Static Wide-Angle Landscape+Astrophotography

Revision 1

by TJ Avery, 18-May-2010

Table of Contents

Revision History:

- First Issue: 14 May 2010
- Revision 1: 18 May 2010 (added table of contents and added section on temperature)

1. Introduction

This article combines my experiences and field notes for shooting static wide angle photos of the stars and Milky Way combined with ground-based subjects.

Juniper Silhouette, Guadalupe Mtns National Park (Sept. 2009)
24mm, 30 seconds, f/2.2, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

What follows is based on my work at this type of photography since December 2008. I'm still learning and experimenting, and will update this article in the future.

The main challenges are:
1. timing, location, and weather
2. having the right gear, getting a good exposure, and "freezing" the apparent motion of the stars

The purpose of this set of notes is to describe the conditions, equipment, and shooting specifics to successfully capture this type of photo. I've received countless questions asking about my gear, camera settings, and in general how I made these photos. Hopefully this article will address them all. Let me apologize in advance – there is a lot to chew through ☺

1.1 Types of Astrophotography

To set this in context, there are different ways to photograph the night sky, and there are different equipment options to do the job. This article focuses on conventional photography using a digital SLR and large aperture wide angle lenses.

1.1.1 No Star Trails

This is the goal: static photos of the stars. There are two categories, 1) pure sky, and 2) ground-based objects combined with the night sky. I want to make that distinction because of the different methods and gear that is best suited for each category.

1.1.1.1 Pure Sky

Photographing a patch of sky without noticeable star trails can be accomplished in several ways. The methods I describe in this article can be used for this type of photography. However, the best quality (technically speaking) can be achieved by using a motorized equatorial mount (usually used for telescopes) that allows the camera to track with the stars.

Looking Up, Texas Hill Country (December 2008)
20 sec., f/1.8, ISO 1600 (also "pushed" +1 in post processing)
(Canon 5D + 50mm f/1.4)

The great advantage of using a special mount is that it allows for longer exposures, and therefore very wide apertures and very high ISO settings are not necessarily needed (I'll get to shooting settings and gear later on). You can also take multiple photos and later stack them using software.

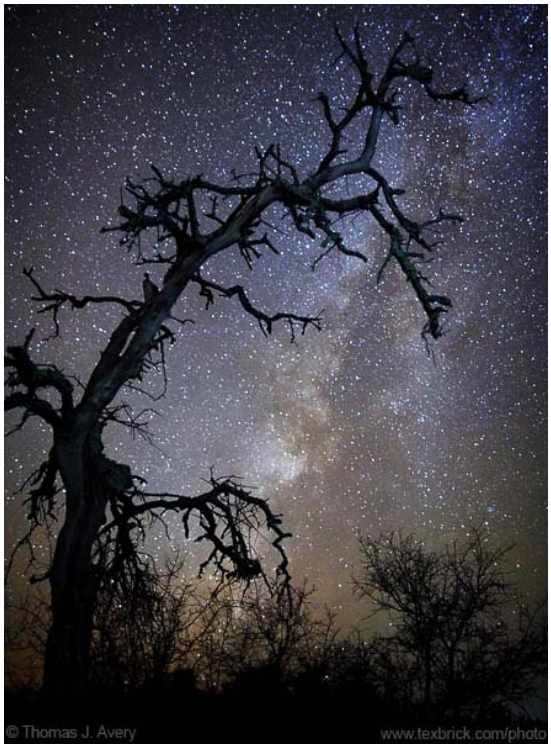
1.1.1.2 Sky + Land-Based Objects

This is the focus of this article. This type of photo has:

- Dark, night skies with a lot of visible stars (and perhaps the Milky Way)
- No noticeable star trails
- Ground-based objects (usually silhouetted against the sky)

The great difficulty here is the overlap of silhouetted landforms against the sky and stars because the stars are moving relative to the camera position and landforms. Taking multiple exposures and later stacking them in post processing is not an option because of the apparent movement of the sky and stars versus the "fixed" landforms.

The best approach is to capture the scene with a single shot. This is now possible with modern digital SLRs and relatively wide aperture lenses.



Tree and Milky Way, Texas Hill Country (Oct. 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

1.1.2 Star Trails

The longer the exposure, the longer the star trails. Photos that have very noticeable star trails usually have exposures several minutes to several hours long.

Star Trails, Texas Hill Country (Dec. 2009)
46 minutes, f/4.5, 17mm, ISO 400
(Canon 40D + 17-40mm f/4L)

This type of photography requires a different approach, and I will not cover it here.

2. Shooting Conditions

The conditions that are just right to capture a lot of stars and the bands of the Milky Way are somewhat difficult to find. The biggest challenge is location. For most people, it requires traveling a great distance to get away from light pollution.

The recipe for dark skies:

1. little or no light pollution
2. few or no clouds
3. no moon or sunlight
4. season and timing (with regards to the Milky Way's position in our sky)

One of the most beautiful features of a very dark sky is the cloud-like band of the Milky Way. This feature is usually only visible to the naked eye (and also well photographed by camera) if the surrounding skies are sufficiently dark and clear.

2.1 Light Pollution

Getting away from light pollution can be difficult. I don't think I've ever been in a place that wasn't affected by it to some degree.

A Little Light Pollution on Horizon, Texas Hill Country (Oct. 2009)
24mm, 25 seconds, f/1.8, ISO 6400
(Canon 5D II + 24mm f/1.4L II)

But I've shot in locations roughly a mile or so from a small town and still seen sufficiently dark skies.

I've also shot near high area lights (these things are everywhere!) with decent results. These lights will not necessarily pollute the sky (unless there are a lot of them or you are very close to them), but they will illuminate ground based objects in your photo with nasty green or yellow tinted light. You can handle this situation by moving your shooting location by ¼ mile or so, or by blocking the light somehow. Find a position where a solid object (e.g. dense tree, building, hill, etc.) is in between the camera and the light.

The Ubiquitous High-mounted Light

The places that I've successfully shot the stars and that have decently dark skies are in the outer reaches of the Texas Hill Country (i.e. a long ways from Austin, San Antonio, and the I35 corridor – all areas being ripe with light pollution) and out in far west Texas (e.g. Big Bend and Guadalupe Mountains National Parks).

2.2 Weather and Clouds

Anything that comes in between the camera and the stars will obviously obscure your view of the sky. I've shot in partly cloudy conditions, and that has actually produced interesting photos. A totally blank sky is interesting enough because of all the stars, but adding some clouds helps to convey your Earth-bound position. Too many clouds will ruin the view of the stars.

Clouds & Milky Way, Big Bend National Park (Nov. 2009)
24mm, 25 seconds, f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

The point is that even with some clouds, don't give up the shoot.

Haze and high humidity can also reduce star visibility. One of my favorite dark-sky viewing places is the Big Bend area in far west Texas. This area is often plagued by heavy haze.

2.3 Temperature

Temperature goes along with weather, but it deserves special mention because it can relate to the performance of the camera's sensor. The amount of digital noise produced by the camera depends on several things, including temperature.

