



Conserve O Gram

August 2008

Number 22/3

Understanding PPI (Pixels Per Inch), DPI (Dots Per Inch), And Digital Display

This *Conserve O Gram* discusses Pixels Per Inch (PPI) and Dots Per Inch (DPI), terms that are used to measure similar concepts of digital graphic resolution. These terms are often misused.

PPI (Pixels Per Inch)

Pixels Per Inch (PPI) is a measure of **Image** resolution, the number of individual square pixels per a linear inch within a digital image. PPI affects the quality of an image's printable size. The number of pixels a digital camera's sensor is able to capture is fixed at a predetermined setting and is referred to as the pixel dimension of an image. However, this fixed collection of pixels can produce many different print sizes.

Changing the print size means changing the resolution or the number of pixels per inch of that image, but not the fixed pixel dimension that the camera captures. In the example in Table 1, the captured pixel dimension remains constant. However with the reduction in size of the image from an 8" x 10" to a 4" x 5" document, it increases the number of PPI available. The opposite is also true, when moving to a larger sized image, from the 4" x 5" image to the larger 8" x 10" image, the number of PPI decreases.

Table 1. How Image Size Affects Resolution

Pixel Dimension	36.6M
Width	3200 PPI
Height	4000 PPI
Document Size	
Width	8"
Height	10"
Resolution	400 PPI

Pixel Dimension	36.6M
Width	3200 PPI
Height	4000 PPI
Document Size	
Width	4"
Height	5"
Resolution	800 PPI

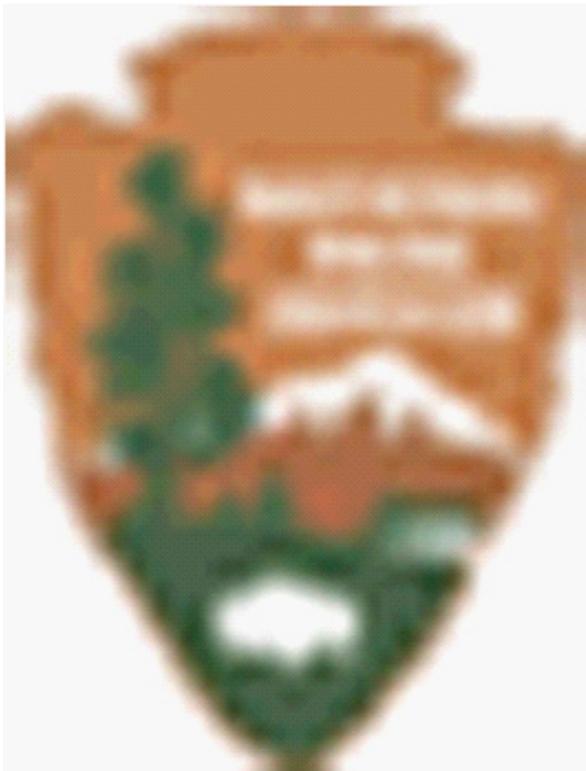
The size of a high-quality print and its PPI is an inverse relationship. The more pixels per inch means the more fixed number of pixels are compressed into an inch. This reduces the print size but increases the resolution quality. For a detailed printable image, keep the pixels small enough so that they don't become visible.



300 PPI



150 PPI



50 PPI

Figure 1: Examples of an image printed at different sizes where the total number of pixels remains constant.

The acceptable amount of PPI needed for a quality print is dependent on the size of the print. Larger prints are generally seen from a further away than small prints, so a lower number of PPI will generally look acceptable visually. The 150 PPI image in Figure 1 has less PPI than the 300 PPI image but still remains readable. Images in National Park Service waysides and museum exhibit backgrounds are printed between 150-200 PPI. Without magnification, the human eye can't differentiate detail in a print greater than 300 PPI. Depending on the printer, the general standard today requires 300 PPI for a quality print of a digital photograph.

DPI (Dots Per Inch)

Dots Per Inch (DPI) is a measure of printing resolution. It is the number of individual dots of ink and spaces between the dots that a printer produces within a linear inch space of paper. Each pixel within a digital image is reproduced by a printer and contains a series of colored dots. A printer set at a higher DPI usually produces a better tonal quality of picture, with more dots within inch. However, a higher DPI does not affect the actual size of the print.

DPI is a printing term that is often mistakenly applied to all forms of digital resolution. Older digital graphic software uses the term when it actually means PPI. It is important to understand the context when these terms are used.

Digital Display

How large an image appears on a computer monitor is determined by the monitor's pixel count and aspect ratio. All monitors have their own set of pixel dimensions for display, usually

an 800 pixel by 600 pixel setting. If an image is set at 800 pixels by 600 pixels, then it will display as a full screen on a monitor set at an 800 pixel by 600 pixel setting. If an image is set at 3000 pixels by 2000 pixels, it is too large to see the total image

Editing software is used to change the actual image size, sometimes referred to as “down-sizing or “up-sizing.” The terms DPI and PPI have nothing to do with web or monitor display, unless software intervenes.

References

Atkins, Bob “*Digital Cameras, a Beginner’s Guide.*” Luminal Path Corporation and Contributors, 2003. <http://photo.net/equipment/digital/basics/>

Evans, Kass “*Image Creation and Management Guide.*” NPS Focus, 2005. <http://npsfocus.nps.gov/docs/guide/imaging/index.html>

Fraser, Bruce *Real World Camera Raw with Adobe Photoshop CS2.* Peachpit Press, Berkeley, CA, pp.17-19, 2005.

Muse, Mike *Digital Image Guide.* Harpers Ferry Center, NPS, 2006. <http://www.nps.gov/hfc/products/pubs/#>

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