

Making Nature Time-lapse Movies: An Introduction

www.joelefevrephoto.com

email: joe@joelefevrephoto.com

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I. Introduction

We've all seen them: time-lapse movies of flowers opening over time or clouds racing by in a beautiful sky. Now, with the advent of digital cameras and fast home computers, we can make our own time-lapse movies. In this session I will show you how.

Time-lapse photography is a technique in which images are captured at a much slower rate than video, which is normally filmed at 24 frames per second (fps). When a time-lapse movie is played back at a standard speed of 24 fps, relatively long periods of time are condensed into a short video.

The technique has been around for a long time. It was first used back in 1897 by Georges Méliès in his motion picture *Carrefour De L'Opera*. In 1909 Jean Comandon used it to document various biological processes, while in the 1950's Dr. John Ott animated plants with time-lapse photography in his film *Dancing Flowers*. In 1992 Ron Fricke made limited use of time-lapse photography in his stunning documentary film *Baraka*, about which the late film critic Roger Ebert said, "The restored 2008 Blu-ray DVD is the finest disk I have ever viewed, or ever imagined." In 1995 David Attenborough made extensive use of time-lapse in his film, *The Private Life of Plants*, while the popular 2006 BBC documentary series *Planet Earth* shows stunning time-lapse sequences shot from orbiting satellites. Recently, filmmaker Tom Lowe took time-lapse photography to a whole new level in his 2012 epic film *Timescapes*.

II. Field Techniques

A. Choosing a subject

The first question that we should ask is, "What kinds of scenes lend themselves to an effective time-lapse movie?" I always look for movement of some kind. Scenes that do not change over time are not appropriate for this technique. An interesting, static foreground object helps to anchor the scene. Here are some examples that I have shot as time-lapse movies:

- Cloud movement
- Sunrise or sunset
- Moonrise or moonset
- Clearing fog
- Intermittent light (sun or moon) on the landscape
- Melting snow
- Stars

Once you have chosen your subject, you must decide how long you want your movie to be. This requires a little bit of math, so stay with me! The normal playback rate for a movie to run smoothly is around 24 frames per second (fps). If you want your movie to be one minute long (60 sec) that means you must make 1,440 (24 fps x 60 sec = 1,440) exposures! Now you can see why this was next to impossible to do using a film camera with 36 exposure rolls of film! If you make one exposure every 5 sec, the elapsed time

will be $1,440 \text{ frames} \times 5 \text{ sec/frame} = 7200 \text{ sec}$. Since there are 3600 sec in one hour, the sequence will take two hours ($7200/3600 = 2$) to photograph. Clearly, you must do some advanced planning.

B. Equipment needed

Here is a list of equipment you will need to begin shooting time-lapse movies:

- A steady tripod. This is an *absolute necessity* for a smooth running movie! Don't even think about shooting a time-lapse sequence without a sturdy tripod.
- A digital camera with a large memory card (16 to 64 GB). The raw files (more about why I use raw files later) from my Canon 5D Mark II camera run about 20-30 megabytes (mb) each. This means that I can record around 1,200 frames ($25 \text{ mb/frame} \times 1200 \text{ frames} = 30,000 \text{ mb}$ or 30 gigabytes) on a 32 gigabyte (gb) card.
- A fully charged battery. I get about 3-4 hours use from my battery. For longer time-lapse sequences, additional external power is needed. This is beyond the scope of our discussion here.
- A remote timer such as the TC-80N3 Timer Remote Controller if you are a Canon user. Many of the latest Nikon DSLR's have the timer built in. Without a remote timer you will have to manually trip the shutter for each exposure. Believe me when I say that this gets very old after about 10 minutes!
- Hand warmers. I learned the hard way that over time, especially late at night and early in the morning, dew has a tendency to form on the front lens element, thereby obscuring your view. I solved this problem by placing a couple of chemical hand warmers around the lens barrel, securing them with rubber bands. If you can keep the temperature of the lens above the dew point, moisture will not form on it.

