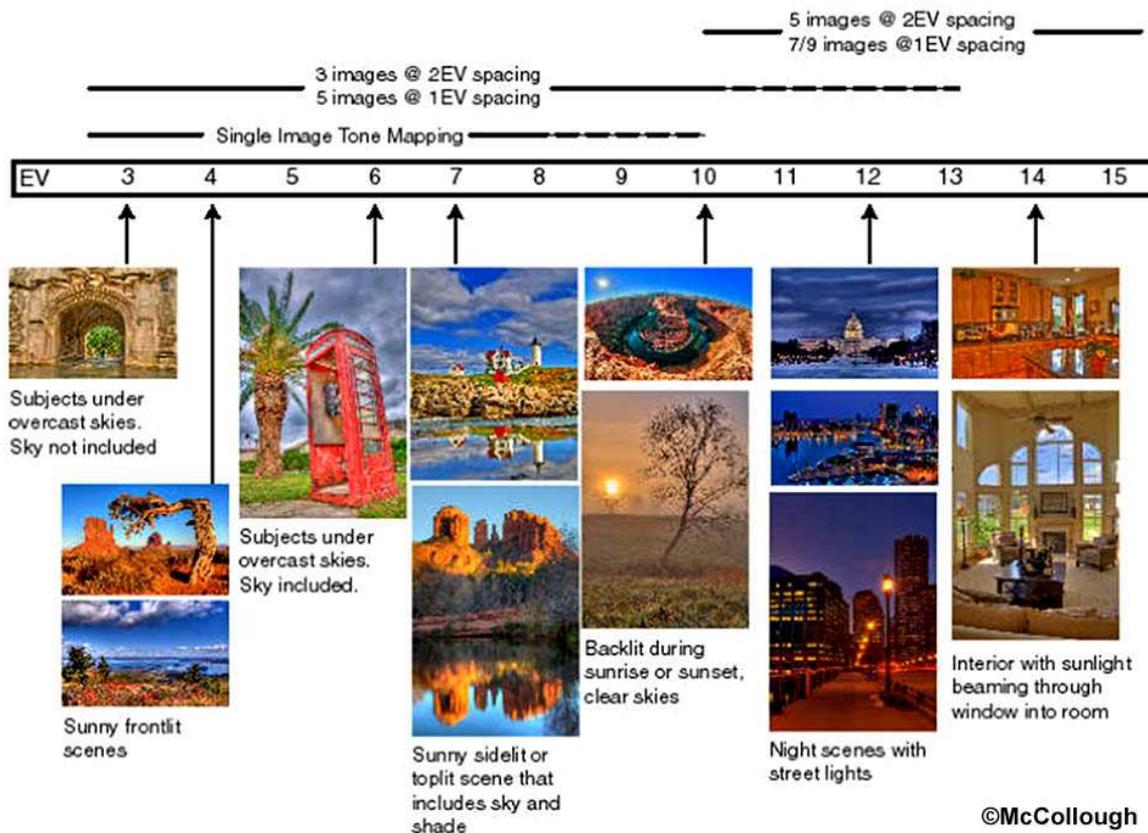
Increased Noise Range

As you increase the contrast between light and dark, noise increases. This change in contrast, lightness, and darkness is called tonality.

3 Images @ 2EV

Sunny Front Lit ΔEVm=3

9 Images @ 1EV

Sunny Side Lit ΔEVm=7

Back Lit Sunrise/Sunset ΔEVm=10

13 Images @ 1EV

Night Scenes Moonrise/Stars ΔEVm=12

Continuous Bracketing & 0, -1, +1 Sequence
EC Exposure Compensation #

Essentially, Magic Hour and Night Scenes contain lots of noise. Fortunately, Lightroom contains an advanced Noise Reduction algorithm. One usually reduces or eliminates noise before performing other standard workflow steps to go. We'll touch on Noise Reduction in *Class # 2 - From Raw File to Fine Art Image*.