Basically, digital sensors generate less noise with lower temperatures. I lack any quantitative evidence, but I've read many reports of photographers getting better noise performance (i.e. less noise) while shooting in temperatures at or below freezing.

I have not tested this yet mainly because I have not done much shooting in cold weather. Most of my night photos have been taken at temperatures well above freezing.

Another thought I have regarding temperature is that this type of shooting results in using very high ISO settings. I would imagine that after several shots in a row, the sensor heats up, and each shot becomes slightly noisier. Again this is just a thought. I've not done any detailed comparisons to see what difference, if any, exists between the first shots of a given session versus the last shots.

What I can conclude is that you probably should not worry too much about temperature. I.e. trying to shoot during colder months and/or in higher elevations so that you experience lower temperatures should be low priority. The most important aspects are finding a suitably dark location, weather, and timing regarding the moon.

2.4 The Moon & Sunlight

The moon and sun are natural sources of light pollution. Dark skies can be found when the effects of both are negligible.

Regarding the moon, try to shoot when the moon is new (or the days surrounding a new moon) or when the moon is well below the horizon.

Regarding the sun, the skies will be sufficiently dark (for mid-latitudes) in the block of time starting 1.5 hour (90 minutes) after technical sunset and up to 1.5 hour (90 minutes) before technical sunrise. Note that the 90 minute time is approximate; this is the twilight and it varies a little depending on your exact location and time of year.

The cycle goes in periods like this:

0 daytime
1 sunset (technical sunset – just when the sun drops below the horizon)
2 about 1.5 hours of twilight (civil, nautical, and astronomical; about 30 min. each)
3 total darkness (length depends on time of year) **This is prime-time dark sky shooting.**
4 about 1.5 hours of twilight (astronomical, nautical, and civil; about 30 min. each)
5 sunrise (technical sunrise – just when the sun appears on the horizon)

There are specific definitions for each twilight, and you can look them up if you want. In my own terms, starting at night and transitioning to morning (note that each of these lasts roughly 30 minutes for mid-latitudes, but it depends on your exact location and time of year):

- astronomical twilight: you just barely notice the sky getting lighter with your own eyes, but it's still pretty dark; you may just barely notice the transition between the horizon (dark land) and sky.

- nautical twilight: sky is noticeably lighter and starts getting some color (blueish tones), land-based objects silhouette against the sky well by the naked eye, but it's still too dark to see the ground well without a flashlight.

- civil twilight: clouds, if present and in the right spot, will start catching color from the sun (the last half of civil twilight is usually the best for deep reds and oranges in the clouds if the conditions are right), you can see details on the ground fairly well without a flashlight.

Just reverse all that for sunset. Civil twilight follows the sunset and is then followed by nautical and finally astronomical twilights.

Photographing the stars in astronomical twilight can be interesting. The faint sunlight that is still visible in the sky will render a deep blue in your photo. It will drown out faint stars, but there will be a lot of stars still visible.

In the evening, roughly at the end of astronomical twilight, if the skies are sufficiently dark, you will see a faint, white light towards the west. This is the Zodiacal light. It almost looks like light pollution from a distant city, but it is a white-ish light and not yellow or green tinted like artificial light usually is. The Zodiacal light will go away after a while.

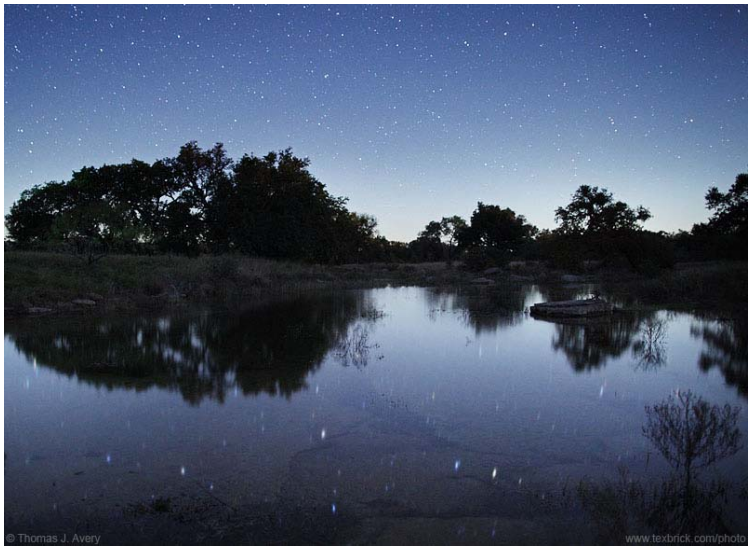
Zodiacal Light (column of light on the left side), Big Bend National Park (Mar. 2009)
24mm, 25 seconds, f/1.8, ISO 1600
(Canon 5D II + 24mm f/1.4L II)

I've found that under dark conditions, the ground will always render near-black without detail (unless some objects are very light or white and they may show very faint detail in the photo).

You will need to light-paint ground-based objects to show detail in them, or you will need to use moonlight to illuminate them. The effects of the light will depend on the phase of the moon. I haven't photographed much using moonlight, but it doesn't take much light to show up in this type of photo (given the high sensitivity).

From my visual (non-photography) experience, a full moon (or nearly full) will drown out faint stars and even prevent the Milky Way from showing. However, I have photographed dark skies during a near-full moon about 30 minutes before it rose above the horizon. There was a faint glow in the sky on the horizon, but the skies overhead were sufficiently dark.

If the moon is partially full and/or has just barely risen (conversely: just as it sets), then the conditions are similar to astronomical twilight. The sky will render a deep blue from the moonlight and the faintest stars will not be visible.



Water and Stars Just Before Moonrise, Texas Hill Country (Nov. 2009)
Sky: 24mm, 25 seconds, f/2.0, ISO 3200
Foreground: 24mm, 30 seconds, f/1.8, ISO 6400
(Canon 5D II + 24mm f/1.4L II)

2.5 Seasons of the Milky Way

The appearance of the Milky Way changes in an annual cycle. It will generally appear as soft bands of thick stars in the night sky. The bands will be heavier towards the south-to-west and taper off towards the northern sector of the sky. People seeing it for the first time often confuse it as being strange looking clouds.

The Milky Way rises and sets just like the sun and moon. So you will need to know when the galaxy will be visible. See the section below (2.5.3 The Night Sky and Stars) for info about determining how the Milky Way will look.

Generally, in the middle of the summer in mid-latitudes of the northern hemisphere, the galactic center of the Milky Way Galaxy will be visible above the horizon (or nearly so). It's the best time to capture the full brightness and color of our galaxy.

I've photographed the Milky Way at several times during the year. This has all been in Texas. What follows below is intended to be a ***rough*** guideline as to how the sky will look after dark. Keep in mind that your dark sky shooting location may be different.

