



New York Botanical Garden

Herbarium Specimen Image Capture and Processing for GLOBAL TCN






Kimberly Watson, Assistant Director of the Herbarium for Botanical Information Management
Leanna McMillin, Digital Asset Manager: April 2021

NYBG Digitization Workflow

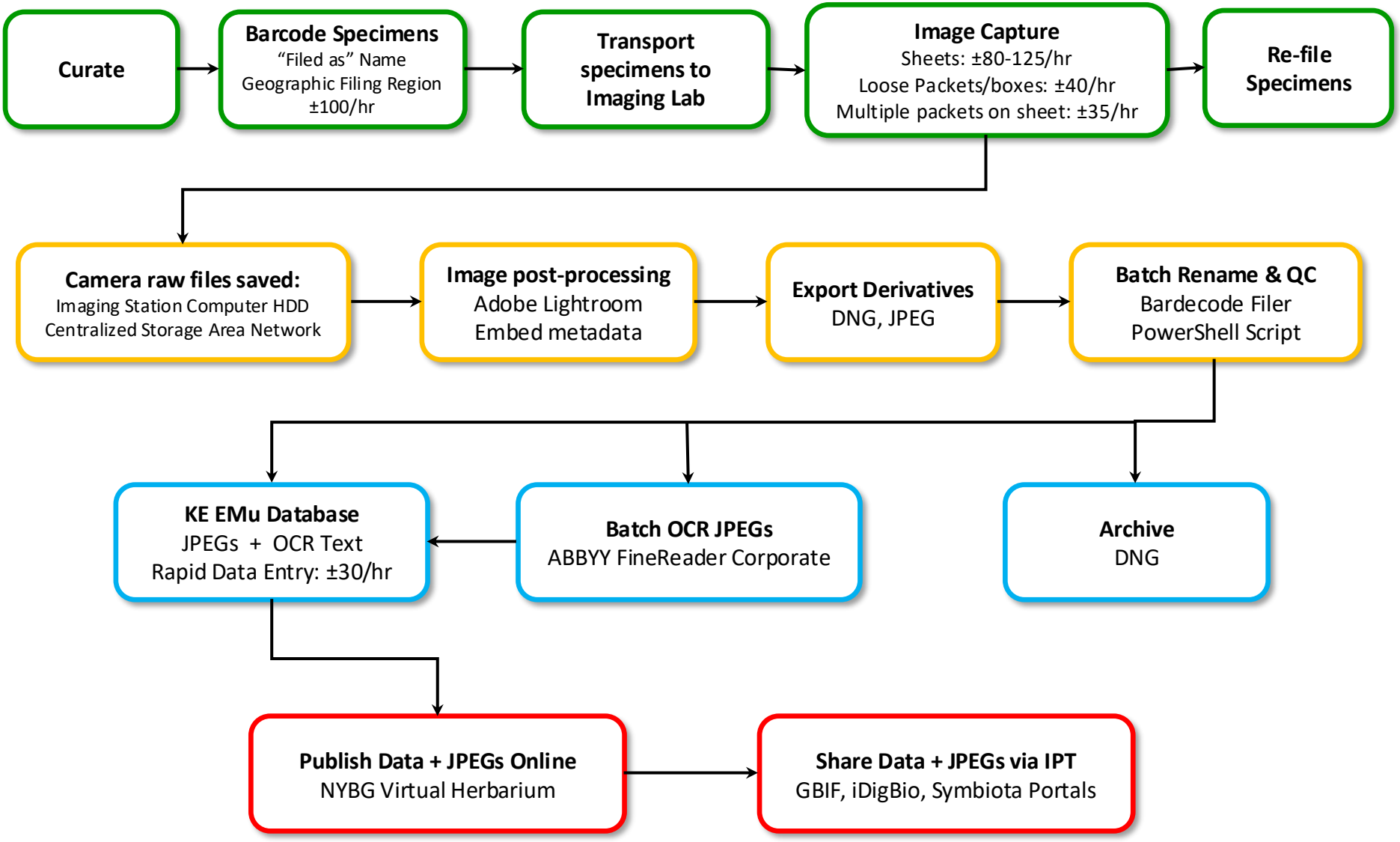


Image Capture

Digitization Station:

- Full-frame dSLR, 50mm macro lens, copy stand, lightbox (or LED panels), computer
- Software: camera-proprietary for remote shooting and raw image viewing
- Manual camera settings specific to each light source/station
- Capture camera raw
- Save files to imaging station computer hard drive and centralized SAN

Workflow:

- Cart specimens to Imaging Lab
- File names: Digitizer_YYYYMMDD_HHMMSS
- QC focus and exposure, 1st image, then every 20
- Capture 1 image per barcode (more if necessary)
- Stamp as “Imaged”
- Refile specimens in Herbarium

