NATIONAL PARK SERVICE

Conserve O Gram

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Understanding Bit Depth

A bit is the smallest unit of data in digital imaging. Each pixel in a digital image is represented by a number of bits. More bits translate into more tones, grayscale and color, represented per pixel in a digital image. The number of pixels represents the two-dimensional height and width of an image. The number of bits represents a third dimension describing how light, dark or colorful each pixel is. This dimensional aspect results in the term **Bit Depth**.

Digital images are produced in **bitonal, grayscale** or **color formats**. The difference between the formats is determined by the number and the type of information each bit records per pixel. Every bit represents two options; 1 or 0, on or off.

- A **bitonal** image is represented by pixels composed of 1 bit, each in the 1 or 0, on or off position. Because of the two possible positions for all bits in the image, a bitonal image consists of only two tones usually described as a foreground color and a background color (normally black and white). Historically, a bitonal digital image has a bit depth of 1. Newer versions of the dependable bitonal format use software that provides more bits per pixel.

- A **grayscale** image is represented by multiple bits of tonal information, usually between 2 to 8 (or more) bits per pixel. Most of the digital world works with 8 bit images. An 8 bit grayscale image has 256 tonal options (2 to the 8th power) compared with the 2 tonal options of a 1 bit bitonal image. The tones of a grayscale image with a bit depth of 8 ranges from 0 (black) to 255 (white) and all the 254 shades of gray in between.

- **Color** images are generally composed of bit depths ranging from 8 to 24 bits per pixel or higher. The most used digital color standard, RGB (red, green, and blue), applies three 8 bit or three16 bit grayscale channels. Each of the three channels (in both 8 and 16 bit) going into the pixel is for one of the three primary colors.

When photographers refer to an 8 bit color image, they usually mean a 24 bit image because of RGB's three separate 8 bit channels (3 x 8=24). The added capacity increases a digital image's tonal quality. A 24 bit per pixel image is capable of creating more than 16.7 million individual color tones (256 x 256 x 256=16,777,216).

An RGB file contains separated color information in red, green and blue channels and is most often used to produce prints and web images. This is considered the industry standard because it is more than enough information for a quality photo print under close examination. But this is generally not considered enough bit depth for high-end digital photo editing. Image editing is destructive

because it modifies the digital values of the image resulting in the loss of original information. Having more tonal data (or bit depth) to work with is a safety net when processing an image.

A three channel RGB 16 bit color image usually refers to a 48 bit (16 x 3=48) image and is able to produce billions of color tones. This is considered sufficient tonal data for editing, although the image needs twice as much memory to store. This is why the industry standard uses 16 (or more) bit depth to edit and 8 bit depth to store or display digital images.

When possible, follow the industry standard noted above for bit depth. However, most non-professional cameras only allow an 8 bit image. An 8 bit image provides a reasonable ability to document objects if the object is adequately lit during image capture.

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