

iDigBio Imaging Equipment Recommendations

Target audience: Digitization Specialists

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This document contains recommendations for cameras, lenses and other imaging equipment to support a digitization program at your institution. We describe the ‘good’, ‘better’, and ‘best’ solutions ranging from those on a tight budget to those with a Cadillac budget. As with most technology, more money usually buys more features, and camera equipment is no different, unless you are leapfrogging technology and the newer product is better featured and lower priced. No one should be reluctant to go for the ‘good’ options though. If they were not good enough we would not recommend them. The difference in the price options applies mostly to camera bodies and lenses. For camera bodies this variation in price affects mostly the sensor size and for the lenses it applies to the f/stop – the smaller the f/stop on a lens the better. For example, the Nikon 50mm f/1.4 has better support for a wider variety of lighting conditions than a Nikon 50mm f/2.8.

Every imaging setup requires the following basics:

- 1) Copy stand
- 2) Camera
- 3) Lens
- 4) An AC adapter to allow you to run your camera off of wall power instead of batteries.
- 5) Remote trigger release to account for jitter when pressing the shutter
- 6) USB cable long enough to reach from where your camera is to your computer, so that you can run your imaging in tethered mode (the camera attached to a computer) using camera control software, instead of using the shutter button on the camera for every shot
- 7) Camera control software
 - a. Nikon
 - b. Canon
- 8) Image management software – Adobe Photoshop Lightroom (LR)
- 9) A computer - at least 4 GB RAM, 500 GB hard drive
- 10) An alternative item to the ‘open’ format copy stand/camera/lights setup: The eBox = Photo-e-Box BIO. The throughput of the eBox is around 90 sheets /hour. It should be noted that this rate depends on the temperament of the staff for maintaining workflow efficiencies, and on the back team to keep the supply of specimens available. The workflow rate depends also on how much handling the specimens need for placing under the lens.
 - a. https://www.idigbio.org/wiki/index.php/Photo-e-Box_BIO
 - b. Additional links

- i. <http://mkdigitaldirect.com/products/lighting-systems/mk-photo-ebox-plus-1419.html> Note: MK Technologies is transitioning to becoming OR Technologies

- ii. <http://digitalphotorepro.blogspot.com/>

Use of the box allows you to shoot herbarium sheets in rapid succession without having to crop them. The strict adherence to the correct dynamics of camera, and lens combined with the opening in the top of the MK box makes this possible. What this means is results may fall short if the correct lens and camera are substituted. The eBox comes with lights.

11) if you are not buying the eBox, then you will need free standing Kaiser lights.

12) There is a list of miscellaneous items later in this document.

13) Colour checker and ruler

We divide the camera choices up by vendor, Canon and Nikon. Our experience is that B&H Video and Photography in NYC is a good all around source for imaging equipment and service, alternatives are Calumet, Adorama and Amazon.com. Additionally, if your institution permits, there is often good used/reburished equipment available. For example, eBay for Kaiser copy stands, LensAuthority and B&H for camera and lenses. These kinds of savings can often allow you to get better equipment than you would by purchasing it new.

We are recommending a full-frame camera (FX) rather than a cropped-frame camera (DX) as the overall resolution (what you can fill the frame with), the pixels count is higher. More pixels are not always better. See 'Resolution' below.

Purchase the camera as a camera body, and add the prime lens. Most stores bundle a zoom lens with the camera, and you want to buy them separately. The zoom lens is not optimal for copy stand work.

Lenses: !! faithful magnification

The goal with the lens you choose for your copy work is to achieve 1:1 magnification. This means that you want to be able to make an image that faithfully reproduces a real-life image, without losing information (becoming fuzzy). When your digitized specimen is displayed on the web from your online catalog, people will be able to zoom in on the image and see more and more detail. This great detail will have a lot to do with your sensor size as well, since the more pixels you have in the camera sensor, the better your range of image sizing you have, the more it will be faithful to your image subject. This applies to printing your images as well (e.g., for member's night or PR material). Enlarging the image does not increase the number of pixels in the image, so you want as many as you can to keep the fidelity of the image to the naked eye when the image is magnified (zoomed) to 1:1.

Our package definitions below come with a camera and a lens. You can mix and match, staying with same vendors.