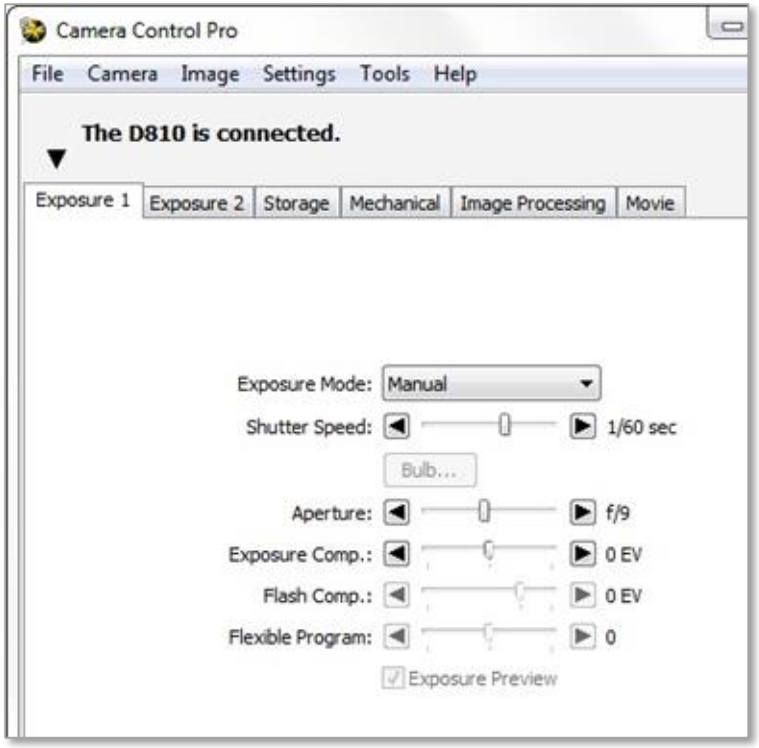


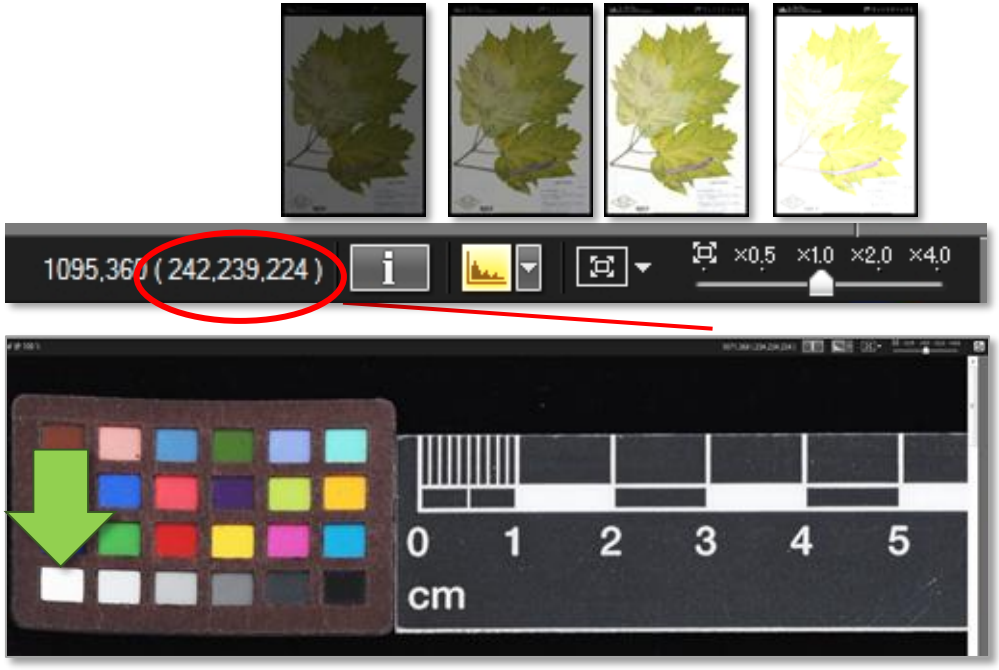


Camera Settings

Step 1: Exposure

- Manual exposure mode
- Shutter speed range: 1/50 - 1/80 sec
- Aperture range: f/8 - f/11
- ISO: 100
- Adjust shutter speed, aperture, and ISO settings until target white values are achieved.
- Optimize exposure for entire frame.





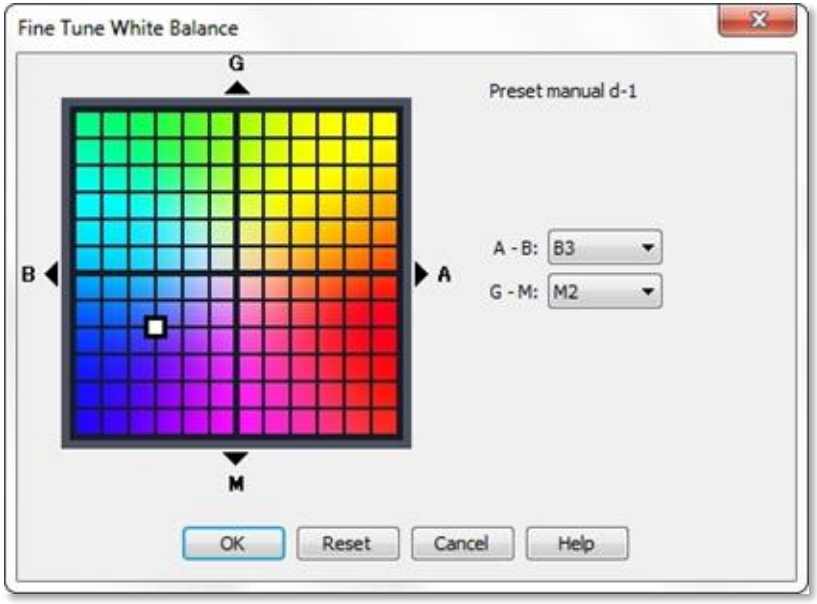
			R	G	B			
19.	white (.05*)		243	243	242	96.539	-0.425	1.186
20.	neutral 8 (.23*)		200	200	200	81.257	-0.638	-0.335
21.	neutral 6.5 (.44*)		160	160	160	66.766	-0.734	-0.504
22.	neutral 5 (.70*)		122	122	121	50.867	-0.153	-0.27
23.	neutral 3.5 (1.05*)		85	85	85	35.656	-0.421	-1.231
24.	black (1.50*)		52	52	52	20.461	-0.079	-0.973

Camera Settings

Step 2: White Balance

- Fine tune until target white values are achieved.





Step 3: Manual Focus

- In live view, at 100% magnification, focus on collection label.
- Use gaffer tape on lens to prevent zoom creep over time.



			R	G	B			
19.	white (.05*)		243	243	242	96.539	-0.425	1.186
20.	neutral 8 (.23*)		200	200	200	81.257	-0.638	-0.335
21.	neutral 6.5 (.44*)		160	160	160	66.766	-0.734	-0.504
22.	neutral 5 (.70*)		122	122	121	50.867	-0.153	-0.27
23.	neutral 3.5 (.1.05*)		85	85	85	35.656	-0.421	-1.231
24.	black (1.50*)		52	52	52	20.461	-0.079	-0.973

Image Capture: Loose Packets/Boxes

Loose packets or boxes

Imaging occurs in lightbox.



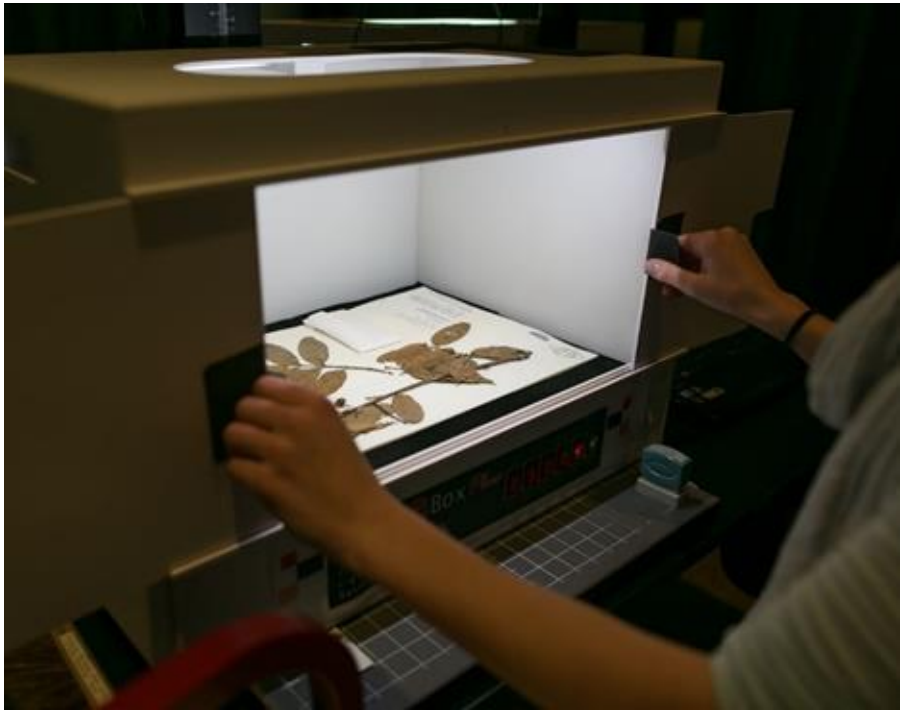


Image Capture: Loose Packets

- Place a clean, blank herbarium sheet inside the lightbox.
- Place the individual packet inside the lightbox.
- Open packet and gently remove plant material:
  - If large and easily handled, use forceps to place the material onto the herbarium sheet, or onto a small rectangular piece of herbarium paper.
  - If small and/or not easily handled without causing damage, gently funnel material from packet into a clean petri dish or onto small piece of paper.
- Neatly display the specimen material. If placed on a small piece of paper, orient rectangle parallel to edges of herbarium sheet.
- Close packet and place on herbarium sheet, ensuring:
  - Entire collection label is visible
  - Barcode is visible
  - As many annotations as possible are visible (without obscuring collection label)
  - Packet is oriented straight relative to sheet
- Photograph specimen.
- If needed, capture additional images of remaining annotations, other side(s) of specimen, ensuring barcode number is always visible.
- Stamp packet as “Imaged”
- Return specimen material to packet