February (very early in the month):

Looking West After Sunset, Just After Astronomical Twilight
Texas Hill Country
16mm, 60 seconds, f/2.8, ISO 6400
(Canon 5D II + 16-35mm f/2.8L II)

March (mid-month):

Looking Southwest After Sunset, Just After Astronomical Twilight
Big Bend National Park
24mm, 25 seconds, f/2.0, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

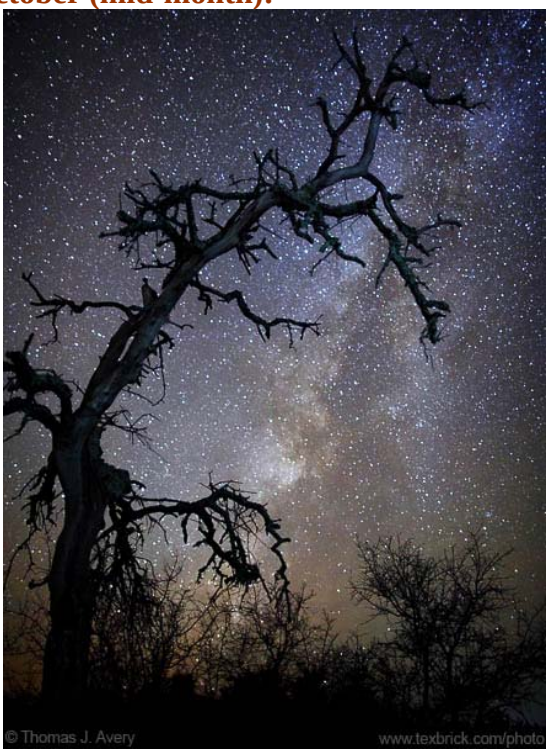
July (mid-month):

Looking South After Sunset, About 1 Hour After Astronomical Twilight
The galactic center is visible in this shot.
Texas Hill Country
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

September (mid-month):

Looking Southwest After Sunset, About 1 Hour After Astronomical Twilight
Guadalupe Mountains National Park
24mm, 25 seconds, f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

October (mid-month):



Looking Southwest After Sunset, About 1 Hour After Astronomical Twilight
Texas Hill Country
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

November (mid-month):

Looking West After Sunset, About 2 Hours After Astronomical Twilight
Big Bend National Park
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

December (mid-month):

Looking West After Sunset, About 1 Hour After Astronomical Twilight
Texas Hill Country
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

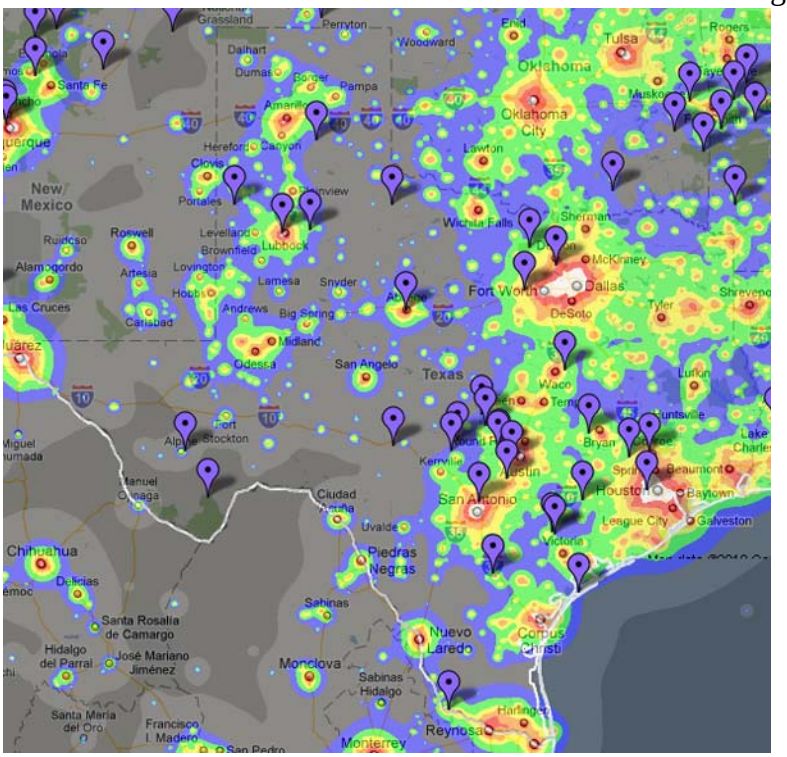
2.6 Resources

Before you plan a trip to photograph the stars, try to research the area, date, time, weather, etc. to give you the best opportunity.

2.6.1 Light Pollution

The most difficult thing will be to determine if the light pollution is sufficiently low enough to get dark skies. You will need to 1) already be familiar with the area, 2) find night shots by others from the area to know if it's dark, or 3) try to estimate the darkness using tools online.

Here's a good site with a map of light pollution in the US:
http://www.jshine.net/astronomy/dark_sky/



Screenshot of Texas from jshine.net

According to this map, all my night sky shots were taken in areas that are either light or dark gray. But this map will NOT plot the small sources of light pollution such as local area lights, as I mentioned earlier. But hopefully you'll be able to deal with those by changing your position by a few hundred yards or blocking the light source with an object (e.g. hill, dense tree, building, etc.).

2.6.2 Moon, Sun, and Timing

Most important: know 1) the phase of the moon, and 2) moon and sun rise/set times.

Here's a site to give you that data on a daily basis:
http://aa.usno.navy.mil/data/docs/RS_OneDay.php

And here's a site that will give you a chart for a month at a time:
http://www.sunrisesunset.com/custom_srss_calendar.asp

Things to note when you look up a specific location and date:

- **phase of the moon**
- **moon and sun rise/set times**
- **twilights (civil, nautical, and astronomical)**

Plan your visit to a dark area to coincide with either a new moon, or when it will be sufficiently dark (i.e. your shoot time is between evening and morning astronomical twilights while the moon is still well below the horizon).

2.6.3 The Night Sky and Stars

Section 2.4 above is a rough guide to the night sky and Milky Way. If you want to precisely know what the sky will look like after dark, then you could use software that will simulate the night sky for a specific location and date.

The Stellarium program is free and easy to use:
http://www.stellarium.org/

You could also talk to a local astronomy club and find out where they go and when to go to get the best view of the Milky Way.

3. Gear and Camera Settings

3.1 Shutter Speed, Aperture, and ISO

Shutter speed is probably the most important aspect of this type of photography. The main goal is to freeze the apparent motion of the stars. Remember that you and your camera are fixed to the Earth, and the Earth is rotating relative to the stars.

Making the stars appear as small points of light (instead of oblong shapes or long streaks) requires that your exposure is sufficiently short. This becomes a challenge because **you need a short enough shutter speed to freeze the motion but you also need a long enough shutter speed to gather enough light to make a good exposure.**

How the stars appear in the photo depends on two things:

1. Your focal length and corresponding field of view
2. The final output of your photo (i.e. viewing on the computer or print size)

The old astrophotography rule of thumb is that star trails will not be noticeable in photos with shutter speeds of 30 seconds or less with lenses 50mm or wider. However, modern digital SLRs, high performance lenses, and "pixel peeping" on the computer has brought a new level of scrutiny to the resulting quality of digital photos.

