

Who knows what the future holds in printer technology? Save your images as high-bit files for the wide-gamut output capabilities of tomorrow.

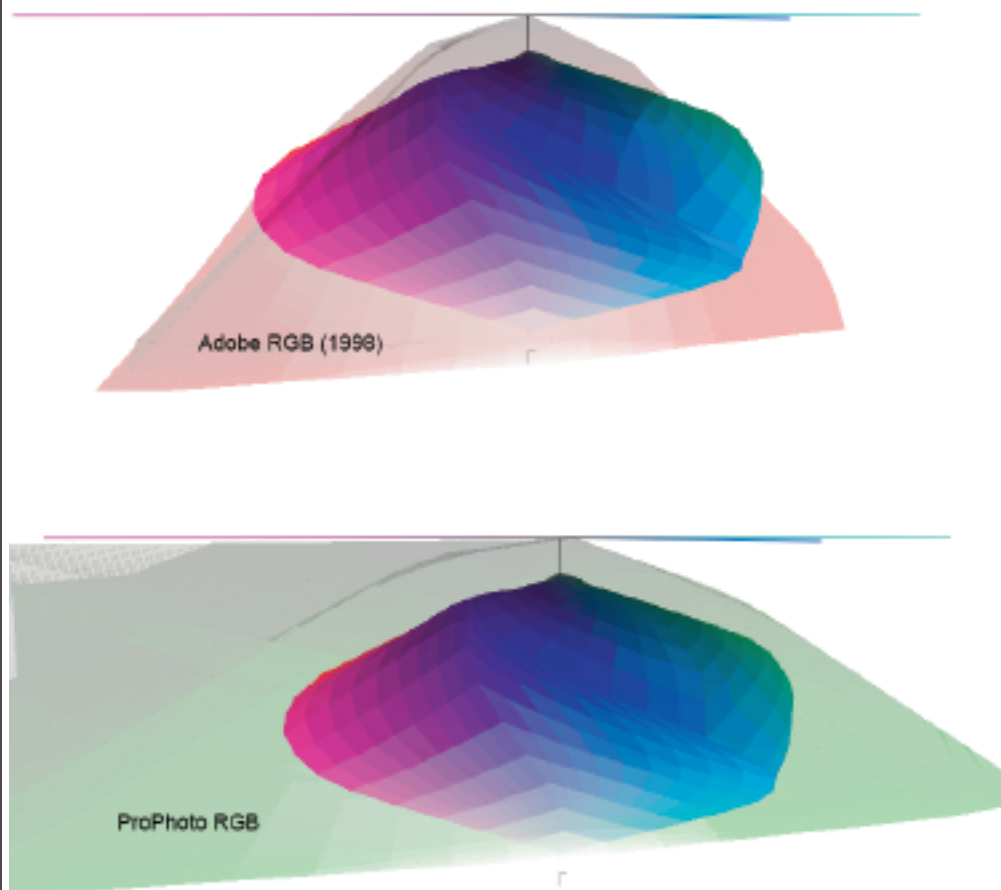
RGB working space debate, Part II

Last month I discussed the merits of using a very wide-gamut working space such as ProPhoto RGB. In the photographic community, there are strong opinions and a lot of confusion on the subject. This month I want to provide a way for you to evaluate various working spaces and decide without any ambiguity what effects they

may have on your final output. But first I need to provide a bit more background on color spaces and why color gamut is necessary.

As mentioned previously, the primary advantage of wide-gamut working spaces is their ability to contain virtually all of the color your scanner or digital camera can capture. It is likely that your

Figure 1. Seen at the top is a slice of the gamut plot of Adobe RGB (1998) (red) with the gamut of my Epson 2400. You can see in this view the saturated reds and greens on either side fall outside Adobe RGB (1998) mostly due to the shape of this color space. Below is the plot of ProPhoto RGB. Since the primaries are so far apart, the shape is such that those reds and greens of my Epson 2400 are fully contained inside this space.



current output device is not able to reproduce all those captured colors. Using a wide-gamut working space at least allows you to archive all those colors; the alternative is to throw them away forever when you convert to a smaller gamut working space. Someday you might want to use these captured colors; we simply don't know what printer technology will provide in the future. You will want to capture and convert your data in high-bit color (more than 8-bits per color) whenever possible, especially images in large-gamut RGB working spaces.

There is a need for wide-gamut working spaces due to their shape when compared to that of an output device. This is illustrated in **Figure 1**. The colored plot in the center is the gamut of my Epson Stylus Photo 2400. Notice the shape of the Epson's gamut in comparison to the gamut of Adobe RGB (1998) and ProPhoto RGB.