Image Capture: Small Boxes

- Place a clean, blank herbarium sheet inside the lightbox
- Place the individual specimen box inside the lightbox
- Open box and gently remove plant material:
  - If large and easily handled, use forceps to place the material onto the herbarium sheet, or onto a small rectangular piece of herbarium paper
  - If small and/or not easily handled without causing damage, gently funnel material from packet into a clean petri dish or onto a small rectangular piece of herbarium paper
- Neatly display the specimen material. If placed on a small piece of paper, orient rectangle parallel to edges of herbarium sheet.
- Display box and loose collection and annotation labels on the sheet, ensuring:
  - Entire collection label is visible
  - Barcode is visible
  - As many annotations as possible are visible (without obscuring collection label)
  - Box is oriented straight relative to sheet
- Photograph specimen. If needed, capture additional images of remaining annotations and/or other side(s) of specimen, ensuring barcode number is always visible.
- Stamp box as “Imaged”
- Return specimen material to box

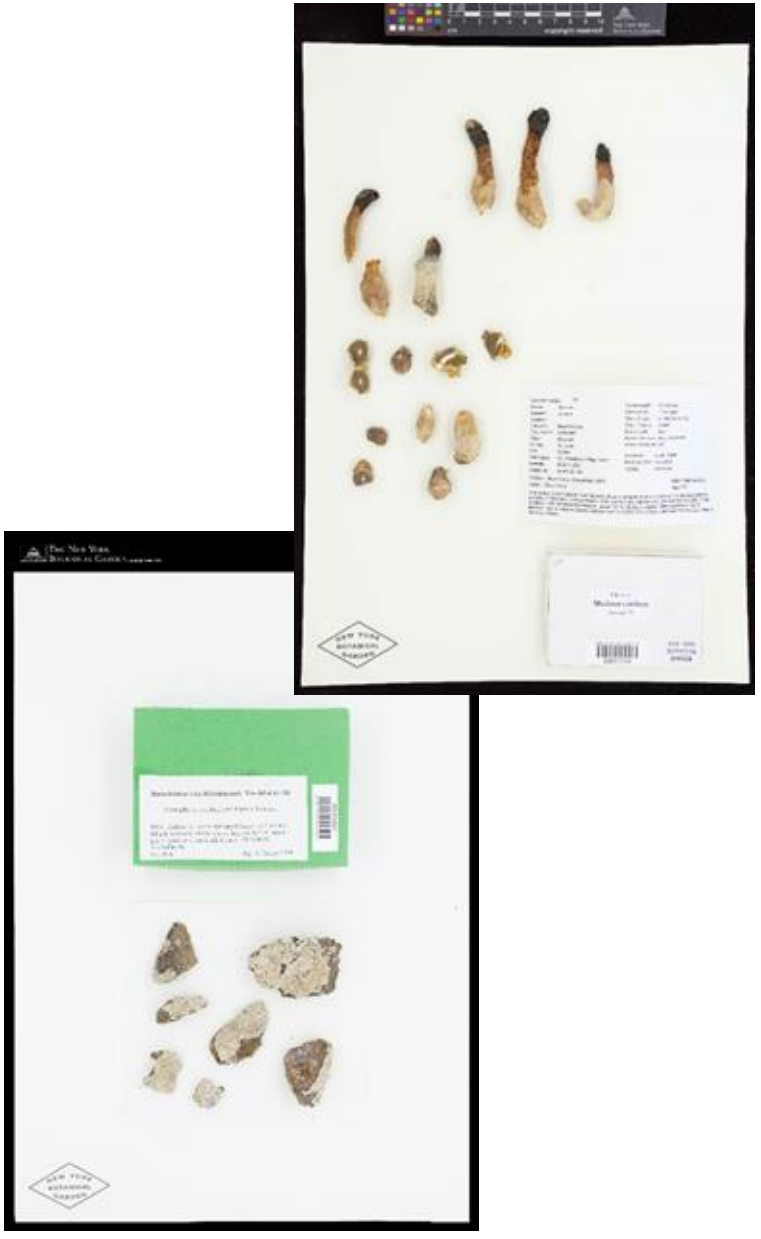
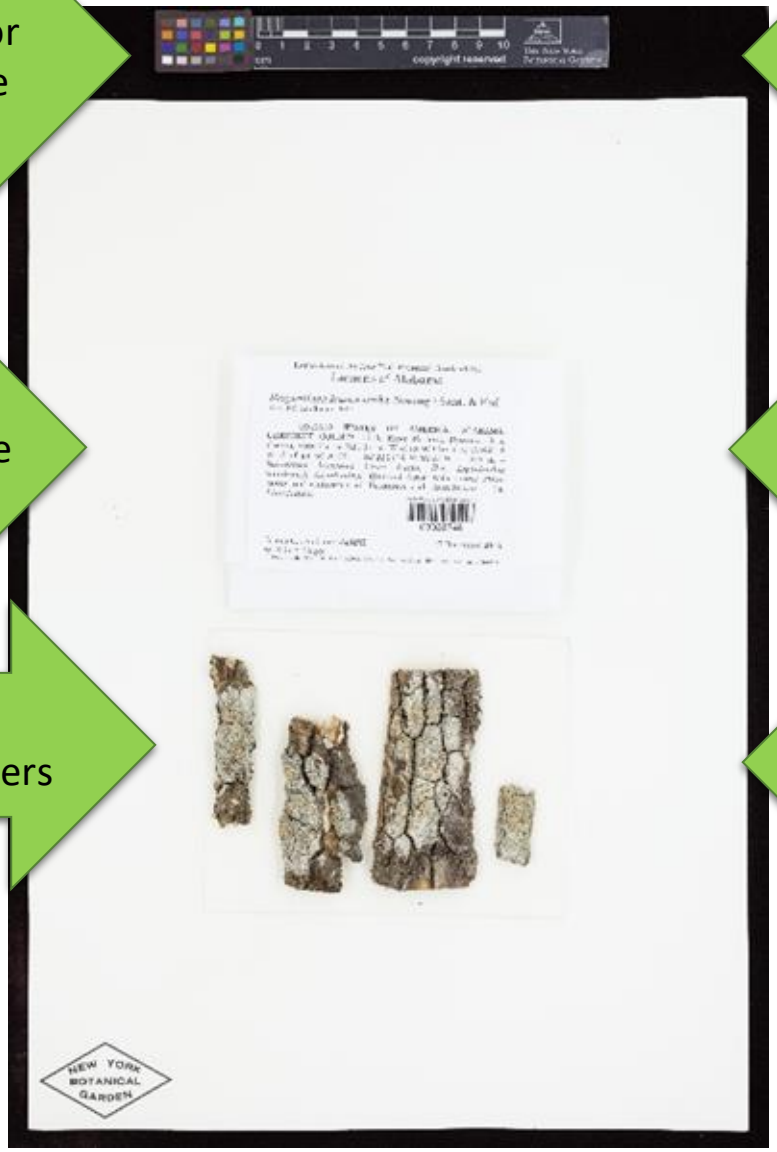