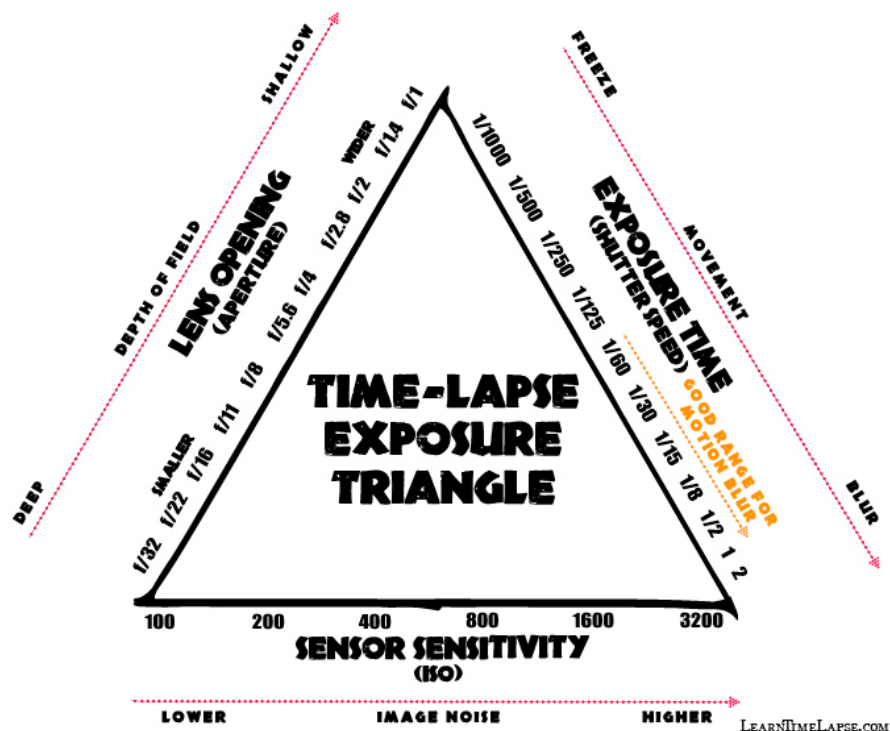
C. Camera settings

In setting up your camera here are some general rules:

- Shoot raw files or high-quality JPEGs. I almost always shoot raw files for two reasons. First, it gives me maximum flexibility in adjusting the color temperature later in post-processing. This is especially important when I shoot star time-lapse sequences. Second, the larger files give me plenty of flexibility for cropping and zooming in, using a "Ken Burns effect." The only time I would shoot jpeg files is if I need to shoot a very long sequence that won't fit on my largest memory card using raw files.
- Do not use auto white balance. Choose a proper color temperature for the scene at hand. Note that this is only an issue if you shoot jpeg files. The color temperature of raw files can be changed during post-processing.
- Use manual focus, and focus on the most important part of the scene. Choose an aperture to give you enough depth of field.
- If you are shooting a scene whose overall brightness does not change significantly, use manual exposure. If you are shooting a widely changing scene in terms of lighting (for example, from pre-sunset to post-sunset), there are two approaches you can make. The first method is to use aperture priority auto exposure. In this case the camera will keep the aperture the same and vary the shutter speed as the light changes. The problem with this method is that slight variations in the exposures throughout the sequence will result in annoying flickering when the

movie is played back at 24 fps. This can be fixed later as I will discuss in the post-processing section of these notes. The second method to use under widely changing lighting conditions is to manually adjust the exposures on the fly by changing the shutter speed. This method also results in flickering, which must be fixed later. I have had good luck with the former method.

- Adjust your exposure using a combination of aperture (lens opening), shutter speed (exposure time), and ISO (sensor sensitivity). Shown in the figure below is a time-lapse exposure triangle from www.LearnTimeLapse.com, which summarizes the relationship between these three variables.



- If you are shooting under low light conditions, as when photographing the stars, use a wide aperture (f/2.8 or wider), a long shutter speed (20-30 seconds) and a high ISO (1600-3200). For shooting the Milky Way (one of my favorite subjects) I will shoot at anywhere from f/1.4 to f/2.8 for 20-30 seconds at ISO 1600-3200. Using a wide-angle lens (14-24mm on a full-frame camera) will render the stars as nearly pin points of light in each frame.
- Make sure your longest exposure (plus the time needed for your camera to write the data to the memory card) does not exceed the time interval between frames. For example, if you are using a 3 second exposure, you must make sure your time interval is approximately 4 seconds or longer. Your time interval between exposures cannot be shorter than your longest exposure.
- For cloud time-lapse sequences I make one exposure every two seconds for fast-moving clouds and one every five seconds for slow-moving clouds. I use a playback rate of 24 fps. For a star time-lapse I use 20 to 30 second exposures, with a one or two second break before starting the next exposure. Since fewer

exposures will be made in a given amount of elapsed time compared with a cloud sequence, I normally play the star movie back at around 15 fps.