Based on my experience and judgment, successful exposures resulted from these settings:

Recommended Shooting Settings

Focal Length	16mm	24mm	50mm
Shutter Speed	40-50 sec.	25 sec.	13 sec.
Aperture	f/2.8	f/1.8 – f/2.2	f/1.4
ISO	3200	3200	3200

Please Note:

1. This is just a guideline – you can still shoot one to two stops slower than these recommended exposures and still get a lot of visible stars; you can also push your exposure a stop or so in RAW processing.
2. Focal length applies to full-frame DSLRs. So if you're using an APS-sized sensor, you'll have to adjust your focal length to get the equivalent field of view.
3. I've not yet used a f/2.8 fisheye lens to shoot the night sky and stars, but I imagine that you could get away with 60 sec. (give or take) exposures because of the huge field of view.

Before you proceed any further, please keep in mind that there are a lot of variables to consider. The recommended shooting settings are based on my preferences and uses for my photos. Here are a few things to think about and remember:

- Acceptable lack of star trails: what I consider "unnoticeable" is my own personal preference. You might see differently.

- Acceptable file quality: I feel that ISO 3200 from the Canon 5DII is rough, but usable. I feel that it's about the same quality as ISO 1600 from the original 5D. I have no experience with other cameras, but I hear the Nikon D3 and D3s are superior for low-noise, high-ISO photos.

- Exposure: There's a certain level of exposure that I feel is correct, and for me that's when only the brightest stars become blown highlights, just barely though (i.e. a very small percentage of the photo).

- Final, post-processed image quality: The largest print that I make is 12x18". If you're content with 8x10 or smaller, then you'll be able to get by with having a little more noise in the original file and perhaps also star trails that are a bit longer (i.e. you can use longer shutter speeds and a lower ISO). If you only use your photos as web-sized/Internet-optimized files, then you can probably get away with having a lot more noise and star trails.

- Lens quality: this is somewhat of a torture test for lenses. They will be used at or very near maximum aperture to shoot very bright spots of light (when properly exposed) against a near-black background. Sharpness and chromatic aberration are two attributes of your lens that you want to consider carefully. Again, the final output and use of your photo should be considered. If you only print small and/or put your web-sized files on the Internet, then you can get by with a lesser-quality lens. If you intend to print larger, then you'll probably want a better-performing lens. This comment somewhat belongs in the gear section below, but then it's also important when considering shooting settings (especially aperture).

4.2 Other Camera Settings

- File type: RAW
- Long exposure noise reduction: ON
- White balance: Tungsten (although not important since it can be changed in RAW processing)
- Mirror Lock Up: not really necessary with such long exposures but I use it anyway

4.3 Gear

By this point, I’m sure you’ve picked up on the gear requirements based on the recommended shooting settings. I currently use a Canon 5DII with either a Canon 24mm f/1.4L II or Canon 16-35mm f/2.8L II.

I could get into an extensive discussion about what gear would be usable for this type of photography, but that’s a bit much. Basically, when choosing your gear, you should consider the following:

- ISO: A setting of 3200 or higher (and remember that you can shoot at ISO 1600 and then push the exposure up when you process the RAW file)

- Focal Length: 24mm (on a full-frame DSLR) is wide enough to capture the brightest parts of the summer Milky Way and its fade-off towards the north. I would say that 24mm (or maybe even 28mm) is the longest focal length I'd consider for this type of photography. 24mm down to 16mm or even 14mm is the range you would probably want to use.

- Aperture: f/2.8 minimum. It's difficult to find affordable wide or super-wide angle lenses with apertures wider than f/2.8. There are a number of alternative lenses that are wide and have a f/2.0 maximum aperture (e.g. some Olympus and Nikon manual lenses – and these can be used on Canon SLRs with a special adapter).

- Tripod: this goes without saying ☺ You need to use one.

4. Shooting and Field Work

Shooting landscapes in the daylight can be challenging enough. Shooting them in near-darkness adds more challenges. Basically, you will need more time when shooting at night.

4.1 Safety

First and foremost, be safe. Watch your step. **Let someone know where you will be and for how long.** Take a back up flashlight and/or back up batteries. Don't get lost (see next section).

Also, mind your tripod. As you pace around in the dark, it's a danger that you catch a tripod leg with your foot and knock it over (speaking from experience).

4.2 Planning

It's best to scout an area ahead of time in the daylight. The landscape and the objects in it will look completely different in the darkness of night (mainly, it becomes very disorienting at night when you lose most of your visual references and the ability to visually judge distances and speed).

Finding a night-time composition in the daylight may or may not work out because it might look completely different in the darkness. However, daylight scouting will help you familiarize yourself with the area and make navigation at night easier.

Unless you're not planning on hiking very far, or you are VERY familiar with the area, take a map, compass, cell phone (if it works in that area), and perhaps even a GPS (be sure to turn it on when you start your hike so that you have a "bread crumb" trail laid down as you hike).

When selecting an area and possible potential compositions, have an idea where the Milky Way will appear (e.g. to the south or west). This can be done by using star simulation software or my example photos given earlier.

You will need gear to get around in the dark. A portable light (flashlight, headlamp, etc.) is the most important. A strong flashlight or portable spot light would be better (for composition – I'll get to this in a bit).

You might also want to take a light weight fold-up chair for comfort. Working a particular scene may take half an hour or more. Exposure times will be 15, 30, 50+ seconds (and twice as long when you use the *long exposure noise reduction* feature in your camera).

Give yourself time. Setting up and making the long exposures takes a while. If you're productive, you'll get just a few shots every half hour or so. If you're new at it, then it may take an hour just to get one shot that you like. This is low-yield shooting so give yourself a few hours in the field.

4.3 Shooting Techniques, Composition, etc.

Composing a scene in near-darkness is a challenge. You will not be able to see through the viewfinder as well as with your naked eyes in the dark. If you have good eyes and let them adjust to the dark, then you will be able to just barely make out the silhouettes of objects and the brightest stars through your viewfinder (assuming you are using a fast lens).

Even with my 24mm f/1.4 lens, I have a very hard time making out the sky and objects through my viewfinder. As I get older, I find that my vision at night gets worse.

There are two things you can do to help set up your composition: 1) use a bright flashlight or portable spot light, and/or 2) trial and error shooting.

As you look through your viewfinder, hold out a bright light in your hands away from your head and camera and shine the light forward. As the light catches on fore and mid-ground objects, you'll be able to see them through your viewfinder and then make adjustments in your composition. It definitely helps to bring along a friend to hold the light therefore giving you two free hands to manipulate camera position.

Trial and error- it's just that. Take a shot, review the shot on the LCD, and then re-compose. Keep going until you find the composition that you want. (This is why you want to give yourself a lot of time while out shooting.)

As for judging the far-off background (e.g. horizon), you might be able to see the ground/sky transition line well enough through the viewfinder to compose, especially if there's a bit of light pollution. If not, then just use the trial and error approach.

It helps greatly to use a level on your camera. Use a two-axis bubble level (the kind that plugs into the hotshoe) - they work great.