Image Capture Quality Control

Check white target values for exposure and white balance

Color target and ruler straight, at top of image



Barcode present and visible

All text visible and in focus

Specimen staged neatly, displaying important characters

Sheet straight, black border even on all sides



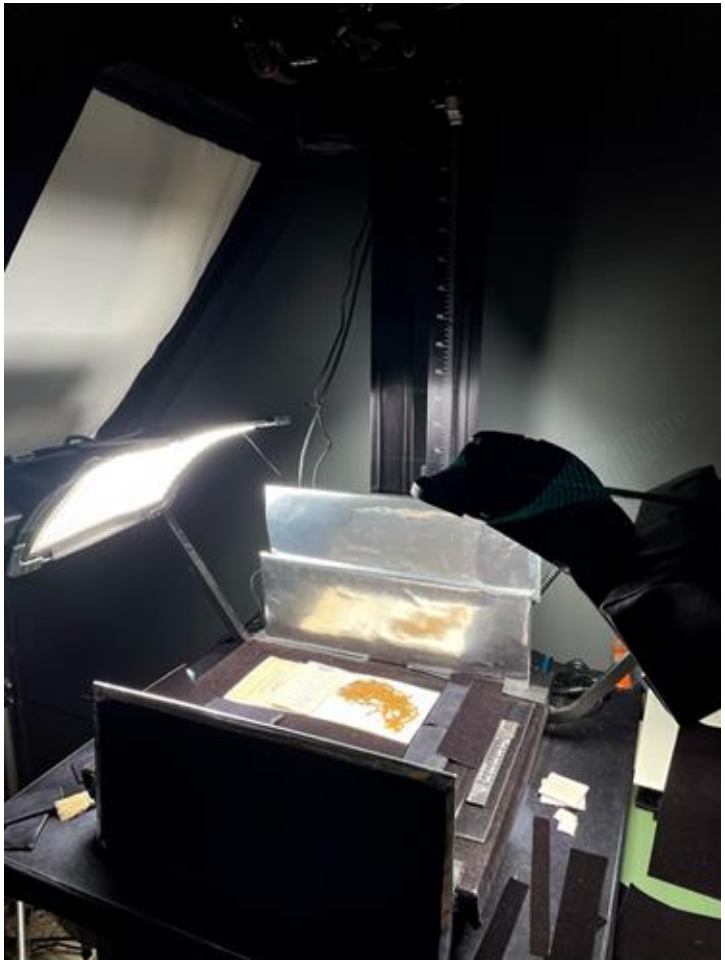
Stamp as “Imaged” after specimen is photographed

Image Capture: Multiple Packets on Sheet

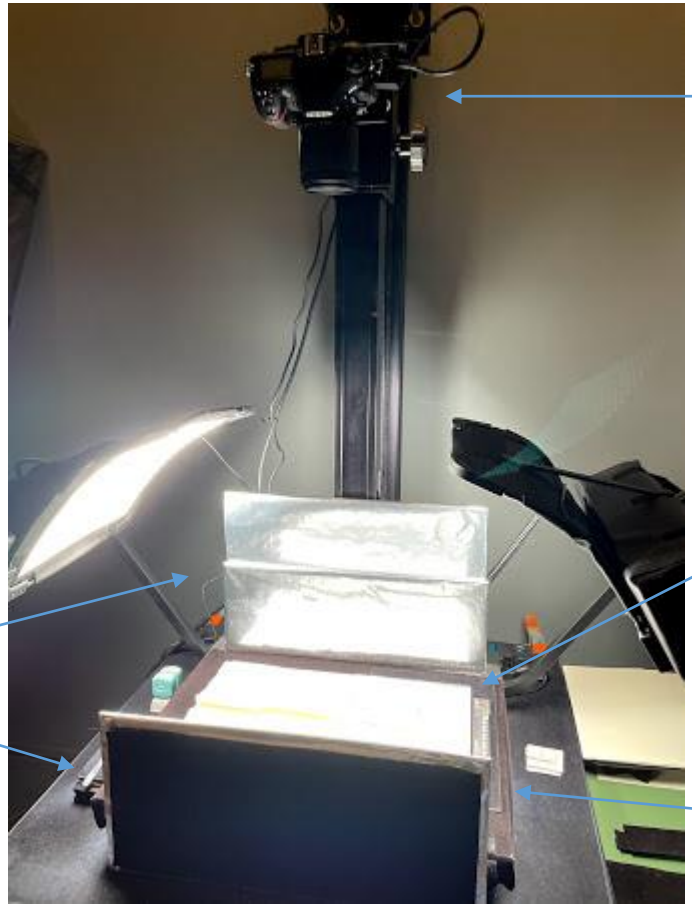
Multiple packets mounted on sheet



Imaging occurs at open copy stand station.



Open Copy Stand Station



dSLR mounted on copy stand, tethered to All-in-one desktop for remote shooting.

Flexible LED panels

Steel L-shaped ruler covered with black velvet paper

Reflectors used to reduce shadows

Copy stand platform covered with black velvet paper

Advantages:

- Easier to open packets, arrange specimens, and place black velvet paper around specimen.
- Black velvet facilitates batch cropping via Photoshop.

Disadvantages:

- Lighting is not as controlled, some hotspots and shadows occur (compared to imaging in lightbox).

Image Capture Overview: Multiple Packets on Sheet

1. Align herbarium sheet to steel L-shaped ruler.



2. If necessary, use clean herbarium paper to create a background on which to display the specimen and any annotations.



3. Create a black border around the specimen and label using black velvet photo paper.



4. Capture image!

Image Capture: Multiple Packets on Sheet

- Align herbarium sheet to L-shaped ruler guides at open copy stand.
- Open packet and gently remove plant material:
  - If large and easily handled, use forceps to place the material onto the herbarium sheet, or onto a small rectangular piece of herbarium paper.
  - You may need to create a space to display the specimen near the label. In the image to the right, a small square of herbarium paper has been placed on top of (covering up) packets that are not currently being imaged.
- Neatly display the specimen material. If placed on a small piece of paper, orient rectangle parallel to edges of label.



Image Capture: Multiple Packets on Sheet

- Use black velvet photo paper to cover all packets that are not currently being imaged.
  - Arrange black velvet around the specimen to create a neat rectangle.
- Display collection and annotation labels on the sheet, ensuring:
  - Entire collection label is visible
  - Barcode is visible
  - As many annotations as possible are visible (without obscuring collection label)
- Photograph specimen. If needed, capture additional images of remaining annotations and/or other side(s) of specimen, ensuring barcode number, color target, and ruler are always visible.
- Stamp as “Imaged”
- Place specimen and all annotations back inside packet. Remove black velvet and move to the next specimen on the sheet.



Image Capture Quality Control

Check white target values for exposure and white balance

Barcode present and visible

Specimen staged neatly, displaying important characters



Color target and ruler straight, at top of image

All text visible and in focus

Velvet straight, black border appears on all sides



Stamp as “Imaged” after specimen is photographed

Image Post-Processing Overview



Amanda_GLOBAL2021-03-02 113744.nef





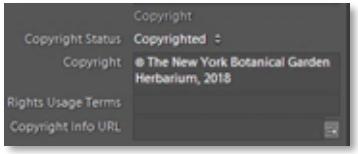
01281910.jpg

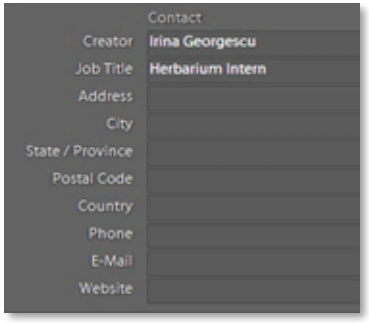
1. Metadata added in Lightroom.
2. Images batch processed in Lightroom.
3. Files renamed with barcode number (and suffix, if multiple images are taken).
4. Cropping, digital black border and digital ruler applied via Photoshop action.