- Consider “dragging the shutter.” This refers to using relatively long shutter speeds to smooth the movement in playback. An example of when this is desirable would be waves washing up on a shoreline. If you use a fast shutter speed in this situation (1/125 sec. or faster), the resulting movie will exhibit staccato, stuttered motion in the waves. Using a longer shutter speed such as 1/4 second or longer will render the waves much smoother in playback. If the conditions are relatively bright, you will need to use a neutral density filter to cut down on the incoming light so that you can lengthen your shutter speed. Neutral density filters in the 3-6 stop range work well for this purpose.

III. Post-Processing

After you shoot your time-lapse sequence, it's time to process the images. The images can be edited in several different programs such as Lightroom or Adobe Camera Raw. I prefer Lightroom for its ease of use and powerful processing tools. Once edited, the files are made into a movie. There are several options such as QuickTime Pro, which I will describe below, Adobe After Effects, Premiere Pro, or Final Cut Pro X for Mac users.

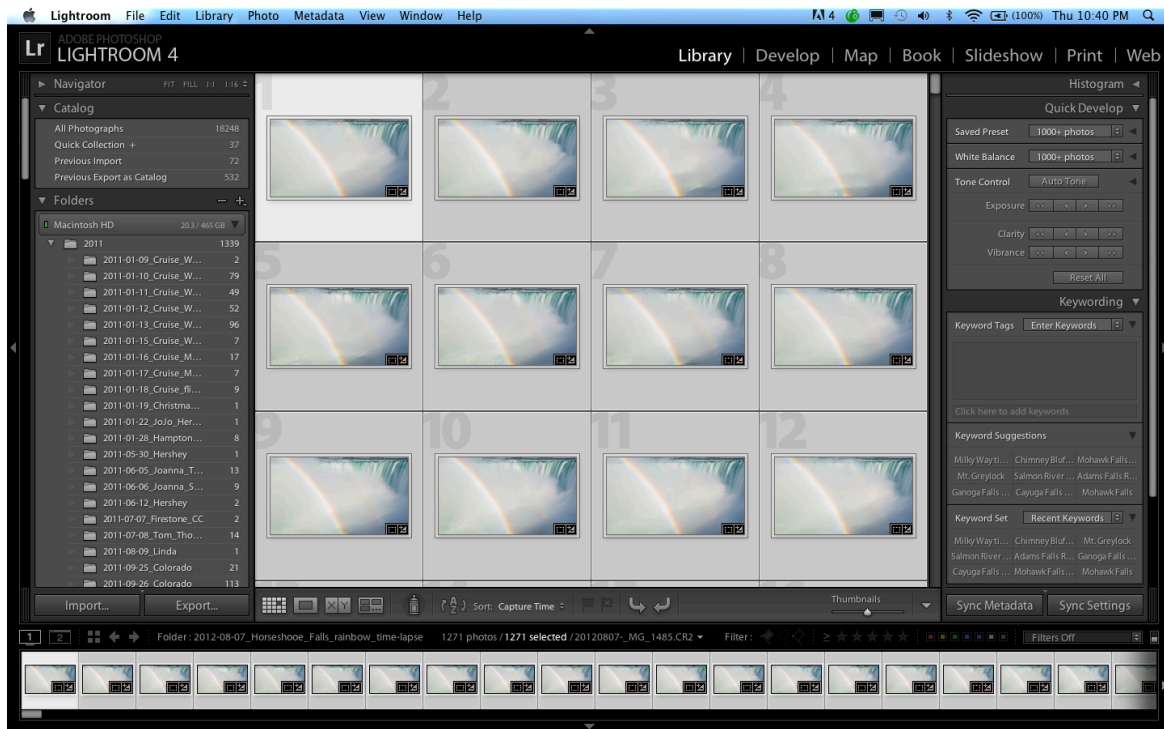
A. Import and edit images in Lightroom.

