Inkjet printing is a deceptively simple process. On the one hand it seems very easy, just use the command File>Print, and click OK. However, when you've spent time trying to get the colors 'just so', it's more than somewhat frustrating when what comes out of the printer does not match what you see on the monitor. Getting an acceptable match is everyone's objective; accomplishing that objective requires knowing some color basics and following a process. This is the first of several columns dealing with Printing. Here we'll look at issues one should consider before getting to 'File>Print'.

Photographers like to share their best images, often with a print. Usually they will first create a Master file in which they optimize the image. For that workflow to be effective they need WYSIWYG (what you see [on the display] is what you get [from the printer]). Getting a good display-to-print match means periodic calibration and profiling of a monitor. It also means using printer profiles for your favorite ink/paper/printer combination. If all these blocks are in place, the print should match the monitor right? Well ALMOST! And, as Paul Harvey would say: "Now for the rest of the story".

COLOR SPACES

Monitors display colors in the RGB (additive) color space; printers deliver output in the CMY (subtractive) color space. These color spaces overlap to a considerable degree, but a comparison of them shows that there are colors present in the monitor color space which are not present in the printer color space. Figure 1 shows a comparison of the colors our eyes can see, the colors a monitor can display, and the colors a printer can print. The horizontal axis is the green-magenta spectrum and the vertical axis is blue-yellow; least saturated colors at the center with saturation increasing as you move towards the edges.

The white-shaded area near the center represents the printer gamut (all the colors it can print). The somewhat larger gray-colored outline is the monitor gamut. Still larger is the gamut our eyes can see, which includes the entire figure (i.e. the whole of the square). The sad truth is that printers can't print many of the
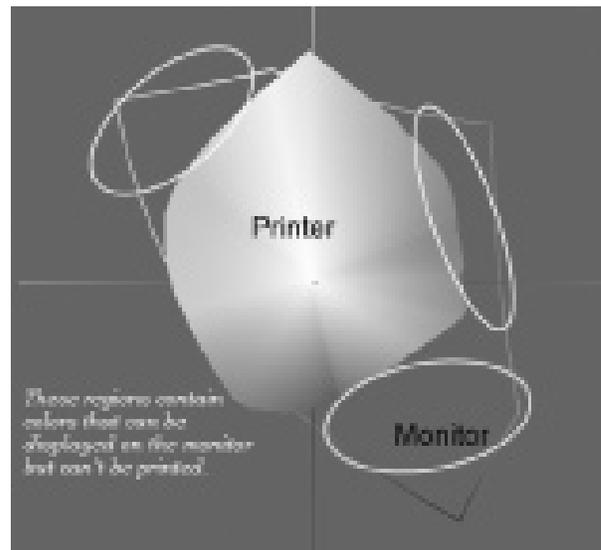

Figure 1 is a 2-dimensional comparison of color spaces. The gray outline represents the monitor and the white area the printer. Notice the 'problem areas' where there are significant differences in their respective footprints.

more saturated colors we display on a monitor (to say nothing of how many more our eyes can see) … however there are a few colors in the blue-green region that can be printed but can't be displayed!

Whether this reduced size of the printer gamut makes any difference is dependent upon the image being printed? Quite often an image does not contain the saturated colors which

are outside the printer gamut. With such an image all of the colors you see on the monitor are present in the printer color space and the conversion from one to the other is comparatively simple. With images containing colors outside of the printer gamut, some system is needed to convert those colors so that they are within the printer gamut. Notice (Figure 1) the big gap between in the lower right blue-magenta quadrant. Here's the answer to why there are often problems with the blue-magenta flowers frequently found in nature. As colors are transformed across that gap it's easy to end up with a result that's more magenta than desired (or the reverse).

TWO PRINTING METHODS

The camera and the computer work in the RGB color space; the printer requires its color information in the CMY color space. How the computer goes about converting from the RGB to CMY color space has a lot to do with whether the colors in the print match those seen on the monitor. The conversion can be carried out in at least two ways.

One can use the **printer driver** to manage color, in which case it will convert the colors from the RGB to the CMY color space. All printers come with drivers. The drivers are specific to the printer and its ink system. They also take into consideration the type of paper chosen by the user. Typically they include one or more printer dialog screens. These provide the user some control over the result, for example they often permit one to increase or decrease the saturation of individual inks.