Image Post-Processing

- Adobe Lightroom: catalog and non-destructive image editing
- Import images with metadata and develop presets
- Process in batches per station, date, digitizer, and camera settings
- **Library Module**: Input metadata
  - Creator, Job Title
  - Copyright statement (preset)
  - Audubon Core Terms
    https://terms.tdwg.org/wiki/Audubon_Core_Term_List







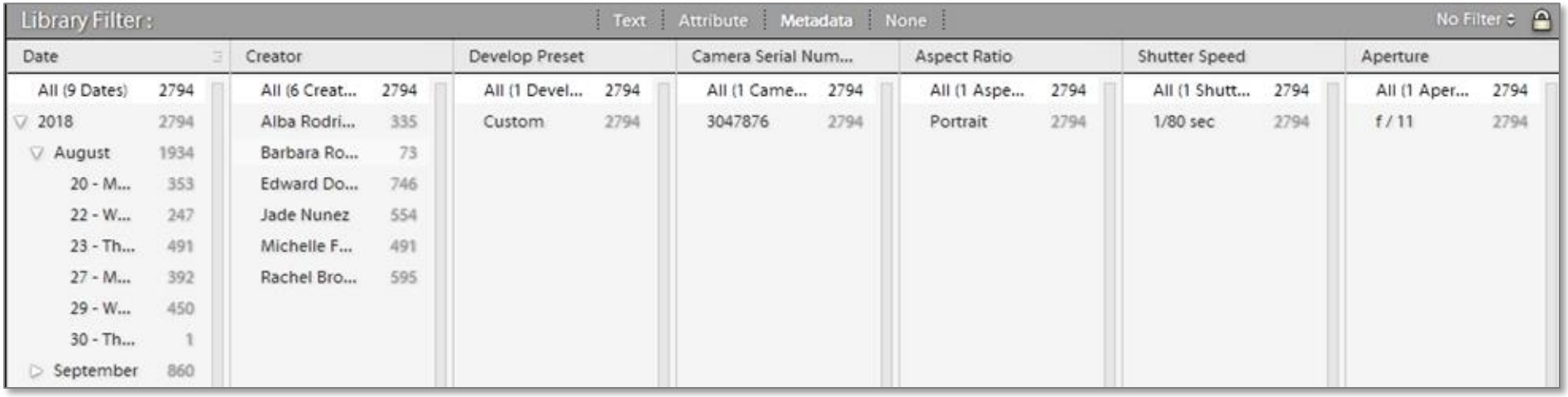


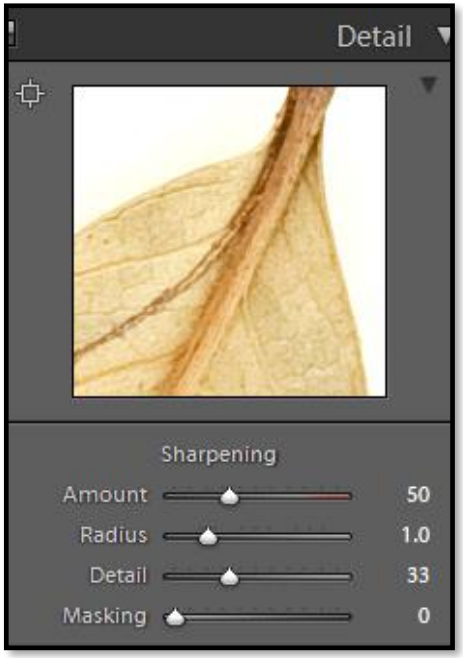
Image Post-Processing

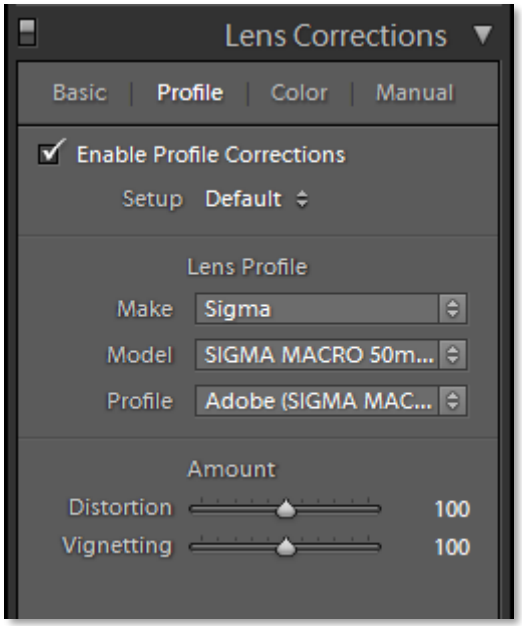
Develop Module:

- Preset applied during import:
  - Camera/lens profile corrections
  - Remove Chromatic Aberration
  - Sharpening
  - Tone curve: linear
- Quick quality control check (e.g. sheet or ruler misaligned, corrupt image, fingers).











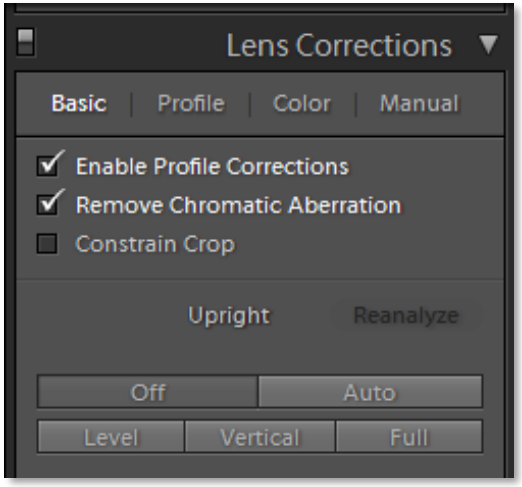


Image Post-Processing

White balance: select representative image, zoom-in on color target. Select eye dropper, move it to the white or neutral gray square and click.