In the lens list are some more refined macro lenses for serious close up work. The average herbarium sheet-sized specimen will MORE than fill the frame using the 100 and 105mm lenses, and we recommend them instead for packet-based specimens like lichens, macrofungi, or 3D objects like fossil ferns, things smaller and more challenging to photograph. It is possible to purchase the box in different sizes, so consideration should be paid to assessing the average sized specimen before purchasing. A fish collection at KU bought a supersized eBox and made further customizations to allow for a tray in the bottom for wet specimens, and also to paint the inside of the top black to avoid reflection from the lights on the fluid in the tray. Keep in mind the original motivation for the design and creation of the box for herbarium sheets: perfect lighting, no shadows, no cropping, portability, no time spent placing the ruler and colour checker. One might want to use the box without feeling the need to meet those particular goals in toto. If those goals were no longer paramount, then some of the careful dynamics of camera type/lens/box opening are no longer as critical.

Focus: sharp

Another goal is for the image to be sharp. This can be controlled by either having the camera in auto-focus mode, and making sure it has contrasty info to look at to achieve good focus, or by putting the lens and camera in manual focus and taking practice shots until when you zoom in to 1:1 in the image capture software (LiveView) it is still sharp.

Another goal is to make sure you fill the frame with your specimen, no more no less. Be mindful to leave a modest border of background around your specimen to achieve that ‘not cramped’ look. The goal should be the whole herbarium sheet with little or no need to crop (cropping wastes pixels). If you are using the eBox, this should happen automatically if your set up is correct.

Other image goals

White balance: accurate

This assures that your images have no untoward colour casts. These can be caused by the camera not being set up with consideration for the kinds of lights you are using (e.g., LED, halogen, fluorescent). Each of these kinds of lights imparts a particular telltale colour cast. Pay attention to the white balance settings on the camera, e.g., auto, tungsten, fluorescent. The Kaiser or eBox lights you are using may be marked with a rating, e.g., 5400 K (Kelvin). You can set this correction in Lightroom. If you are using a free-standing mini-studio (not the eBox), your room ambient lights will affect your Kaiser studio light balance as well. Try to set up your studio

in a place where you can control for lighting, e.g., guard against strong afternoon light streaming in changing the configured lights values. Experiment by matching the camera setting to the kind of lights in your room, being also cognizant of the ambient lighting in your room.

Exposure: well-balanced

Familiarize yourself with the histogram report in some image management software (Photoshop, Lightroom, Adobe Capture Raw, your camera's LiveView, etc.) – it will tell you, by looking at either end of the graph whether your image is under or over exposed. Adjust the camera f-stop, the lights (closer, farther) and make test images until your image does not fall over either side of the graph. The height of the mountains in the histogram is not important. It is critical to avoid the dangle off the edges. All things being equal, 'shoot to the right' is the saying. The images will look *slightly* overexposed, but that is usually a function of your monitor being over-bright. A histogram that is too far to the left is underexposed (dark), and correspondingly, too far to the right is overexposed (light).

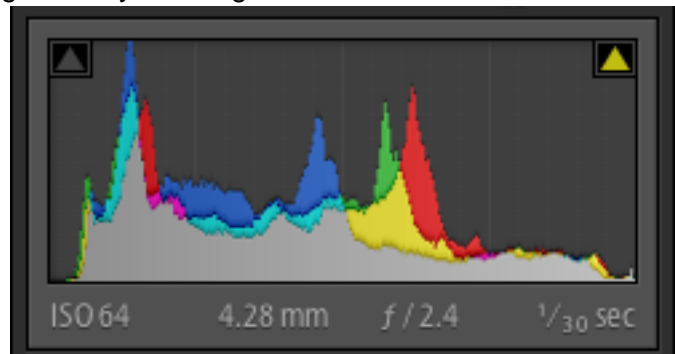


Image resolution

This is the term used by photographers to refer to how many pixels an image has. A full frame camera these days makes an image from a sensor that is roughly speaking 6000 pixels * 4000 pixels. This makes the image resolution in the range of 24 – 35 MP (megapixels). Since megapixels are not all created equal, this number is just an approximation of the expected image quality. The larger the number of pixels, the larger the pixel size, the more sensitive to light, and the sharper the image. The additional factor that distinguishes quality in the image to the visual eye is the RGB (red green blue) software filtering that happens to the image after the pixels have been ignited in the camera's sensor in the process of taking a picture. Digital images are fundamentally slightly soft in focus, the interpretation of the image by the manufacturer determines the image quality, and having more pixels available to help sharpen an image is what makes more pixels better. Our recommendation is to choose a full-frame DSLR with at least a 12 MP sensor. Refer to the subjects of 'anti-aliasing', 'de-mosaicking', 'pixel pitch' for further details. If you find that the images you are making are soft, try sharpening them in the camera.