First, import your images into Lightroom from your memory card and place them into a single folder. In this example, I will use 1,271 photos of a rainbow moving across Niagara Falls taken at 4-second intervals over a 1 hour and 25 minute time period. Highlight the first image and open it in the Development Module as shown below. Here, I



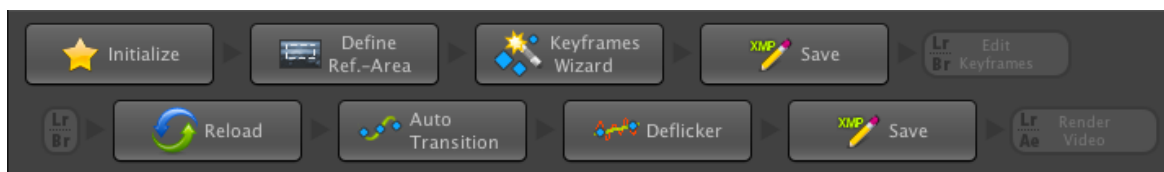
made adjustments to Exposure, Highlights, Shadows, Clarity, Vibrance, and Saturation. Next, I applied these changes to all 1,271 images. To do this, go back to the Library

Module and make sure the first image is highlighted. Hold down the Shift key, and left click on the last image of the sequence. Click on the Sync Settings icon in the lower right and the settings from the first image will be applied within seconds to the remaining images in the sequence as shown below. This saves a tremendous amount of work. Imagine having to make all these adjustments manually to all 1,270 remaining images!



B. Editing images in LRTimelapse

For more complex editing I use a wonderful program called LRTimelapse written by Gunther Wegner (www.lrtimelapse.com). This program is especially useful for removing flicker, and making smooth day to night transitions. Shown below is an overview of the basic LRTimelapse workflow.