Set up for a night shot (bubble level not pictured)

If it's windy, then use a very sturdy tripod or position your tripod low to the ground. Weigh it down with a rock or your camera bag. If you use a lens hood, then be sure that it doesn't rattle in the wind (note the rubber band wrapped around the lens hood in the photo above). Block out the viewfinder with the little rubber cover that comes with the camera (or use the camera's internal viewfinder shutter if it has one).

One could write a ton of info about composition, and I hesitate to go down that road. Basically, shoot what you like.

The photos I've put in this article so far have been favorites of mine. Hopefully they will give you an idea of what I like to put in my star/night images.

4.4 Focusing

Shooting at relatively wide apertures will result in problems with DOF (depth of field, i.e. the extent of acceptably sharp focus). From my experience, you'll have to focus on either the stars (infinity) or your close foreground objects. You will not have enough DOF to get them all in sharp focus (unless you shoot at f/4 or f/5.6, but that will require a very high ISO like 12k, 25k, or more).

4.4.1 Infinity

To get the stars in crisp focus, you'll want to focus at infinity, but this can be tricky. Do NOT dial the focus of your lens to the infinity mark and call it good. It's not.

Most auto-focus lenses will go past infinity, and the actual point of infinity is hard to find. It's been at a different point between all the lenses that I've used.

The best thing to do is set your camera up for the shot (i.e. dial in the recommended shooting settings), point the lens towards the brightest star you see, and turn on live view. Zoom in (on the LCD) to that point of light (the brightest star) and then manually focus the lens. Rack the focus back and forth until that point appears as small as possible.

If your camera doesn't have live view, or if live view isn't sensitive enough to pick up the brightest stars, then you will have to focus by trial and error.

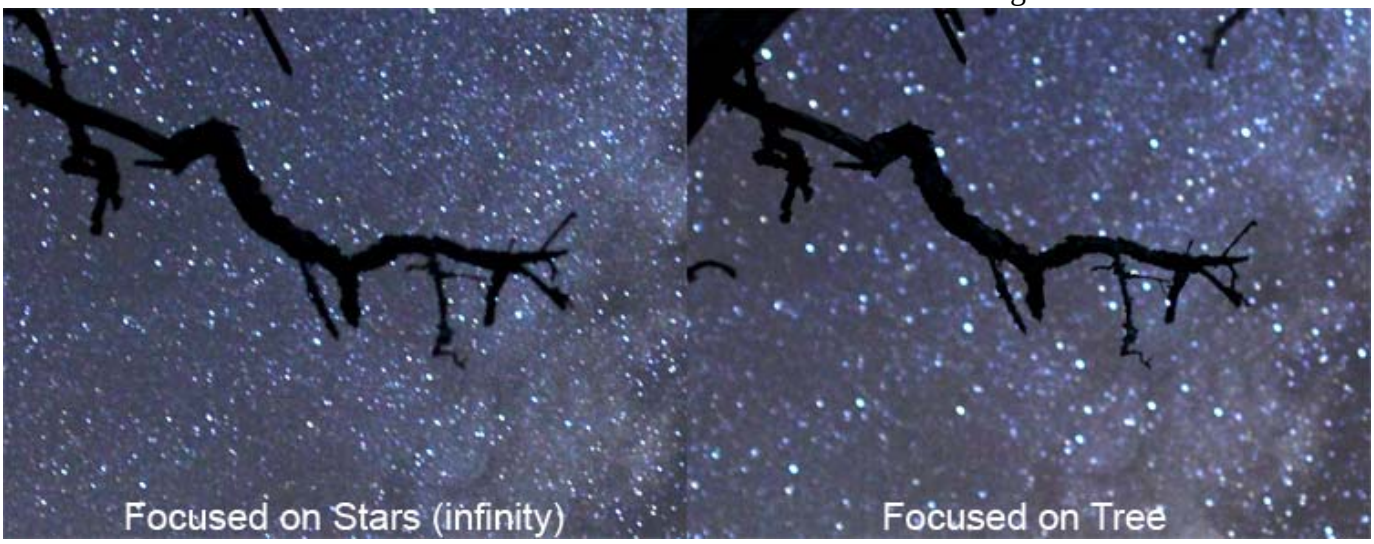
Focus on infinity by using the tick mark on the lens' scale, and then take a series of photos. Adjust the focus ring slightly between photos. Review the photos on the LCD at maximum magnification and note the photo with the sharpest stars. (This can be tricky because you'll have to note the position of the focus ring carefully for each shot and remember it). The best photo still may not look very sharp on its own, but remember that you're doing a comparison between photos, not an evaluation of a single photo.

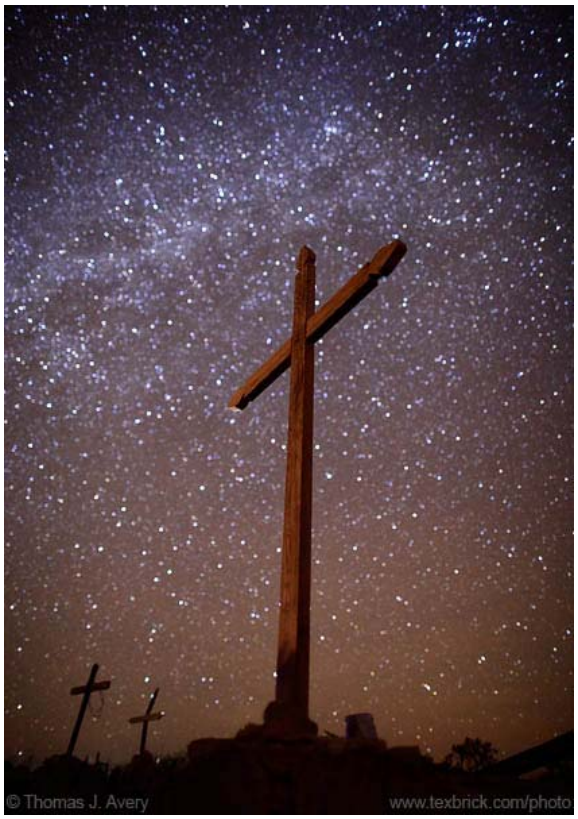
Once the focus is set, then leave the lens on manual focus and don't touch the focus ring thereafter. You might even consider taping it down so that you don't bump it out of position accidentally.

The Milky Way, Texas Hill Country (July 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

4.4.2 Mid/Fore-ground Objects

You can chose to focus on closer objects and let the stars blur a little. This is particularly effective for close objects that are 5 to 20-30 feet away.





Crosses and Graves in Terlingua Ghost Town Cemetery (Nov. 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

In the above photo, the main cross was probably 6 or 7 feet away from the camera. I manually focused by using my bright headlamp to light the cross while viewing through the viewfinder. (note - in the photo, the light on the cross was ambient light coming from a nearby building and not my headlamp; I will cover light painting in the next section)

You can also use live view to focus using this technique. Just dial in the camera settings you need, then turn on live view. While watching the LCD, zoom into your subject, light it up with your flashlight, and then manually focus the lens until the image is sharp.

Yuccas, Big Bend National Park (Nov. 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

Above is another close-focus example. These yuccas were about 8 feet away, give or take.