Camera Lenses

Nikon	Nikon AF-S Micro-Nikkor 60mm f/2.8 ED	\$596
Nikon	Nikon AF-S VR Micro-Nikkor 105mm f/2.8G IF-ED	\$981
Canon	Canon EF 50mm f/2.5 Compact Macro (needs a Life Size converter EF to achieve 1:1)	\$299
Canon	Canon EF 100mm f/2.8L Macro IS USM	\$849

Copy stand: A good solid copy stand makes sure your camera stays put, and has no jitter from ambient causes (barring being on a fault line). If you are photographing the same sized specimens all day, you will not have to move the camera on the stand or adjust the focus, aperture or shutter speed once they have been tested and approved for optimal results. Our recommendation is to find a Kaiser stand that is in stock, as ordering directly from Kaiser can take several months. Unless you are using the eBox, make yourself a marking system of where to place the sheet on the copy stand base, so that you can quickly place it accurately time after time.

Kaiser: http://www.bhphotovideo.com/c/product/93111-REG/Kaiser_205512_Copy_Stand_RSX_with.html

Lights

Kaiser lights: http://www.bhphotovideo.com/c/product/93124-REG/Kaiser_205556_RB_5000_Daylight_Copy.html

If you are ordering the eBox, you will not need lights, they are included with the eBox.

Extra bulbs

Order 2 extra sets of the bulbs on the accessories list. Having spares on hand will ensure that you have no down time when the lights burn out.

Sources for Equipment & Photography Information

Source	URL	Telephone number
B&H	http://www.bhphotovideo.com/	800.606.6969
Calumet	http://www.calumetphoto.com/ 800	800.225.8638
Adorama	http://www.adorama.com/	800.223.2500
Lens Rentals, see also Lens Authority	http://www.lensrentals.com/ http://www.lensauthority.com/	
DPRReview (good for comparing cameras)	http://www.dpreview.com/	

Camera Chart (approximate prices as of Sep, 2015)

Choice	Camera	B&H camera reference	\$
GOOD	Nikon D610 body	B&H Camera	\$1500
BETTER	Nikon D750 body	B&H Camera	\$2000
BEST	Nikon D810 body	B&H Camera	\$3000
GOOD	Canon EOS 6D body	B&H Camera	\$1400
BETTER	Canon EOS 5D Mark III body	B&H Camera	\$2500
BEST	Canon EOS-1D X body	B&H Camera	\$4600

Additional Photo Imaging Equipment

There are a few other things that every imaging station needs:

- 1) a colour checker – one of the benefits of the eBox mentioned earlier is that given the correctly scaled equipment (camera, lens, height of camera on copy stand, and opening in the box), the ruler and the colour checker can be placed in the box and never moved, thus saving time in placing them on or near the specimen) <http://www.digitaltransitions.com/product/targets/colorgauge-nano-target>
- 2) a ruler that can be fitted into the image with little fuss. It can be printed with the herbarium's logo and laminated.
- 3) a barcode scanner. You might be using this to scan in the barcode before imaging to name the image file. An alternative to this in your workflow is to use software to find the barcode in the image if you were using a batch identify sub-task.

General References

Beginners Guide To Imaging Glossary

<https://www.idigbio.org/sites/default/files/sites/default/files/BeginnersGuideToImagingGlossary.pdf>

The AIC Guide to Digital Photography and Conservation Documentation

<http://www.conservation-us.org/publications-resources/special-projects/the-aic-guide#.UnkliJS-CC4>

Setting up your Canon camera

https://www.idigbio.org/wiki/images/8/82/Imaging_Manual.pdf

iDigBio's curated imaging resources

https://www.idigbio.org/wiki/index.php/Digitization_Resources#Imaging_Documents_and_Resources

<https://www.idigbio.org/content/streamlining-collaborative-digitization> - has a great checklist for setting up equipment (notwithstanding the points about a 'site visit').

Digital Photography Review (DPReview): A reliable source of camera comparison information. There are two links below for each of the camera manufacturers we have

discussed. In the interest of space, only the first page screen shot of each side-by-side comparison is included here for your edification.