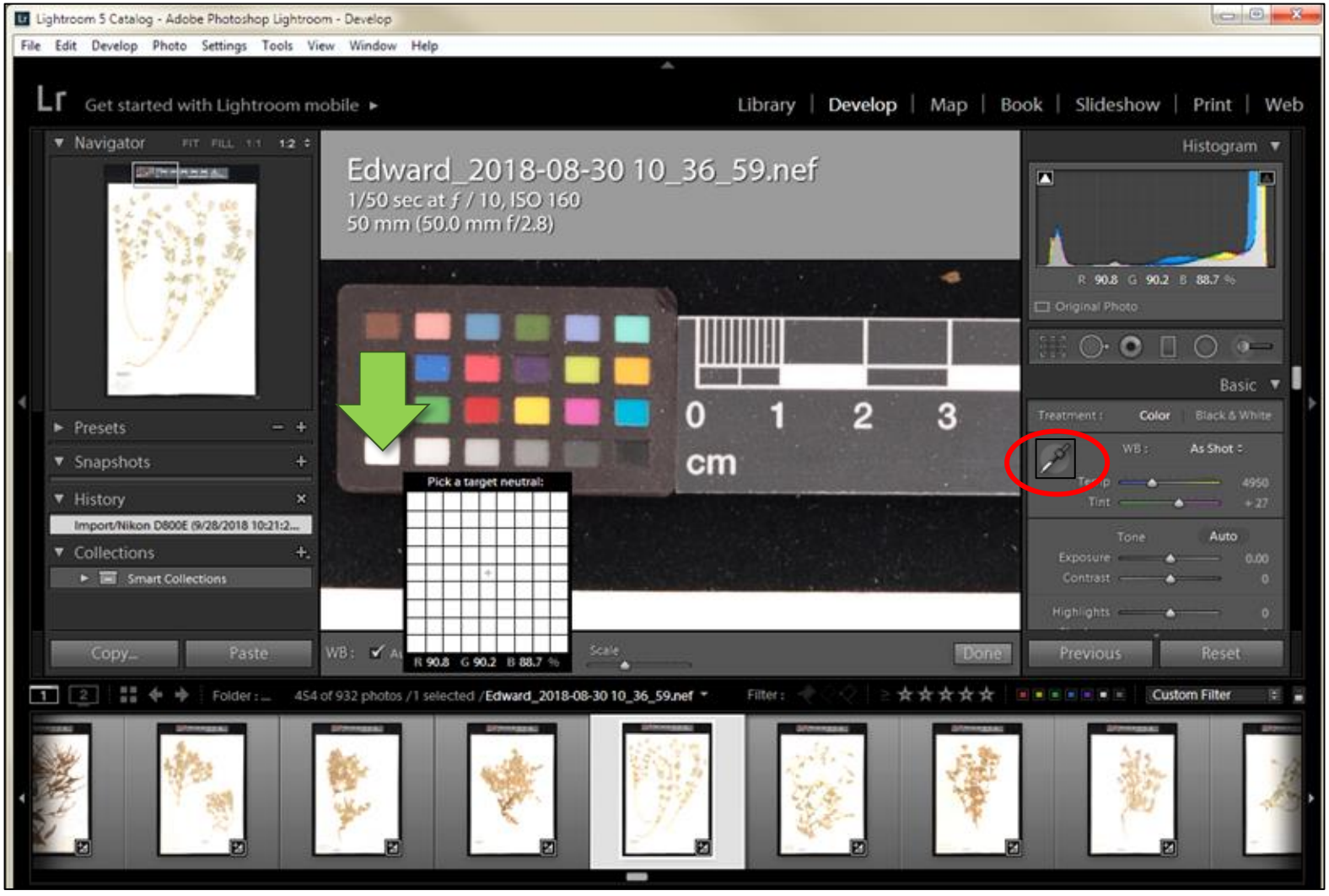


Image Post-Processing

Exposure: select exposure and move mouse to the white square, read histogram. Increase/decrease as needed. Note: optimize exposure for entire frame. Optimal RGB values at perimeter may result in overexposure at center.

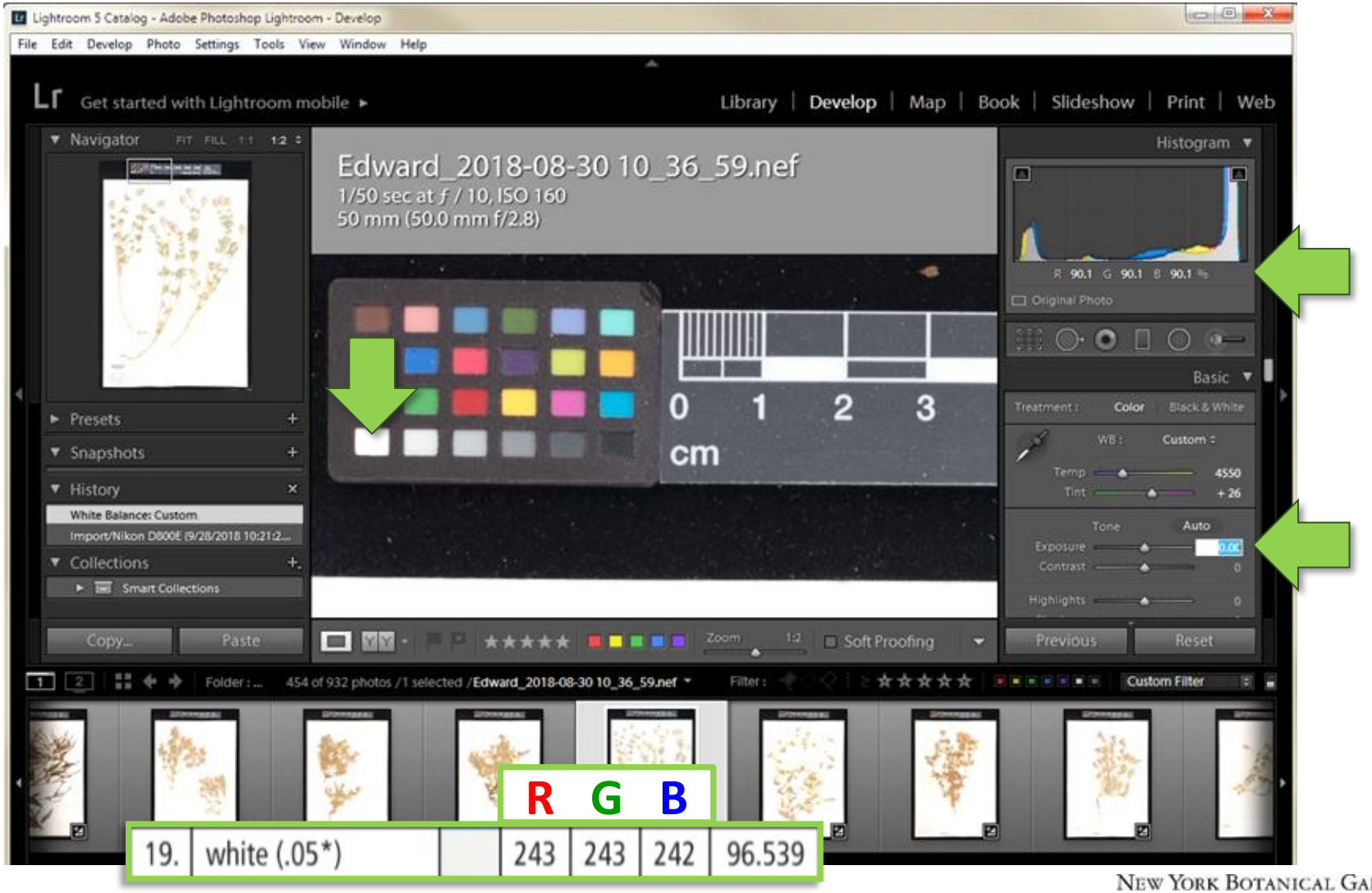


Image Post-Processing

Tone curve: select tonal adjustment tool, position it over the white, neutral, and black target squares, click and drag up/down until achieve desired values. Select “Done”.