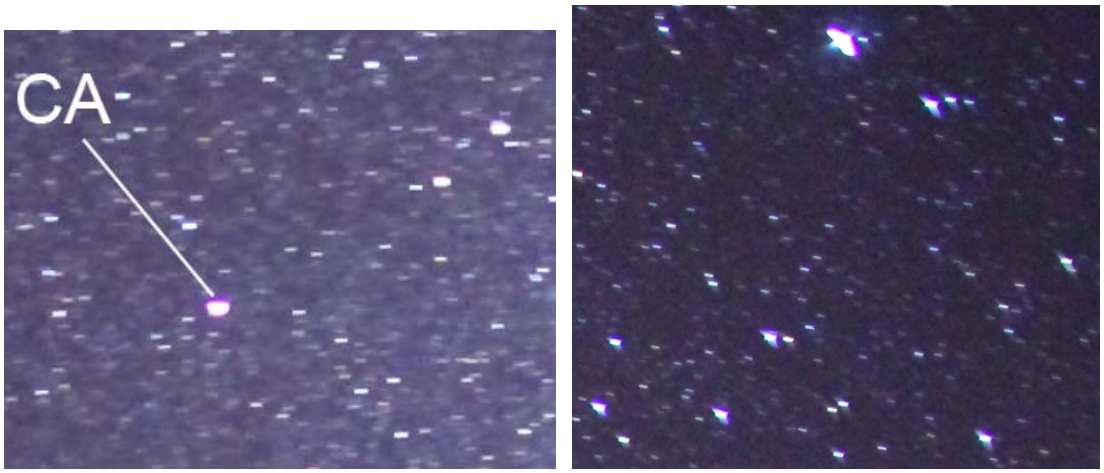
Terlingua Ghost Town Church (Nov. 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

The focus point in the photo above is a split between the church and stars. I focused on the stars (using the method to find infinity as described in the previous section), then backed off just a little on the focus (towards a closer focus point). The actual point of focus stopped short of the church and was therefore somewhere out in space between the church and infinity.

The whole point was to get the "best of both" focus points while dealing with the relatively shallow DOF. The end result was that the stars were a tad bit soft as well as the church. Proper sharpening (done in post-processing) created reasonably sharp stars and church details in the final 18x12 inch print.

Note that this was done on a foreground object (the church) that was more than 20-30 feet away. This approach would not have worked on the previous photo of the cross because it was so much closer than the church.

4.4.3 Bad Lens Characteristics



100% Views: Chromatic Aberration (CA) and "Seagulls"
(Canon 5D + Canon 24mm f/1.4L II lens)

CA (chromatic aberration, i.e. purple/red fringing) can be an issue. As I mentioned at the beginning, this type of photo can be a torture test for your lens.

CA usually happens near the edge between bright and dark areas (like the stars and night sky). "Seagulls" (or lens halation) usually happen in the corners.

You can deal with the CA in post processing, and most RAW converters have a tool to help eliminate it.

However, my experience has been that these undesirable lens characteristics are worst with the lens focused on infinity. The mid/fore-ground focused shots (see section 4.4.2; where the stars are in soft focus) exhibit much less CA and halation (it's mainly not noticeable just because the objects at infinity (the stars) are slightly soft).

Shooting at, or near, wide-open apertures will also exhibit any vignetting characteristics of the lens. In my opinion, vignetting helps these types of photos. It helps to put an emphasis on the

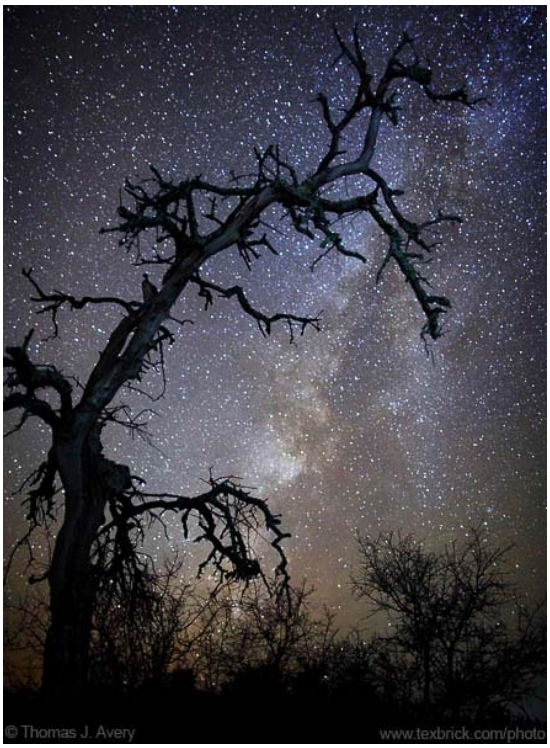
Milky Way (which is usually somewhat centered in the photo) and any objects silhouetted in the photo.

I've found that the difference between f/2.0 and f/2.8 on my 24mm fast prime is significant regarding vignetting. If I want to eliminate it some, then I will bump the ISO up and shoot at a smaller f/2.8.

4.5 Light Painting

You can get interesting results by artificially lighting the objects that are silhouetted against the sky. Light painting these types of photos takes **very** little light. Remember that the combination of the relatively wide aperture and high ISO setting gathers A LOT of light!

Three of the photos in this section have appeared previously in this article, but I will state the details of the light painting.



Tree and Milky Way, Texas Hill Country (Oct. 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

This was a happy accident. The faint blueish light on the tree was from my LED headlamp. I had my back to the tree and was shining my headlamp on the ground during the exposure. The light reflected off the ground and then the tree, and it was just enough to show up in the exposure!
(For a better look at this, see: http://www.texbrick.com/photo/dl_fall09/4326.jpg)

I actually had to lighten it a little in post processing, but there was enough headroom in the file to bring out detail in the tree trunk (which would have been pure black if my headlamp had been turned off).

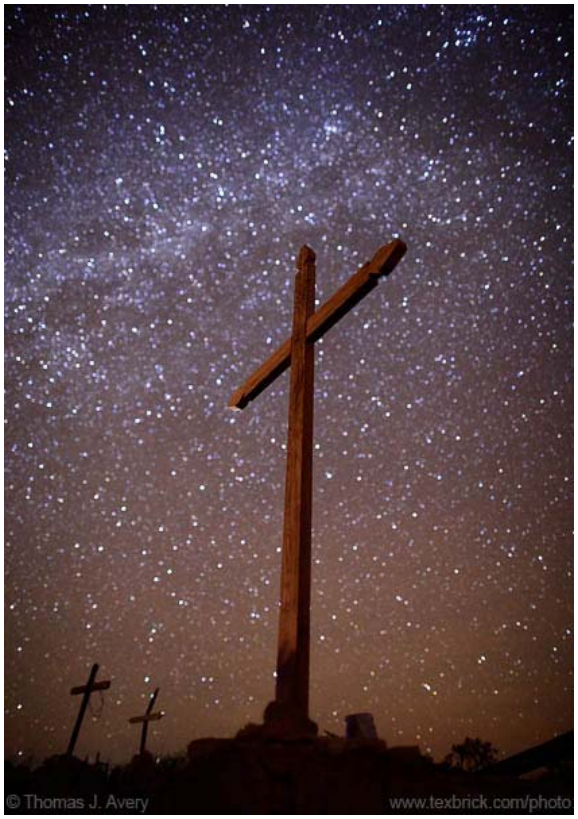
Tree and Milky Way, Texas Hill Country (Dec. 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

The trees in this photo were lit directly from my LED headlamp. Each tree was hit with a very quick pass of the lamp. Total illumination time was probably less than a second for each tree. Yes, it's THAT sensitive!