Nikon

http://www.dpreview.com/products/compare/side-by-side?products=nikon_d810&products=nikon_d750&products=nikon_d610

Note: the Nikon D600 and 710 has been discontinued, but good used models can be found.

Canon

http://www.dpreview.com/products/compare/side-by-side?products=canon_eos1dx&products=canon_eos1dc&products=canon_eos5dmkiii&products=canon_eos6d&sortDir=ascending




Full frame versus cropped frame

This document's premise is that the best equipment you can get for your available funds is the preferred alternative. If a full frame camera is out of reach budget-wise or beyond the scope of your project, less expensive cropped-frame cameras can also produce high quality scientific images and in some instances may be preferred. Important to remember is that the camera under review should support live preview and tethered shooting. For example, several Canon cameras in the EOS Rebel T5 series offer these features as well as image management software. A note about labels: one does not need high-end equipment to image labels. A point-and-shoot in jpg is usually sufficient to capture text on paper, though images of paper labels that are later to be processed through Optical Character Recognition software should be of a resolution to ensure that the height of a lower case "x" is at least 20 pixels.




Mirrorless Cameras

We are keeping an eye on the mirrorless cameras, however at the moment, the ideal Sony does not have a tethering port.

Nikon

Side by side 3 cameras compared ADD CAMERA ...			
	 Canon EOS-1D X ◀ move left move right ▶	 Canon EOS 5D Mark III ◀ move left move right ▶	 Canon EOS 6D ◀ move left move right ▶
Basic Information			
Buying options	\$4,599	\$2,499 - \$5,447	\$1,399 - \$2,198
Review / Preview	Read preview... Oct 18, 2011	82% Read review... May 23, 2012	83% Read review... Feb 13, 2013
Announced	Oct 18, 2011	Mar 2, 2012	Sep 17, 2012
Price			
MSRP		Body only: \$3499, €3299, £2999 with 24-105mm: \$4299	Body: \$2,099.00/£1,799; with 24-105mm f/4L IS USM \$2899/£2,519
Body type			
Body type	Large SLR	Mid-size SLR	Mid-size SLR
Body material		Magnesium alloy	Magnesium alloy, polycarbonate top plate
Sensor			
Max resolution	5184 x 3456	5760 x 3840	5472 x 3648
Other resolutions	4608 x 3072, 3456 x 2304, 2592 x 1728	3840 x 2560, 2880 x 1920, 1920 x 1280, 720 x 480	3648 x 2432, 2736 x 1824, 1920 x 1280, 720 x 480
Image ratio w:h	3:2	3:2	3:2
Effective pixels	18 megapixels	22 megapixels	20 megapixels
Sensor photo detectors	19 megapixels	23 megapixels	21 megapixels
Sensor size	Full frame (36 x 24 mm)	Full frame (36 x 24 mm)	Full frame (36 x 24 mm)
Sensor type	CMOS	CMOS	CMOS
Processor	Dual Digic 5+	Digic 5+	Digic 5+
Color space		sRGB, Adobe RGB	sRGB, Adobe RGB
Color filter array		RGB Color Filter Array	RGB Color Filter Array
Image			
ISO	100, 200, 400, 800, 1600, 3200, 6400, 12800, 25600, 51200 (50, 102400 and 204800 with boost)	Auto, 100 - 25600 in 1/3 stops, plus 50, 51200, 102400 as option	Auto, 100 - 25600 in 1/3 stops, plus 50, 51200, 102400 as option
White balance presets	6	6	6
Custom white balance	Yes (5)	Yes (1)	Yes
Image stabilization	No	No	No
Uncompressed format	RAW	RAW	RAW
JPEG quality levels	Fine, Normal	Fine, Normal	Fine, Normal
File format		<ul style="list-style-type: none"> JPEG (Exif 2.3 [Exif Print] compliant) Design rule for Camera File system (2.0) RAW: RAW, sRAW1, sRAW2 (14bit, Canon original RAW 2nd edition) Digital Print Order Format [DPOF] Version 1.1 compliant 	<ul style="list-style-type: none"> JPEG (Exif 2.3), RAW: RAW (5472 x 3648), M RAW (4104 x 2736), S RAW (2736 x 1824) (14bit, Canon original RAW 2nd edition)