Linear Sensors in Digital Cameras
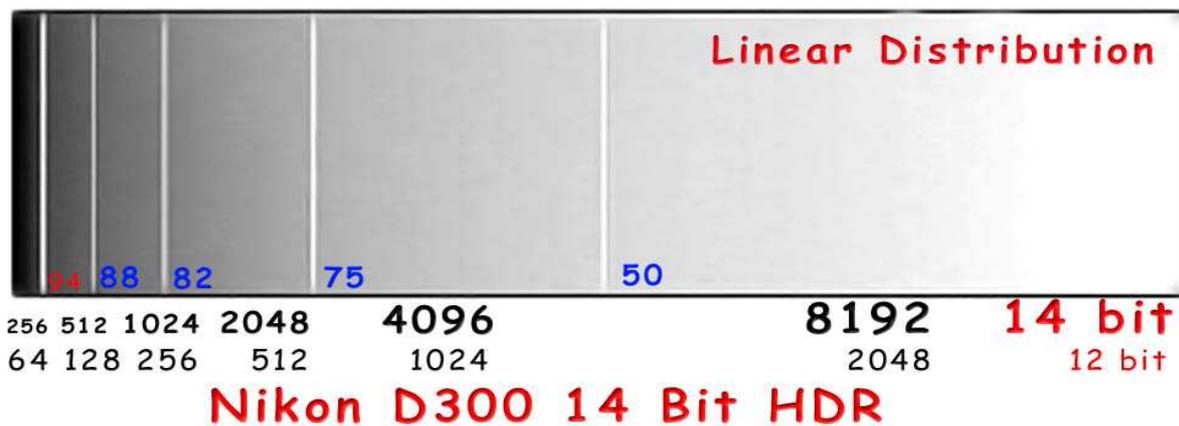
In a 12 bit capture, half the light occurs in the upper range of a linear sensor.

3

In other words, 2048 of 4096 bits are in the sensor's upper half. In Lightroom terms, these are lights and highlights in the image.

Some Nikon's and most Canon's shoot in 14 bits. With 14 bits, the sensor can accommodate 16,400 bits per pixel for a much wider range of color.

How Does All This Gobbledygook Relate to Our Human Eye?

For starters, our eyes see things in a nonlinear fashion. They are not restricted to linear vision. Hence, the camera is only a crude estimate to the often startling combination of eye and brain for creating a fantastic memory!

On this diagram, we see a Linear Raw Sensor (Raw) and a Gamma Corrected Curve (Eye). In effect, the eye is much better at sorting the tonal range for shadows and darks than the camera.

Clearly, our camera sensor, at best, takes only a very crude picture.

Gamma Corrected Curve
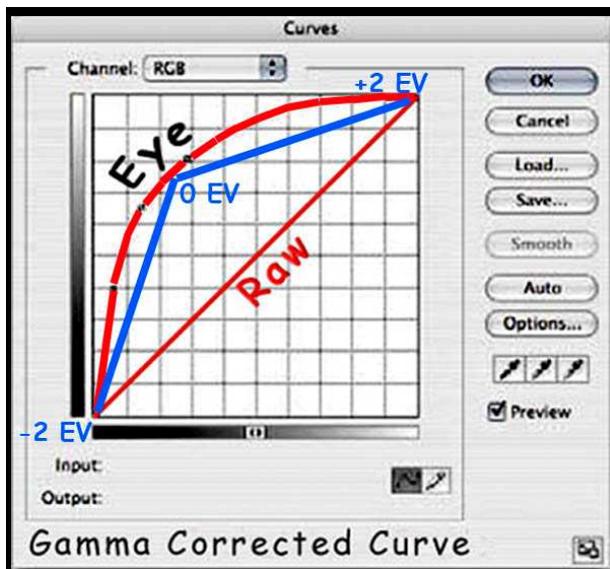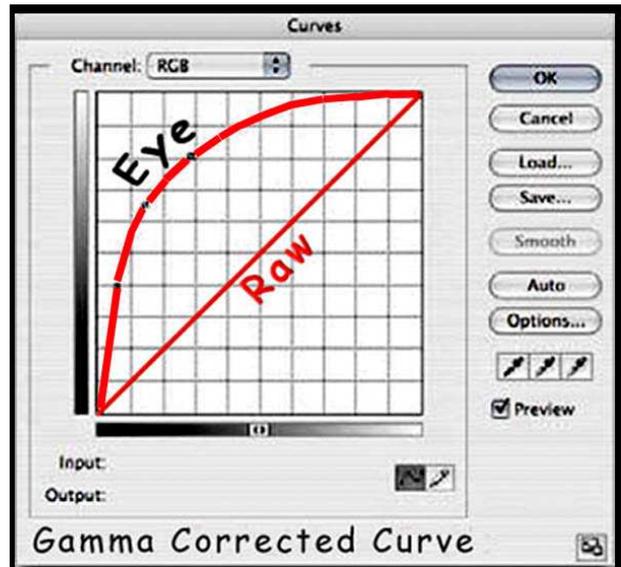
Gamma Corrected Curve

Never fear...