Zodiacal Light, Big Bend National Park (Mar. 2009)
24mm, 25 seconds, f/1.8, ISO 1600
(Canon 5D II + 24mm f/1.4L II)

This was my first attempt at light paining with this type of photo. I'm actually in this photo, squatting behind my tent. I lit the tent for 2 to 3 seconds with my LED headlamp. The light was

actually too much and resulted in blown-out areas on the tent that I was not able to recover in RAW processing.



Crosses and Graves in Terlingua Ghost Town Cemetery (Nov. 2009)
24mm, 25 sec., f/1.8, ISO 3200
(Canon 5D II + 24mm f/1.4L II)

And, as mentioned earlier, the light on the cross in this photo was ambient light coming from a nearby structure. The faint light hitting the cross was not really visible with the naked eye. It was another happy accident that the light was sufficient to illuminate the cross and show just enough detail to see the grain in the wood. When I reviewed the shot on the LCD in the field, I could see the effect and was quite happy with the results.

I cannot provide a technical 1-2-3 step formula for light painting. There are too many variables. It's more of an art than a science, and you learn by experience and trial-and-error.

Just one warning- if you see blinking areas (blown highlights) when you review the photo in the field, then go back and re-shoot it. It's been my experience that when I blow highlights while light painting, they're toast and cannot be fully recovered in RAW processing. It's too easy to "paint" too much light on a subject.

And remember that these high ISO shots have less dynamic range relative to your camera's base ISO settings and therefore have less headroom (i.e. the ability to recover blown highlights in RAW processing).

5. Post Processing

There are two phases to my post-processing routine. First, a huge disclaimer: there are a dozen and more ways to get from RAW file to the final image. My way is just my own. You do not have to do it this way.

5.1 RAW Processing

If you've shot as per the recommended shooting settings given earlier, then your exposure should be good enough. If it appears too dark or light, then definitely give the exposure slider a tweak in the RAW processor of your choice.

I've pushed up my shots as much as 1 stop before with decent results. The drawback is the noise increases substantially, so heavy-handed noise reduction is a must.

I shoot Canon and process the RAW files using the Canon DPP software. Below is a list of my typical settings, and similar settings are available in other RAW processors such as Adobe Camera RAW:

- exposure (not usually tweaked, but can be done if necessary)*
- white balance: tungsten, and then warm it up slightly using the *tune* adjustment
- black point: I adjust it *slightly* (DPP's histogram and adjustment curve are crude, and leveling the black point is not exact)
- contrast: usually 0, but adding +1 is sometimes okay (to taste)
- sharpness: 3 and sometimes 4 (generally a low setting for the first-stage sharpening; you don't want too much here)
- Luminance noise reduction: 5 or 6 (this is at the expense of detail so go easy with this setting)
- Chrominance noise reduction: 11 to 15
    - note: view the noise reduction at 100% and adjust to taste
- Apply chromatic aberration with color blur (to taste – it sometimes doesn't look good)
- All other settings: default or neutral

* Note: I may process the file twice: once at the base exposure and then another with the exposure adjusted up to a stop either direction (each "process" results in one TIFF file as the output).

The purpose of this is to combine two exposures to emphasize something. For example – if I have a faintly light-painted foreground subject that isn't bright enough compared to the sky, I will process the first file as-is (for the sky area) and then a second file at +1/2 or +1 stops exposure adjustment for the foreground object. These two files will be combined in Photoshop later.

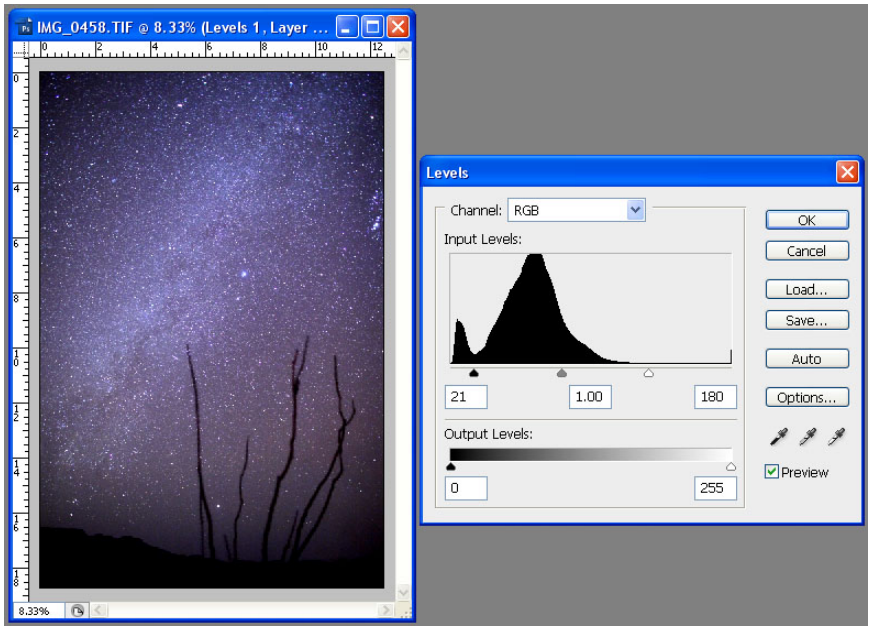
Convert to a 16-bit TIFF file. I use the Adobe RGB color space because that looks best for my printing needs.

5.2 Photoshop Editing

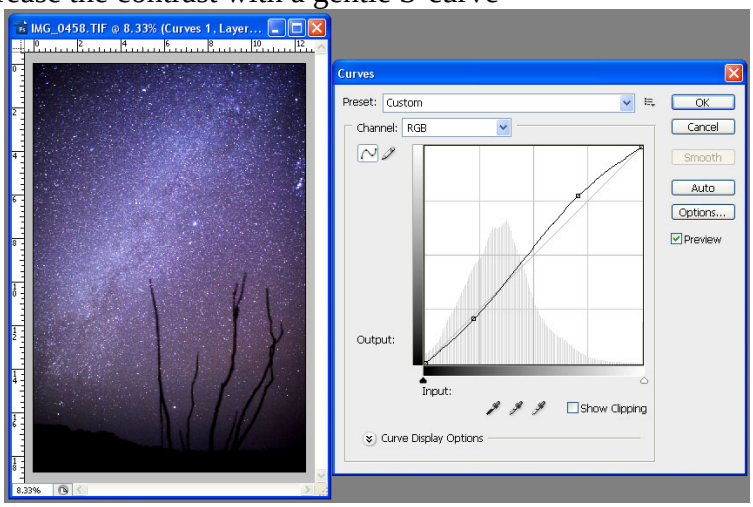
For all of my photography in general, my editing in Photoshop is done gently and minimally. Most of my workflow is just simple Levels, Curves, dodge/burn, and perhaps a color adjustment.