Canon

Side by side 3 cameras compared ADD CAMERA ...			
	 Nikon D810 ◀ move left move right ▶	 Nikon D750 ◀ move left move right ▶	 Nikon D610 ◀ move left move right ▶
Basic Information			
Buying options	\$2,997 - \$6,281	\$1,997 - \$5,281	\$1,497 - \$3,047
Review / Preview	Read preview... Jun 26, 2014	90% Read review... Dec 20, 2014	87% Read review... Mar 12, 2014
Announced	Jun 26, 2014	Sep 12, 2014	Oct 8, 2013
Price			
MSRP	\$3299.95	\$2299.95 / £1799.99 / €2149 (body only), \$2249.99 / €2679.00 (body + 24-85mm lens), €2799.00 (body + 24- 120mm lens)	\$1999/£1799.99/€2499.99 (body only), \$2599/£2299.99/€2499 (with 24-85mm F3.5-4.5 lens)
Body type			
Body type	Mid-size SLR	Mid-size SLR	Mid-size SLR
Body material	Magnesium alloy	Magnesium alloy, carbon fiber	Magnesium alloy top and rear, polycarbonate front-plate
Sensor			
Max resolution	7360 x 4912	6016 x 4016	6016 x 4016
Other resolutions	FX: 5520 x 3680, 3680 x 2456; 1.2: 6144 x 4080, 4608 x 3056, 3072 x 2040; 5:4: 6144 x 4912, 4608 x 3680, 3072 x 2456; DX: 4800 x 3200, 3600 x 2400, 2400 x 1600	FX: 4512 x 3008, 3008 x 2008, 1.2x crop: 5008 x 3336, 3752 x 2504; DX: 3936 x 2624, 2944 x 1968, 1968 x 1312	4512 x 3008, 3936 x 2624, 3008 x 2008, 3008 x 1688, 2944 x 1968
Image ratio w:h	5:4, 3:2	3:2	3:2
Effective pixels	36 megapixels	24 megapixels	24 megapixels
Sensor photo detectors	37 megapixels	25 megapixels	25 megapixels
Sensor size	Full frame (35.9 x 24 mm)	Full frame (35.9 x 24 mm)	Full frame (35.9 x 24 mm)
Sensor size notes	RAW (NEF) available at 12 or 14-bits, lossless compressed, compressed, uncompressed, large or small size.		
Sensor type	CMOS	CMOS	CMOS
Processor	EXPEED 4	Expeed 4	Expeed 3
Color space	sRGB, AdobeRGB	sRGB, Adobe RGB	sRGB, Adobe RGB
Color filter array	Primary color filter	Primary Color Filter	Primary Color Filter
Image			
ISO	Auto, 64-12800	Auto, 100-12800, expandable to 50-51200	100 - 6400 in 1, 1/2 or 1/3 EV steps (50 - 25600 with boost)
White balance presets	12	12	12
Custom white balance	Yes (6 slots)	Yes (6 slots)	Yes (4)
Image stabilization	No	No	No
Uncompressed format	RAW + TIFF	RAW	RAW
JPEG quality levels	Fine, normal, basic	Fine, Normal, Basic	Fine, Normal, Basic
File format	<ul style="list-style-type: none"> JPEG (Exif 2.3, DCF 2.0) RAW (NEF) 	<ul style="list-style-type: none"> JPEG Raw (NEF, lossless compressed, 	<ul style="list-style-type: none"> NEF (RAW): 12 or 14 bit, lossless compressed,

Additional notes about ordering the eBox:

- 1) as recently as October, 2013, in conversation with a new installation of the eBox, in a notable herbarium, the following things were found wanting in the MK Technologies custom-made boxes:
 - a. the box doors, in order to be efficient, opening and closing them hundreds of times a day, need handles. Here is an option:



[Clear Acrylic Stick-On Mirror Knob - 1-3/4" Square](#)
by C.R. Laurence

[Learn more](#)

The eBox with the handles installed.



- b. The stock eBox comes with 3 pairs of feet, one pair at each end, the other pair in the middle. The middle pair causes the eBox to wobble on the Kaiser stand, and MK was asked to remove them. In the near future there may be a way to specify that in your order.
- c. If you are using the eBox, and the Canon 6D, you will need a second set of spigot adapters to bring the camera out far enough to view through the hole on the top of the box.

Run the camera tethered to your computer, and use the wall power (see previous notes about cables). Dispense with the camera battery, as it could hold you up if you forget to recharge your spare. Activate LiveView and use the camera control software.