The other more reliable printing method is to allow **Photoshop** to manage color. In this case **Photoshop uses a profile** to convert the colors from RGB to CMY. This process requires the user to select the appropriate printer profile. Profiles are most often supplied by the printer manufacturer, either on a CD that comes with the printer, or downloaded from their website. Printer profiles are specific to a particular paper/ink/printer combination. **This article and those that follow assume that you are using Photoshop to manage the colors.**

With two methods for printing, it's critical that whichever method is chosen, the other is turned OFF. Inadvertently printing with both methods ON is guaranteed to produce unacceptable results!

PRINTER PROFILES

A 'printer profile' is the color managed method for linking the printer output to a 'standard'; it defines how the printer 'sees' color. It provides a recipe for converting colors from one color space (RGB) to another (CMY). Since papers and inks influence the printer output, profiles are specific to paper/ink/printer combinations. In fact profiles are specific to the entire set of variables used including printer resolution, and print speed. Figure 2 illustrates why profiles are necessary. It shows the results of printing the same RGB skin tone (199,169,150) on four different printers without any printer profile; none of the results are satisfactory. The colors actually delivered by the printer were measured, and are shown in each case.

There are several options for sourcing printer profiles, all of which are less expensive and a lot less time consuming than building your own. Printer manufacturers are the 1st choice. Amongst the majors, Epson has done the best job of embracing the need for profiles and routinely provides them on the CD that comes with their photo-grade printers. In addition, they provide updates on their website, see: **http://www.epson.com/cgi-bin/Store/support/supDetail.jsp?BV_UseBVCookie=yes&infoType=Downloads&oid=54861&prodoid=53540920&category.**
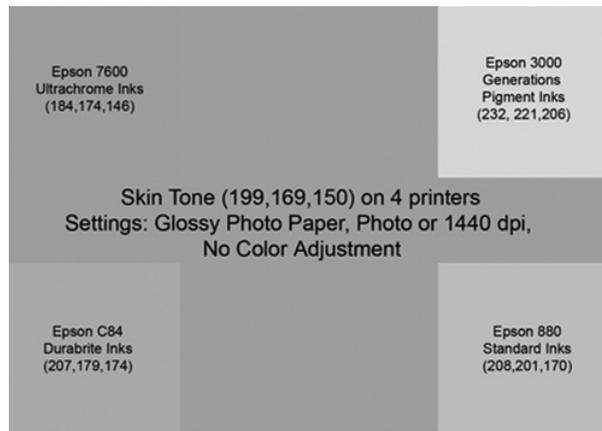

Figure 2 shows the extreme variability that results without the use of any printer profile.

HP and Canon, slow to pursue the photo/art market are now scrambling to catch up. HP has profiles available for some 3rd party papers, but do not believe they're required for their ink/paper combinations, see: **https://h41186.www4.hp.com/country/us/en/iccmedia.html?profile_type=ICC&new_product=130&pageseq=3960254.**

A 2nd option is paper suppliers … there are quite a number of suppliers and many have recognized the importance of profiles. For example: Inkjetart.com, Moab, or Red River, see: **http://www.redrivercatalog.com/profiles/index.htm.**

A 3rd option is a professional profile made specifically for your favorite ink/paper/printer combination and tuned exclusively to your printer. Several services do this work, typically for about $100. Download a file, print it using specific print settings, and mail it to the supplier … they 'read' the print, build a profile, and return it by email. Vendors providing this service include: Inkjetmall.com, Cathy's profiles or Chromix, see: **http://www.chromix.com/ColorValet/index.cxsa?-session=tx:444BAAAD07e321621Frlw269848D.**

The last and least attractive option is to create personal printer profiles. DataColor and X--Rite both offer printer profiling packages. They are expensive, time consuming and tedious to use. However they do give you the freedom to create profiles for any paper/ink/printer combination you might choose to use.

IIn the next column the second in this series on printing, I'll show you how to view an image as its colors are 'seen' by the printer. This is a more accurate 'color-view', and provides the opportunity to make last minute tweaks if you see 'color problems'.