- Combine multiple exposures (i.e. multiple files processed from a single RAW file) – ignore this if you're doing just a single exposure.

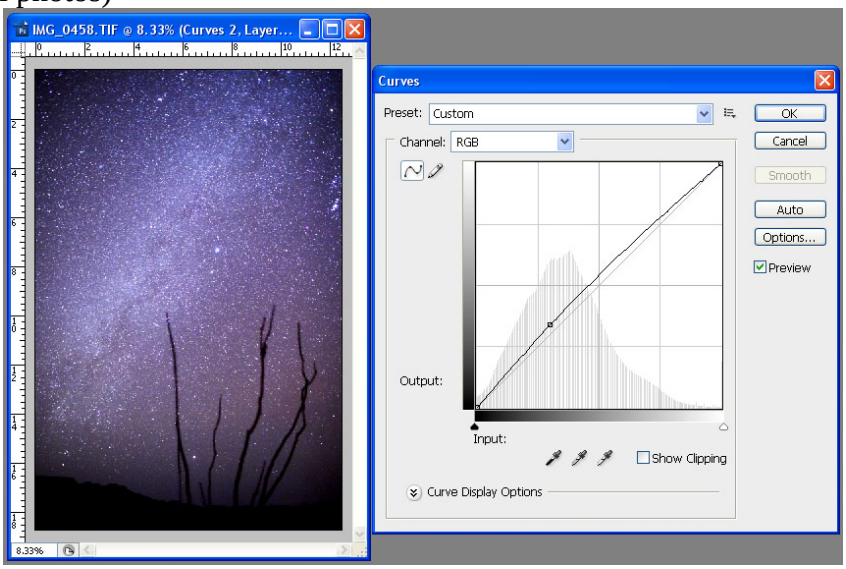
- Set black and white points: use Levels and slide the left and right ends towards the center. The stars may already be at their white point, so sliding past that won't hurt too much (just do it minimally). The dark ground areas may already be at their black point, but the sky won't.



- Curves 1: increase the contrast with a gentle S-curve

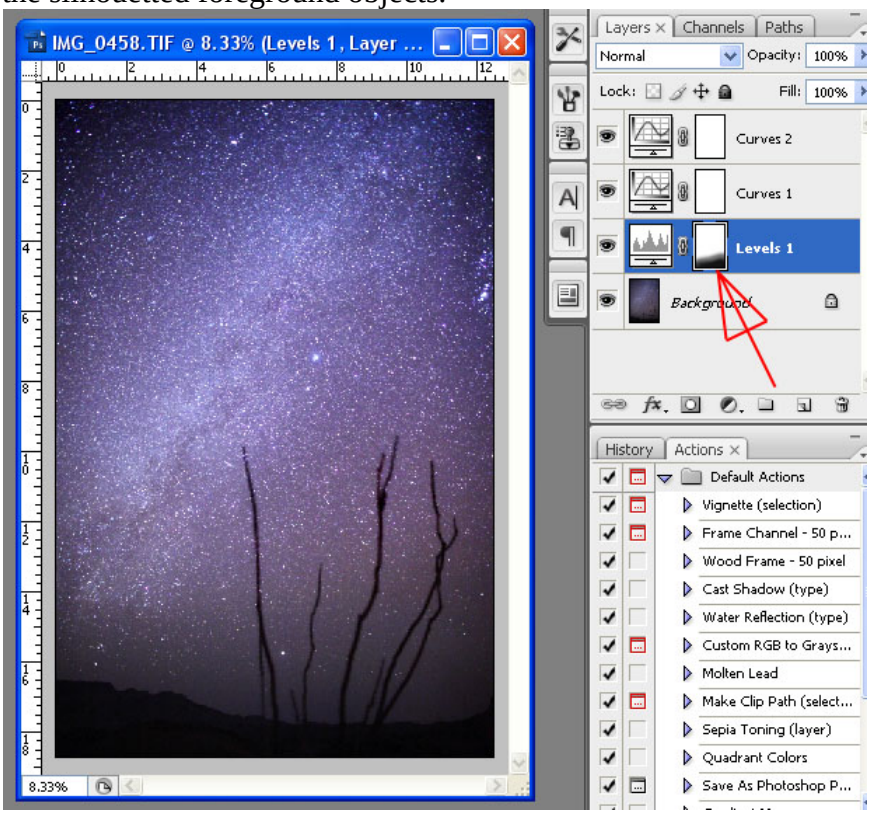


- Curves 2: bump up the low/middle tones gently (I would consider this optional – it's not best for all photos)



- Color adjustment: the sky is probably a blue/purple color at this point. If it's too much, then change the curves layers (the ones just made) blending type from normal to luminance. If you want more color, then increase the saturation a bit. (if you've captured the deep, core parts of the Milky Way in your photo, they may appear reddish; consider selectively saturating those parts so the red tones stand out more and compliment the blue tones of the sky better)

- Selective adjustments: if you have a foreground object that has been light painted, you may want to lighten up selected areas to increase the effect. Also – you may want to "black-out" the Levels and Curves layers (using their layer masks) because they will darken the silhouetted foreground objects.



From this point onwards, it's a matter of personal preference and your own workflow specifics.

I save it as a "MASTER" file and archive it. When I need to *output* the file to something (e.g. a file for printing or web-use), I resize, sharpen, and "save as" to a new file. The "MASTER" file always remains as I originally edited it.

6. The Future

As technological advancements develop in photography, there are several areas to keep note of. These things will benefit this type of photography:

ISO:

Look for better, cleaner high ISO settings (lower noise and increased dynamic range). This will mean better technical quality in the photos and/or the ability to shoot at smaller apertures. The ability to use smaller apertures would mean:

- A wider choice of lenses for this type of photography
- Increased DOF
- Increased sharpness because you would not need to shoot at, or near, the lens' maximum aperture (regarding the general trend of most lenses – their sharpness improves some as you stop down)

Live View:

More sensitivity: this will allow easier composition in the darkness.

More magnification: this would allow closer inspection of the preview to make focusing on the stars (or other objects) more accurate (better quality LCD screens would help as well)

Lenses:

The advancement in lenses will most likely take place on an order of magnitude slower than advancements in digital photography, but it's something to keep note of.

Recently, Nikon introduced a new design: a 24mm f/1.4 (Canon has had a lens of this specification for quite a while). This lens has great potential for Nikon shooters.

Also, newer versions (i.e. "revisions") of existing lenses can happen. These newer designs should be sharper and will provide an advantage to this type of photography since most photos are taken at, or near, maximum aperture.

Two lenses that are readily available with the right specs are the Sigma 20mm and 24mm f/1.8. However, every review that I've read on these lenses states that they are poor performers in sharpness until they are stopped down some. I hope that someday Sigma revises their design and improves them.

TJ Avery
Houston, Texas
May 18, 2010