Camera settings:

- 1) Put the camera in manual mode
- 2) Use matrix or evaluative metering
- 3) Put the lens in auto focus (have some sort of contrasty focusing device to 'grab' the focus if the lens starts hunting).
- 4) f-stop: somewhere in the range starting at f/9 - f/11
- 5) ISO: 100
- 6) Shutter speed: 1/60 sec.
- 7) White balance: in auto, or tuned to the kind of lights you have, this will need some test shots, also use the colour checker you have put into the frame as the benchmark. (use Lightroom's white balance eyedropper with the colour checker's 18% grey patch, or experiment with the LR Temp and Tint sliders to match the Kelvin of the lights in your camera environment)
- 8) Focusing: Camera on the copy stand - move the camera up and down, until the composition in the frame looks good, and the focus is sharp at 1:1, using the zoom to check. Use the camera's LiveView on the computer monitor.
- 9) Shoot in camera raw (NEF or CR2) format, save as DNG or TIFF for your master, and a JPG for web. Do not edit the master. If you want to make any corrections make a copy and edit that. Don't make adjustments on the jpg version of the image, as you will lose image information with successive edit/saves.

Refer to <https://www.idigbio.org/content/idigbio-image-file-format-requirements-and-recommendations> for useful info about imaging standards.

Image Storage and Maintenance

No doubt you will be creating a lot of images when you embark on an image digitization project. Here are some things to consider:

- **Image Policy:** Does your institution have an image archiving policy, e.g., long term storage of a TIF format image, with a proxy JPG image for the web, fit for display?
- **DAMS:** Does your institution have an image archiving store, like a Digital Asset Management System (https://www.idigbio.org/sites/default/files/workshop-presentations/chicago2013/Chicago_DAMS.pdf)?
- **File naming:** Have you considered your file naming strategy, e.g., is your image named for the barcode on the specimen it represents? Do you have a strategy for multiple images per specimen, e.g., ‘_a’, ‘_b’ naming suffix?
- **Backup Strategy:** Do you have a backup solution, e.g., daily, weekly, monthly, yearly, offsite long term storage?
- **More Backup:** Keeping one copy of your images on an external hard drive on someone’s desk is the opposite of good stewardship. Two copies are a good way to go, one at hand, the other copy farther afield in case of local catastrophe. Temp storage is critical to moving files from one place to the other. Keep in mind that the speed of a transfer is bound by the slowest protocol in the link. Even if you have fast 100BaseT Ethernet to your server from your imaging computer, if it is going via a USB2 port on the server, then that is the choke point. Moving images around takes time, and it is imperative to do it carefully, and with all due attention to detail, e.g., don’t delete before checking for sure that the files are on the remote fileshare.

Troubleshooting

All of these settings may need to be tweaked, one at a time to achieve your optimal image. The lights are constant, but none of the camera settings are set in stone, the final test is how the image looks, how close to reality is the image. Many of these settings work together (e.g., f/stop, shutter speed and ISO), so if you tweak one, another might need to be correspondingly corrected. Be on the look out for:

- 1) Fuzzy, not in focus – the focus needs adjustment.
- 2) Depth of field issues - wrong f/stop. The depth of field is defined as the area in front of and behind the subject that is in acceptable focus. The bigger the number of the f-stop, the better depth of field resolution. With a 1:1 macro lens the DOF

ratio is different from the regular lens - $2/3$ in front of point of focus and $1/3$ behind. In a regular lens, it is the opposite.

- 3) Over or underexposed – issues with f/stop, shutter speed, use the histogram to detect. If the depth of field is OK, then change the shutter speed. They work together to create the magic of enough light and enough depth of field.
- 4) Color cast (pink, yellow, blue, green) - white balance: change setting in the camera. These effects are caused by not tuning the white balance to the light on the image. You could also try moving the lights around as a last resort if you are shooting in an open studio and not with the eBox.
- 5) Not filling the frame the way you want it - move the camera up or down on the copy stand.
- 6) Light not evenly spread across the frame, shadows – something wrong with the lights, maybe one of the bulbs is burnt out. Perhaps the specimen needs to be flattened, or moved, try some small magnets or glass weights. Perhaps the ambient room lighting (e.g., lighting or windows) is interfering.
- 7) One issue often overlooked is that images look different on different computer screens – color correct your monitor with a tool (e.g., ColorMunki). Be sure that whatever monitor you are correcting your setup for is balanced. This might entail borrowing a color corrected monitor during the setup process, in the event that you are ultimately driving your image creation with a laptop. Note: when you save as jpg, your image will look slightly less bright.
- 8) Spots on the image – there can be dust on the front of the lens, on the back of the lens, or on the sensor. If it is the case of the first two, use a handy dust blower and gently blow the dust off. Good lens cleaning tools can be purchased at Visible Dust. If on the other hand the dust is on the sensor, it is better to send the camera to a service center to have it cleaned. In the event of the dust on the sensor not being to be removed, a negating image can be created and stored in the camera to offset the offending dust.