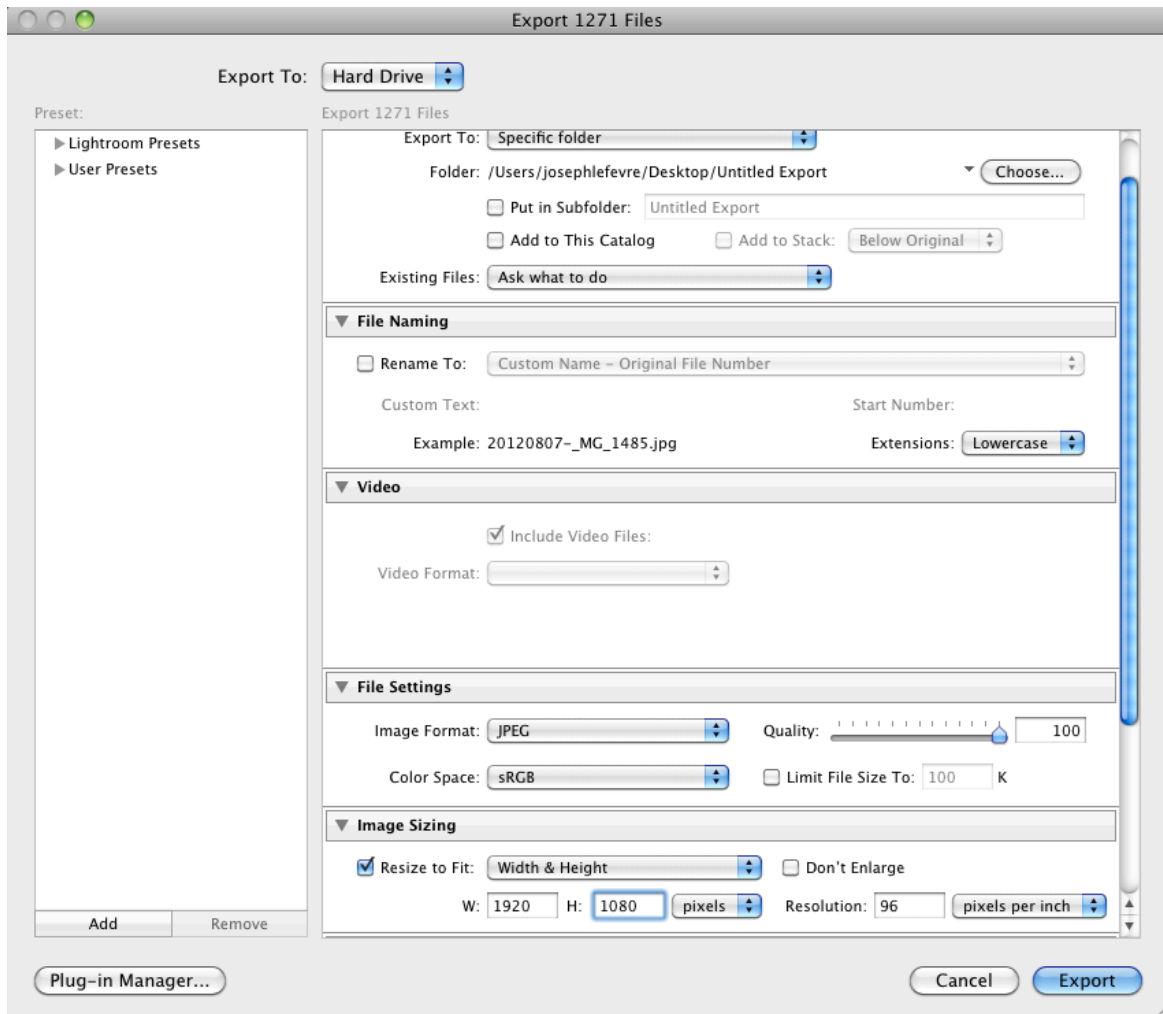


First, the images are imported from Lightroom and initialized. Next, a reference area is defined. Third, keyframes are selected. These are frames where, for example, changes in exposure are made. Next, the keyframes are saved in the XMP data. Upon returning to Lightroom, the keyframes are easily identified and modified in the Develop module. After saving the new XMP data, the images are reloaded into LRTimelapse. When the Auto Transition icon is clicked, the program makes a smooth transition of exposure changes (in this example) in all the images between the keyframes. This is extremely powerful in ensuring smooth transitions. If there is flickering present, clicking on the Deflicker icon

effectively removes it. Finally, the XMP data is saved once more, and the frames are ready for rendering the time-lapse movie in your favorite software. It is even possible to produce the movie in Lightroom using some of Gunther Wegner's templates available on his website.

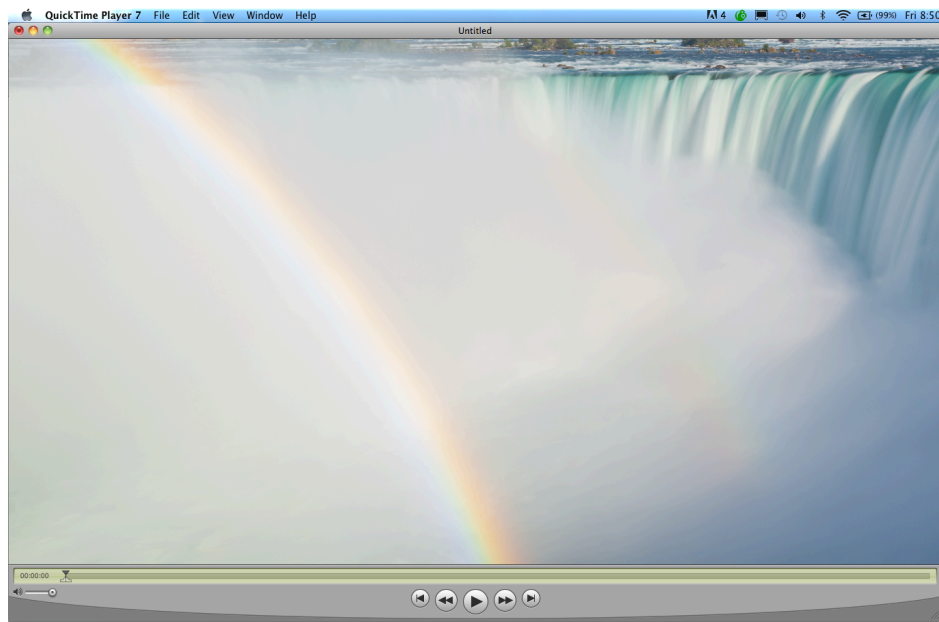
C. Making the movie in QuickTime Pro

We are now ready to make the movie using QuickTime Pro. First, export the edited images from Lightroom to a folder. Right click on the first image and choose **Export > Export...** An Export window appears as shown below.

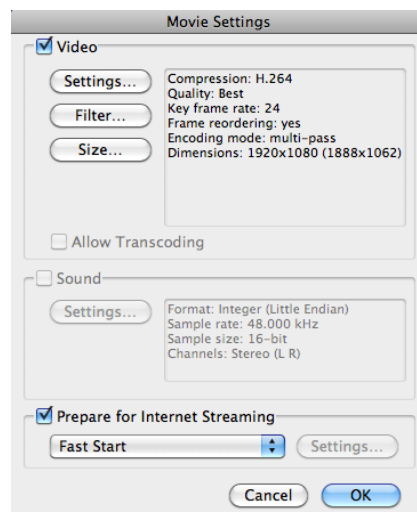


Choose a specific folder to which the images will be sent. In this example, I want to make a high definition (HD) movie, using high-quality jpeg files, which measure 1920 x 1080 pixels. Therefore, for **File Settings** I chose **Image Format: JPEG, Quality: 100, Color Space: sRGB**. Check **Resize to Fit**, and adjust width, height and resolution as follows: **Width & Height W: 1920 H: 1080, Resolution: 96 pixels per inch**. For **Post-Processing/After Export** (not visible in the figure above) choose **Do nothing**. Make sure you *do not* choose Open in Adobe Photoshop. If you do, it will attempt to open all 1271