There is a good way to provide a better approximation to our natural eye. It's called High Dynamic Range capture (HDR).

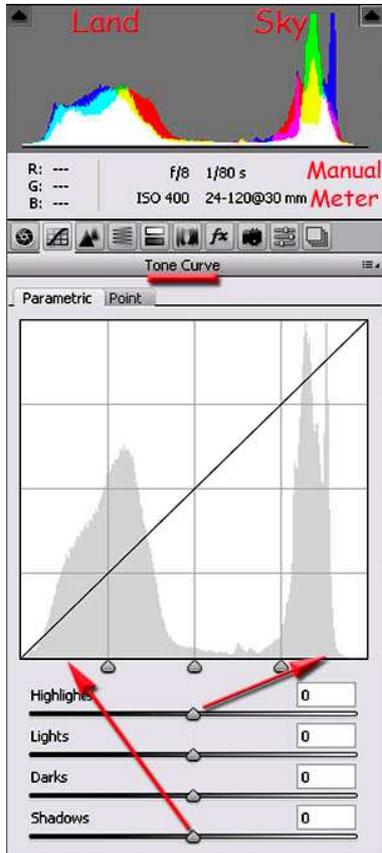In this figure, we refer to the standard ±2 EV exposure accepted by early HDR users. If a linear approximation misses the mark, at the very least, ±2 EV is somewhat better.

Nevertheless, you'll note missing information between 3 2 EV shots and our nonlinear eye.

As you increase individual shots and decrease EV range between each shot, high dynamic range more closely approximate colors and tones your eye would see in high contrast situations. We'll talk more about HDR in an upcoming workshop...

Balanced Capture, Histogram, and Tone Curve

Let's return to our 0 EV Histogram. In math lingo, this Histogram is bimodal. There's a lot of data in the landscape and a lot in the sky. But, not a lot in upper mid-tones (lights). This Histogram results from manual metering.

Tip: Photoshop, Lightroom, and Bridge call on digital darkroom tools from Adobe Camera Raw (ACR). Adobe's engineers enhance ACR tools on a regular basis. With release of Photoshop CS5 and Lightroom 3, we began using ACR 6.0. Five, 6, or 7 enhancements later, they're ready to add a new level to Photoshop or Lightroom, e.g. CS6 or LR4.

This Tone Curve image is from Bridge. Note, Tone Curve is underlined. It's the second tab icon in list of ACR icons for different functions.

We've chosen the parametric view to discuss the range of pixels in the Histogram. In Tone Curve view, we again see bimodal distribution but without color. For ease, Adobe has created 4 zone names; Shadows, Darks, Lights, and Highlights. To help you see, I've shown the slider relating to each end-member central position.

Recap

In the digital darkroom, learning the Histogram is a very important piece of swiftly and successfully Tone Mapping an image, a series of HDR images, or complex series of HDR images to be used in a panorama.

With Histogram and Tone Curve, Adobe has designed a conceptual slider system. I say conceptual ~ if I move a slider, I can change color, contrast, saturation, black point, white point, brightness, clarity, vibrance, etc.

For me, the key to using sliders is to make a slider change, evaluate the image changes, then look at the Histogram to see what I've done. In such an iterative fashion, I will ultimately Tone Map my image from what the camera saw to what my creative memory envisions.

I urge you to devote quiet, enhanced learning time to Adobe's slider concept. It takes a little work to master. Each of you will express your sense of fine art

images differently; but, with finesse, you'll find this slider concept to actually be quite a freeing effect on your ultimate creation path.

Upon mastery, you'd be utterly amazed at how smoothly (quickly) you can create just that exquisite fine art image whose impact makes even a male judge gasp.