An example of a balanced image:

http://mkdigitaldirect.com/blog/wp-content/uploads/2011/06/IMG_0031.jpg

What should you look for: The light is balanced, there are no shadows on the edges; the image is evenly sharp, there is no color cast, the color of the herbarium paper is natural and realistic; the image is not overexposed or underexposed (blown out or overly dark areas). There is a color checker, a ruler, and the sheet is not crooked.

Software - Camera Control for Tethering

We recommend that you control your camera's shutter via a setup called 'tethering'. This involves a cable going from the camera to the computer, and interfaces with camera control software. With this software you can control all the features of the camera (f/stop, shutter speed, ISO, etc.). Run in LiveView mode so that you can see on the computer's monitor what the camera sees.

We recommend a combination of software:

- 1) one system to control the settings and shutter of your camera and
- 2) the other to control the workflow of moving images from the camera to your file system, in the correct format (e.g., from camera raw -> DNG -> JPG), with all the metadata (e.g., EXIF) filled in. An example would be Adobe Lightroom (LR). There are also batch operations you might want to do to your images, and LR would manage that. LR can be configured to watch an image deposit folder so that multiple actions can be going on at the same time: capturing the next image while LR is processing the last one in the watch folder.

Each camera manufacturer has camera control software tuned to their equipment.

Nikon:

Camera Control Pro 2

Canon:

EOS Utility (comes with the camera if purchased from a licensed dealer)

Agnostic:

DSLR Remote Pro (Breeze Systems)

Software – Image Workflow Management

- Adobe Lightroom (LR)
- Adobe Camera Raw (ACR)
- Adobe Photoshop CS5/CS6

Software – Camera Image Control

- Nikon Capture NX2
- Digital Photo Professional

Purchase Order

This is a representational list only to aid in your selection and in obtaining funding. *The prices listed here are for the 'Good' camera choice. Factor upwards if you choose the 'Best'. These are very approximate prices, rounded up, not including or shipping. Note: if you are purchasing the ePhoto Box, you will not need the Kaiser lights.*

Some of these external accessories below are for Nikon, if you are using Canon, match accordingly.

Camera of your choice (body only)	\$1500
Macro lens – paired to camera manufacturer	\$600
Kaiser Copy Stand RS 1 with RA-1 Arm, 40" Column and 18 x 20" Baseboard	\$790
Manfrotto 3/8" + 1/4" Adapter Spigot (if purchasing the Canon 6D, get two of these)	\$6
Manfrotto 066 Double Female Stud for Super Clamp	\$5
Wasp Bar code reader - WCS3905 CCD Scanner with 6ft USB Cable	\$88
2-Axis Hot Shoe Bubble Level	\$25
MK Direct Photo-eBox PLUS 1419 (shipping not included)	\$2060
Laptop computer: min. 4GB memory, 500GB hard drive	\$900
ColorGauge Nano Target	\$165
Roll of 1" black Gaffer tape for taping down cables between the copy stand and the laptop for aesthetics and safety	\$18
External hard drive or other appropriate mechanism (i.e., network connection) to backup images (optional)	\$150
Extra light bulbs (depends on your setup)	
Kaiser RB 5000 Daylight Copy Light Set with Two 36 Watt 5400K Fluorescent Tubes (if not purchasing the eBox)	\$1050
Cleaning supplies for your lens - cloth and blower (Visible dust)	\$22
Color calibration software for your monitor (Color Munki) (optional)	\$510
Cables: AC adapter to exchange battery life for wall power	\$85
Cables: Long (5') USB cable to reach from camera up on the copy stand to your computer (match to your camera)	\$25
Software: Nikon camera image control (comes free with Canon)	\$180
Software: Photoshop Lightroom 6 (Education edition)	\$149
Remote camera trigger (match this to the camera model and manufacturer)	\$25

Approximate total: \$7300 (eBox) \$6300 (w/o eBox)