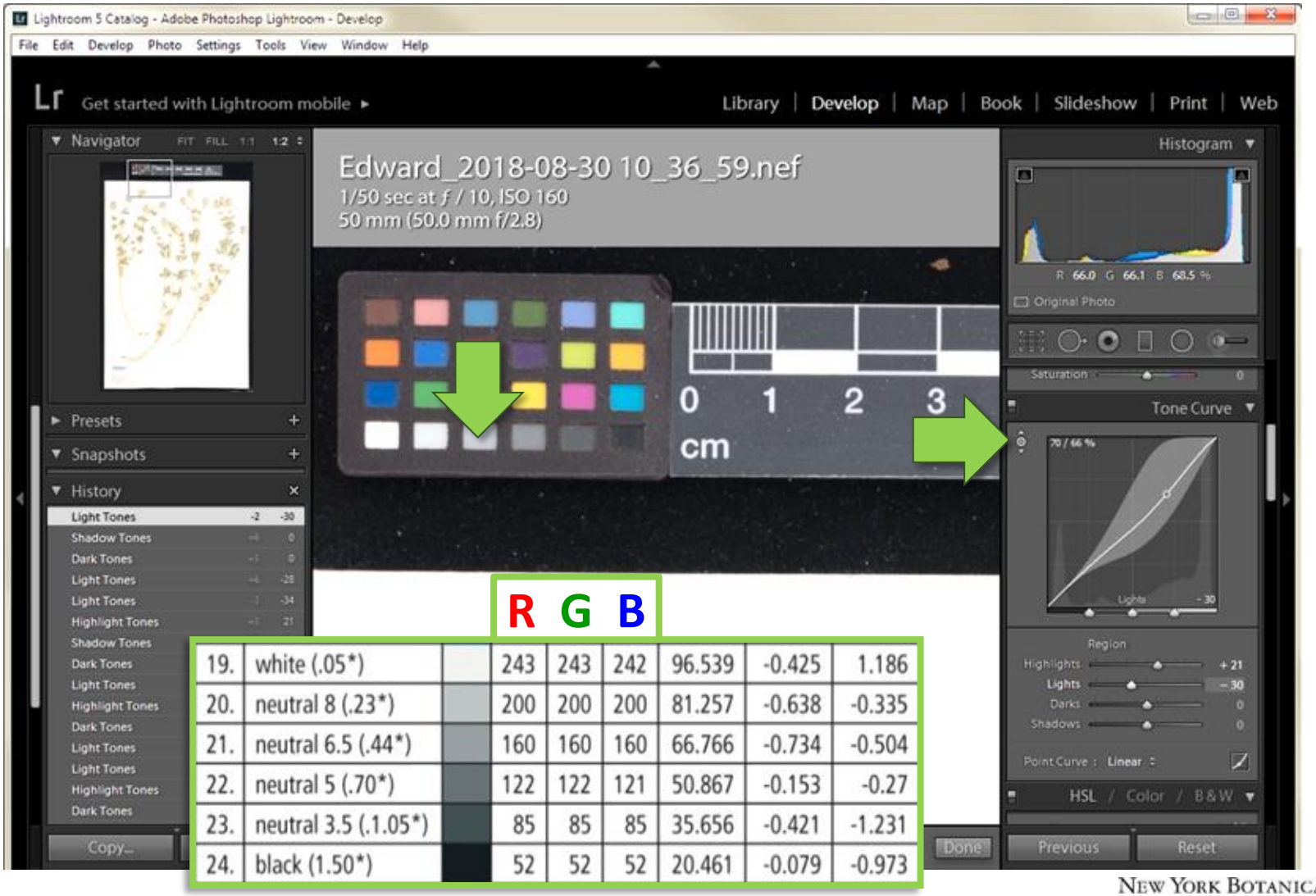


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Image Post-Processing

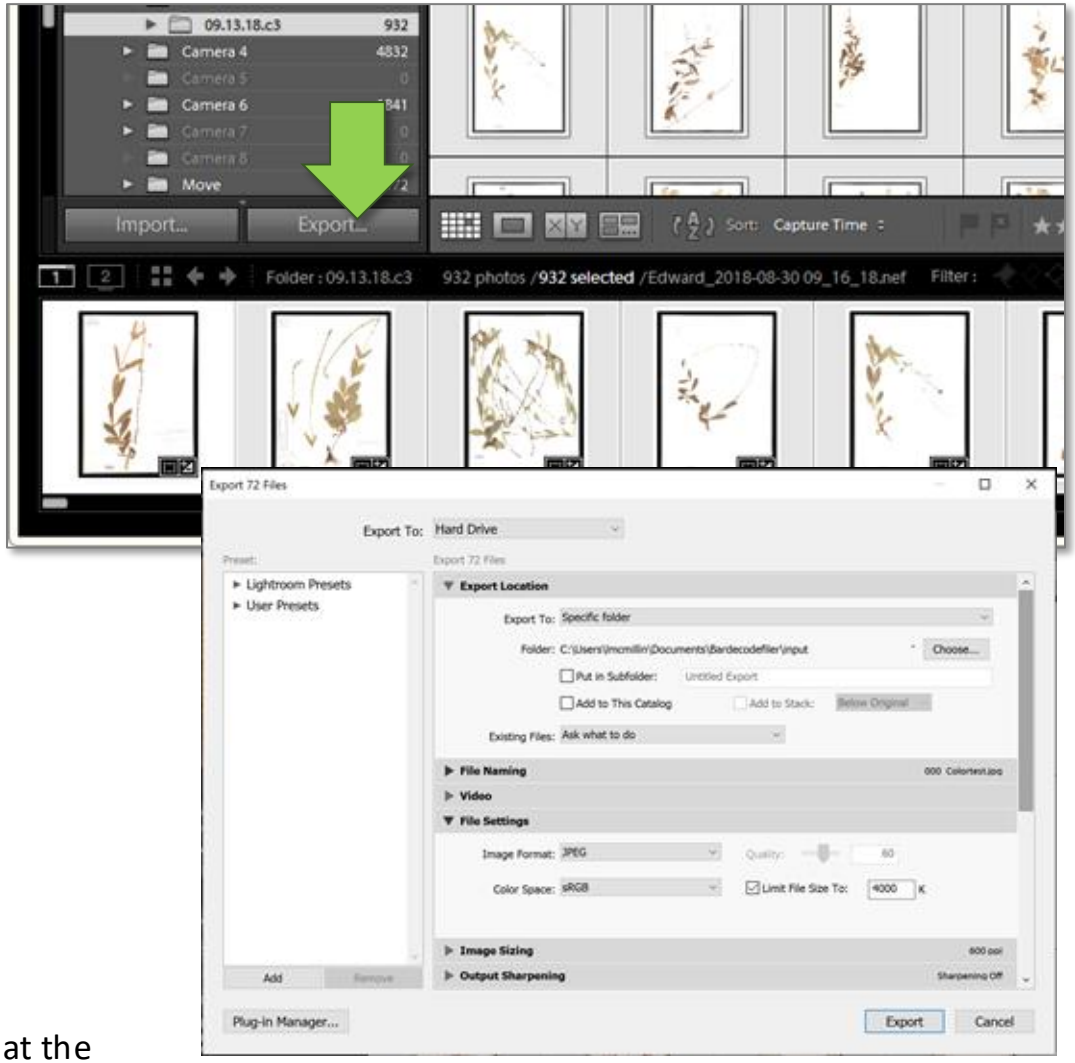
When editing is complete, select all images in batch* and synchronize develop settings.