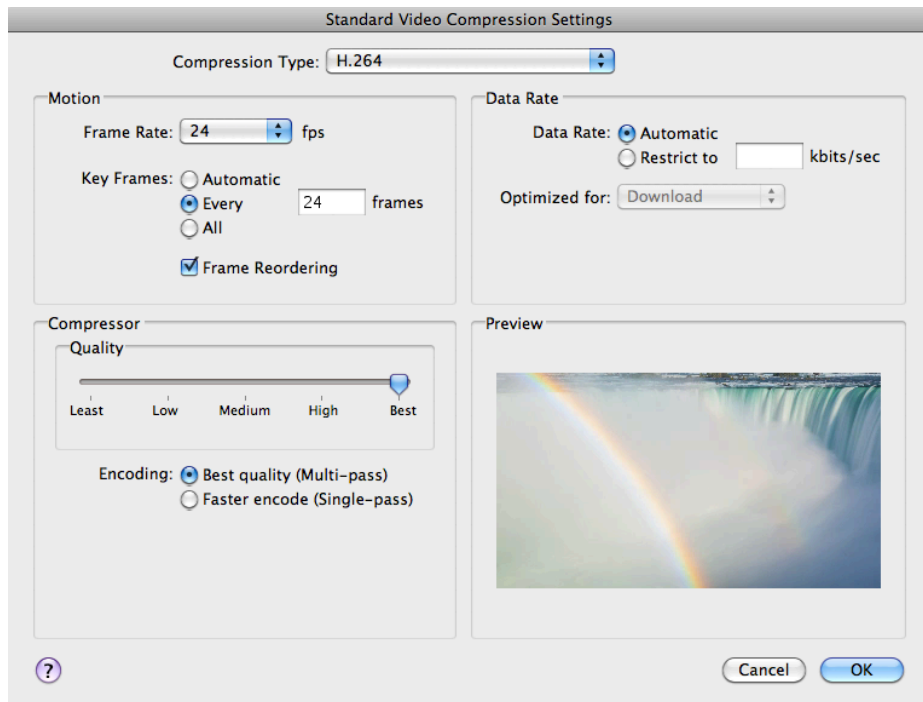
raw files in Photoshop. Click **Export**. It will take some time for the images to be transferred to your folder depending on the speed of your computer. Go read for awhile... To make the movie you will need QuickTime Pro. You can purchase it for approximately \$30 (<http://www.apple.com/quicktime/pro/>). To begin, open QuickTime Pro. Choose **File > Open Image Sequence...** Navigate to your folder, which contains the images in sequential order, click on the first image of the sequence, and then click **Open**. A window entitled **Image Sequence Settings** will appear. Choose a **Frame rate of 24 frames per second** from the drop down menu, and click **OK**. The program will assemble the movie. After a short time, a window will appear containing the first frame of your movie. To make it fit on the screen, click on **View > Fit to Screen**.



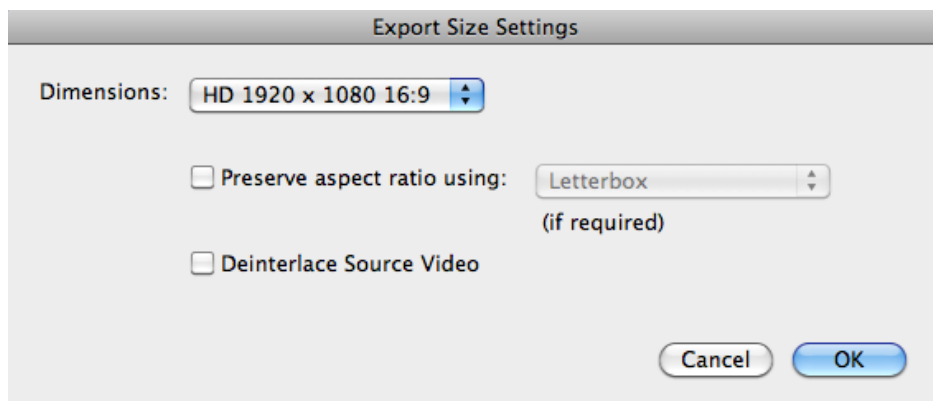
To export and save the movie, click on **File > Export** and a window entitled **Save exported file as:** will appear. Choose **Export: Movie to QuickTime Movie** and click on **Options...** A **Movie Settings** window will appear.