As the luminance (lightness) of working space tapers off to black, seen at the top of the plot, the shape tapers off sharply. Yet when you examine this reduction of luminance on the Epson gamut, you see its shape differs considerably and that it doesn't taper off equally. It's much fatter in the center and doesn't taper off as sharply as Adobe RGB (1998). Reds on the left and greens on the right fall outside the gamut of this working space. These colors cannot be reproduced on this printer when converted into Adobe RGB (1998).

ProPhoto RGB is a significantly larger color space that can fully contain the gamut of the Epson 2400. The scale of the red, green and blue primaries that define the boundaries of ProPhoto RGB are spread very far apart in order to define



Figure 2. A Granger Rainbow helps you evaluate the output behavior of RGB color spaces.

this large color gamut. In fact, ProPhoto RGB needed such a large scale to plot RGB that the blue primary falls outside the plot of human vision. This results in a huge color space that

can contain many colors that far exceed the space of this and virtually all printers.

Because of the size and shape of an output device gamut and its mismatch with simple working spaces, the only

way to contain these colors is to use a very large gamut working space. Metaphorically it's like trying to fit a square peg in a round hole. The round hole must be significantly larger overall to allow the square peg to fit within. There are many areas within the round shape that are not filled by the square peg. It appears this is wasted space, but it's necessary to make a fit between these two dissimilar shapes.

ProPhoto RGB is a very large gamut working space and defines a lot of colors we can neither capture nor reproduce. However, this size is necessary if we hope to contain colors from capture and output devices that would be discarded in a smaller gamut working space.

Is a large-gamut color space really useful? The only way to decide is to test different working spaces with the same image and examine the output. You can try to capture a very colorful scene with a digital camera, convert the RAW data into several working spaces, and print each.

MAKING A GRANGER RAINBOW

1. In Photoshop, create a new file (cmd/ctrl-N).
Make the document at least large enough to fill a half page for your output device.
Set Color Mode: LAB Color/16 bit.
Set Background Contents: White.
The Color Profile will automatically be set to Don't Color Manage this Document as LAB is self-defining, and no profile is necessary. Click OK.
2. Once the document is created, select the Gradient tool (keyboard shortcut = G). On the options bar, open the Edit Gradient pop-up menu and pick the gradient named Spectrum (hold your cursor over each gradient to see its name in the tool tips or select Small List from the flyout menu).

3. Press Enter or click outside the menu to dismiss the gradient palette. In the option bar, ensure the gradient type is set to Linear (the first icon in the group), that Mode is set to Normal and Opacity is 100%.
4. Move your cursor as far left and center of the document as possible. Hold down the shift key and click and drag from the far left to the far right of the document (horizontally) to produce the spectral gradient. The shift key ensures you create a nice straight gradient from side to side.
5. Click the Edit Gradient pop-up menu once again, but this time pick the gradient named Black,White (the third gradient from the left on the top of this palette).
6. In the option bar, set the Mode pop-

up menu from Normal to Luminosity.

7. Once again, hold down the shift key, click and drag from the bottom to the top of the document (vertically) to produce the black-to-white gradient. The image should appear as seen in Figure 2. Save the document as GrangerRainbow.tif.

Since the Granger Rainbow image is in LAB, you can convert this document to any working space you wish. Using this Granger Rainbow in sRGB, Adobe RGB (1998) and ProPhoto RGB will allow you to further see the effect of each working space using a single output profile on your printer. Depending on the gamut of the image, a smaller working space might produce preferable results. Test for this yourself!

Unfortunately, it's often difficult to find a scene that contains all the colors and tones to do this test justice. This is when using a synthetic image can be helpful.

You can create an image that contains a huge amount of smooth saturated colors and tones using Photoshop. The sidebar shows a recipe for making such an image, which is called the Granger Rainbow (after famed color scientist Ed Granger). Create this file to test how various working spaces behave. Once you create this file, in LAB, convert it to sRGB, Adobe RGB (1998) and ProPhoto RGB, then convert to your final printer color space. Print each and examine the results. It's interesting to see how the working space and its gamut affect the final reproduction.

The subtle to dramatic problems that synthetic images can exhibit in reproduction won't necessarily happen with your real-world images. The possibility always exists, though, so this can be a useful exercise. For example, I was recently evaluating the quality of printer profiles generated from two different software packages. With the real-world images I printed, it was often difficult to see the effects of abrupt transitions of saturated colors, usually for image-specific reasons. With the synthetic images, severe banding in one of the profiles was easy to detect in many areas of the color spectrum. ■

Don't miss Andrew Rodney at Imaging USA in Austin, Texas. His presentation, "Color Management from A-Z," explains how Photoshop can be set up easily to accurately preview digital images and get predictable color output. Monday, January 23 at 9:15 a.m. to 10:45 a.m. Register at www.imagingusa.org.