TAT

All right Joe, why can't you keep it to just one thing at a time? Well, you may presently think it's a lame excuse, but, "Because it **all** works together...!"*

TAT stands for Targeted Assessment Tool. Kelby doesn't make a lot of hooraw about it.

But, I'm here to tell you, "With due diligence, you'll find TAT tool is your best friend when it comes to converting raw files to Color-Balanced, Tone-Mapped fine art images!"

When you click the little circle in either Tone Curve or HSL panels in Lightroom, it's replaced with an icon containing an Up and Down arrow. When you move the cursor over the image, a + is offset lower right beside the up and down arrow.

If you click on an area of the image, if you drag down, you will darken that range of tone. If you drag up, you will lighten that tonal range.
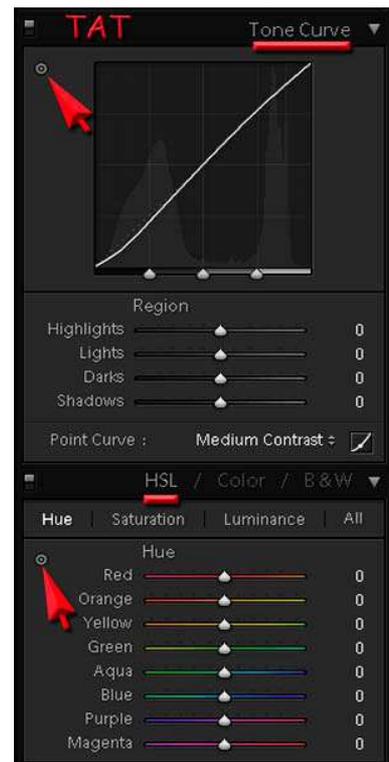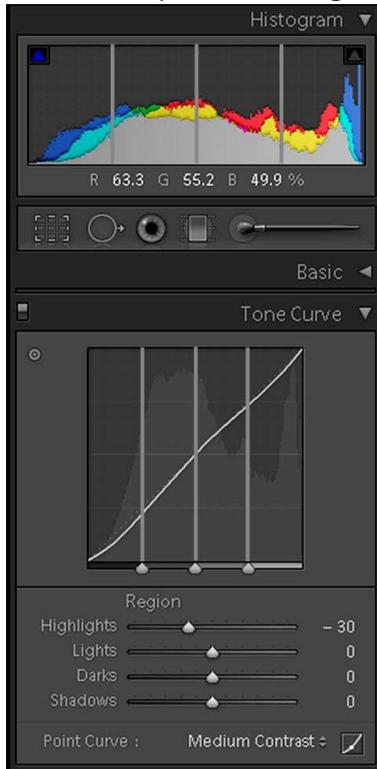
*Tip: As you drag, look at the difference in your Histogram. If I put TAT tool atop Ship Rock, drag it downward, Darks can ultimately show a -30. Unfortunately, the upper Histogram pointer for blowing out shadows turns white (upper left). So, I've lost all control of tone in each channel in the shadows. **Not** a good thing...*

Important Histogram Regions

After staring at Histogram's for a while I've decided to think of them in a manner following Lightroom. Because the TAT tool can become such an important workflow element, the regions it modifies also influence how I think of the Histogram.

Let's take any Histogram and its projection in Lightroom as well as in the Tone Curves panel. For emphasis, I've added gray bars to separate the regions (makes it look like you're going to jail doesn't it?).

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The key to thinking about and remembering Histogram regions in this image is the Region at the bottom of the Tone Curve. Take note of Shadows, Darks, Lights, and Highlights. For this particular case, when I engage TAT tool, I dropped highlights to -30.

Although two histograms are created to different scales, their shapes have a resemblance. The bars are emphasized at a convenient 25% increment across the Histogram for each Region category. Nikon DSLR's mark their histograms in this manner. I'm not so sure about Canons...

I usually read a Histogram from left to right. Since a linear sensor takes the most data in Lights and Highlights, I usually pay careful attention so Highlights are not blown out.

Most professional photographers use some variation of Histogram, Tone Curve, and HSL in Lightroom to quickly color balance and Tone Map global aspects of their fine art images.

*First Tone Curve panel was from Bridge; 2nd from Lightroom.