Check **Video** and click on **Settings**. A window entitled **Standard Video Compression Settings** appears.



Choose **H.264** for the **Compression Type**, **Frame Rate: 24 fps**, **Key Frames: Every 24 frames**, **Data Rate: Automatic**, **Compressor Quality: Best**, and **Encoding: Best quality**. Then click **OK**. Back in the Movie Settings window choose **Size**, and a window entitled **Export Size Settings** appears.



A number of choices are available in the drop down menu. I chose **HD 1920 x 1080 16:9** for the dimensions. Choose **Custom** if you want to specify your own dimensions, then click **OK**. When all these parameters have been chosen, navigate to a folder that you want to save your movie in, enter a name for the movie after **Save as:** in the **Save exported file as:** window, and then click **Save**. The movie will be saved in the folder you have designated. To play it, click on **File > Open File...** and navigate to the folder where you saved the file. Click on the play icon.

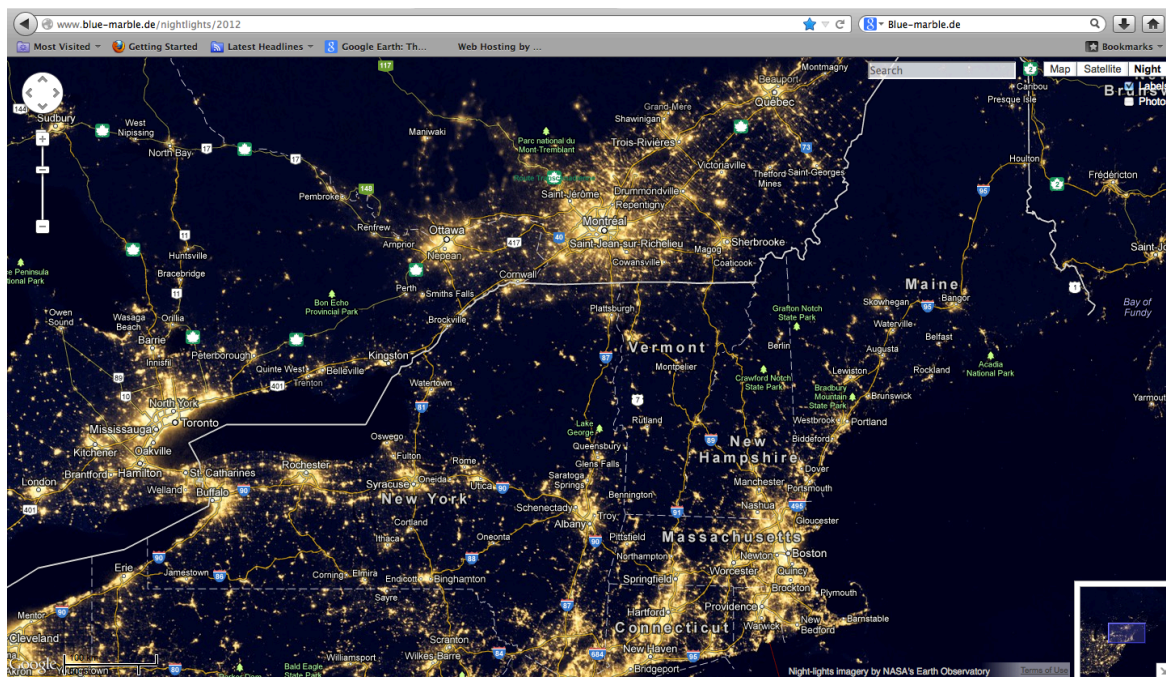
To add music to your movie, choose an MP3 music track that is approximately the same length as your movie. Within QuickTime Pro, select **Open File** from the File menu, and navigate to your music file. Once it is open, choose **Edit > Select All** followed by **Copy**. Open your movie and be sure the time cursor is at the start of the movie (00:00:00). From the Edit menu choose **Add to Movie**. The music will now be imbedded in your movie.

IV. Planning, Shooting, and Processing a Milky Way Time-lapse Movie

In this section I will show you some of the thinking that goes into producing a time-lapse movie of the Milky Way galaxy. There are some special considerations that must be taken into account to be successful in this exciting endeavor.

A. Find a dark location.

This is critical to the success of your project. Light pollution from cities will greatly diminish, if not completely obliterate, views of the Milky Way. A good way to evaluate potential places is to use a map, which shows world-wide light pollution at night (<http://www.blue-marble.de/nightlights/2012>). A view of the northeastern US shows that good star viewing is possible in the Adirondack Park in upstate New York, north central Pennsylvania, northeastern Connecticut and Massachusetts, and most of Vermont, New Hampshire, and Maine.



B. Plan carefully.

Shoot at a time somewhere near the new moon. Light from the moon will diminish your views of the Milky Way, so it is best to shoot close to the time of the new moon. A good way to determine this is to use the Photographer's Ephemeris, which will show you where and when the moon (and sun) will rise and set (<http://photoephemeris.com/>). You must also know when and where to find the Milky Way. In the northern hemisphere, you will find the brightest parts of the Milky Way visible in the summer months. In late May it

risers around 11 pm in the southeast. In June, July, and August you will find the brightest parts visible to the south and southwest. A free download called Stellarium can help you locate the Milky Way (<http://www.stellarium.org/>). My favorite tool in this regard is an iPhone app called Starwalk. The advantage of this is that you can scout a location beforehand and see exactly where the Milky Way will be at a given time in the future. This is an invaluable tool in helping me find a suitable foreground during the daytime. It is very difficult, if not downright dangerous, to scout a location in the dark. Shown below is a location I found east of Tupper Lake, NY with the aid of my good friend, professional photographer Mark Bowie. I was looking for a location that would afford me interesting foreground trees with a lake in the background and a view to the southwest. I had



Star Walk with me, and it showed that the Milky Way would be visible across the lake



in mid-September starting around 9 pm. Now, it was only a matter of returning on a clear night near the new moon. This occurred on the night of September 15, 2012. I returned and was able to capture the requisite images for a successful time-lapse sequence.

C. Shooting the sequence.

First, the camera was securely locked down on a sturdy tripod. I used a 14-24mm zoom lens set at around 16 mm. I used f/2.8 as a lens aperture (wide open) and focused on the stars at infinity. Auto focus must be turned off. I knew from previous experience where the infinity focus is on my lens barrel. I taped it down so that the focus would remain secure. The ISO was set to 3200. An exposure of thirty seconds was used for each raw file, with a 1-2 second delay between exposures. I did not use high ISO in-camera noise reduction. This would add an additional 30 seconds of dead time before the next exposure could be made. This is too long of a time interval between exposures for the stars to move smoothly across the sky in the final movie. A total of 321 exposures were made over a 3 hour and 15 minute time period. The color temperature was arbitrarily set at 4850 K. Knowing from Star Walk that the stars would be moving across the scene from left to right as the night progressed, I placed the Milky Way on the left side of the frame. Here is the first image of the sequence right out of the camera as viewed in Lightroom.



D. Processing the images.

As you can see, the image needs some work. The color cast is too warm for my liking, and the image lacks contrast. The following adjustments were all made in Lightroom in the Develop module as shown in the figure below. Most notable are the following

adjustments: WB: (white balance) 3222 (made the color bluer), Contrast +40 (increased global contrast), Clarity +64 (increased local contrast), Luminance: Blue +73 (made the stars shine brighter), Noise Reduction: Luminance 60, Detail 30 (smoothed out some of the digital noise resulting from shooting at ISO 3200).



Here is the first frame of the sequence with all of the adjustments applied. The orange color on the horizon was from an unknown light source. Now that's more like it!



The same adjustments were applied in Lightroom to the remaining 320 images, and the movie was produced in QuickTime Pro as described in section III above.

V. Putting Them All Together

After awhile, you will accumulate several time-lapse movies that you may want to string together into a sequence of separate movies. There are many options for doing this. I will not elaborate on these here in detail, but I will mention a few possibilities. If you are a PC user you can use a free program called Windows Movie Maker (<http://www.windows-movie-maker.org/>). This program will allow you to add transitions, sounds and captions. Another possibility for PC users is ProShow Gold (<http://www.photodex.com/proshow/gold>). Simply drop your videos onto the timeline, add your transitions and music, and you're good to go! For Mac users, Final Cut Pro X (<http://www.apple.com/finalcutpro/>) is an excellent choice. Adobe Premiere Pro (<http://www.adobe.com/products/premiere.edu.html>) is the Cadillac of movie processing software and is available for both the PC and the Mac platforms. However, it is quite expensive.

Good luck as you create your time-lapse masterpieces!