Export JPEGs:

- Save JPEGs to “input” directory
- Color space: sRGB
- Limit File Size To: 4000K max
- For web, print

Export DNGs:

- Save DNGs to “dng” directory
- Open license raw image format
- Preserves metadata in the file
- Smaller file size
- Full bit depth



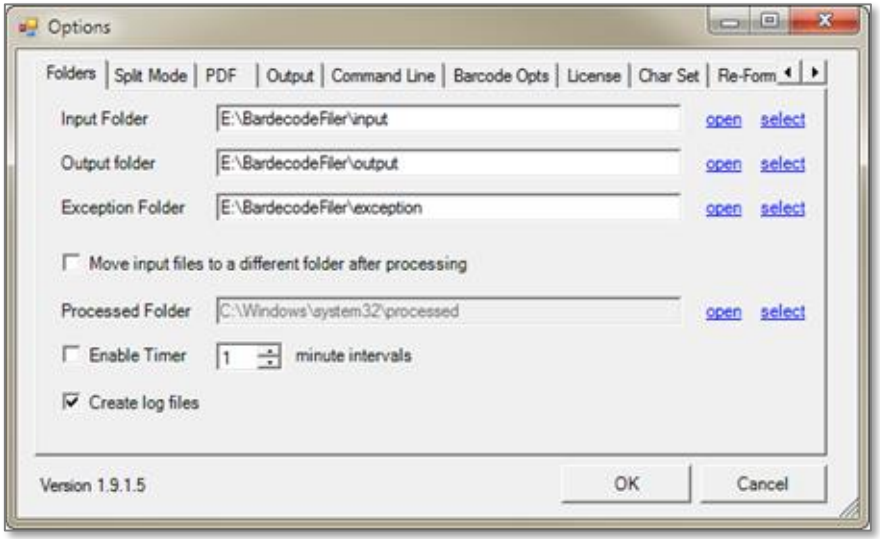
*Batch = all images captured by the same digitizer, at the same camera station, on the same day.

Image Renaming

http://www.bardecode.com/en1/app/bardecodefiler

BardecodeFiler Application

- Renames TIF, JPEG, and PDF
- Proprietary ($250/license)
- Renames files from “input” folder
- Moves/copies renamed files to “output”
- Creates log file and “results.csv”
- Exceptions = Quality Control
  - Out of focus
  - No machine-readable barcode found
  - Multiple images with same barcode(s) e.g. 01234567.jpg, 01234567 (2).jpg
  - Images with more than one barcode e.g. 01234567_01568798.jpg



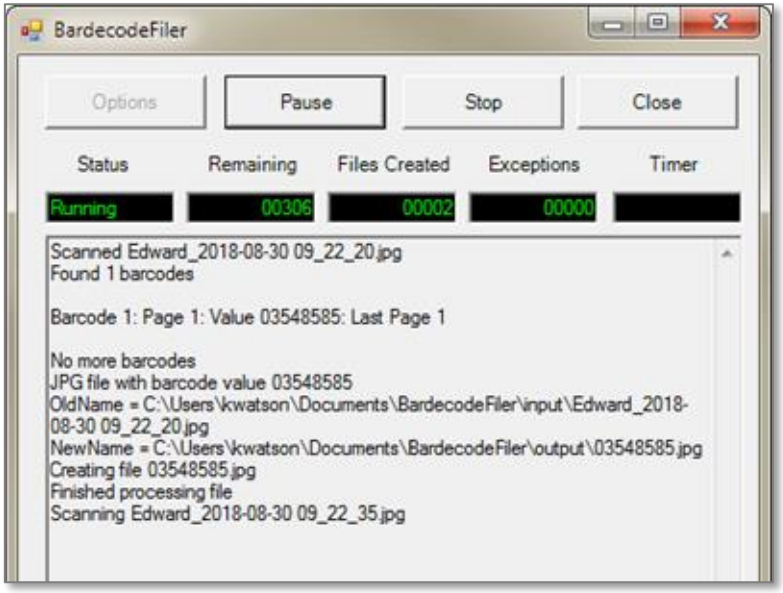
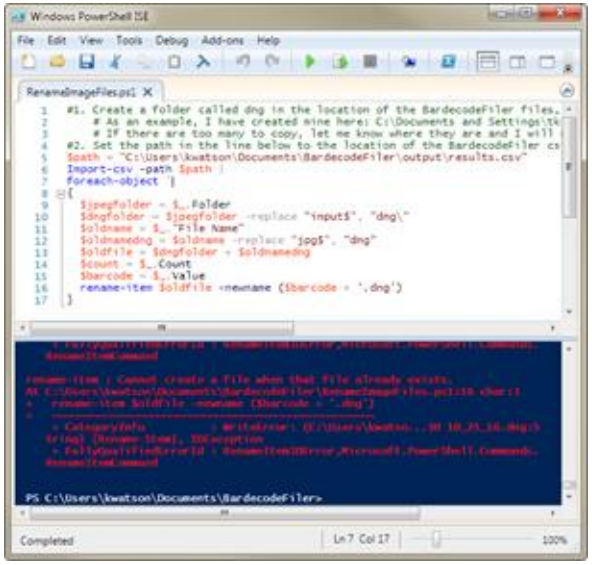


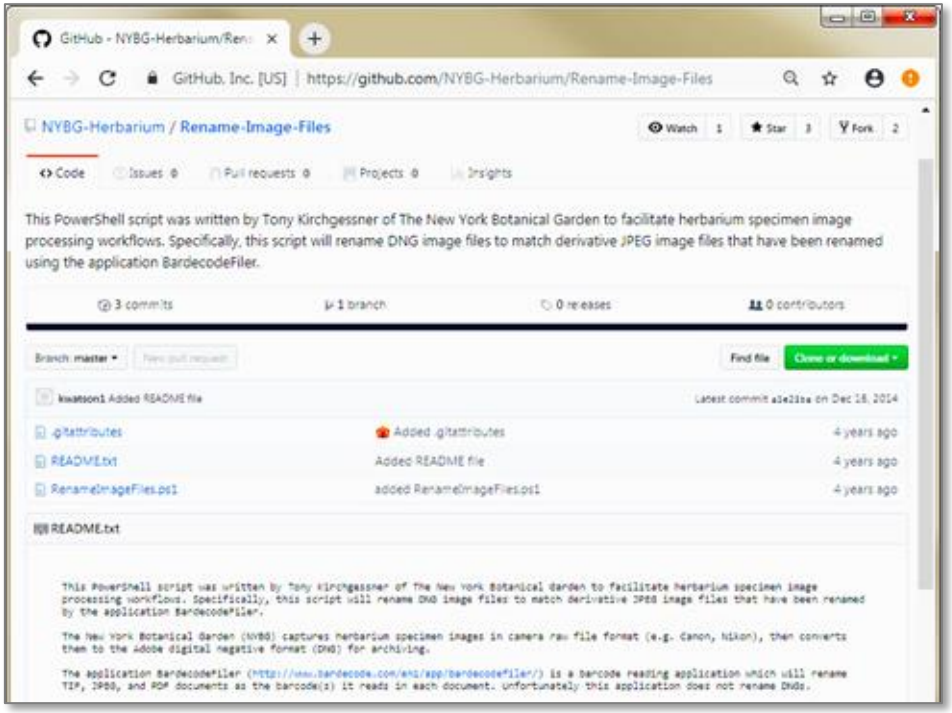
Image Renaming

Windows PowerShell script

- Uses “results.csv” to rename DNGs
- Re-run BardecodeFiler and script until all JPEGs and DNGs are renamed.



https://github.com/NYBG-Herbarium/Rename-Image-Files



Another option: Zbar bar code reader

- Open source software
- Use with Perl wrapper script: reBar.pl
- Requires Zbar, ImageMagick, and Perl

http://zbar.sourceforge.net/

https://github.com/psweeney-YU/reBar

Helpful Resources

- *Digitization Workflows for Flat Sheets and Packets of Plants, Algae, and Fungi* (G. Nelson et al., 2015) https://doi.org/10.3732/apps.1500065
- iDigBio Workflow Modules and Task Lists https://www.idigbio.org/content/workflow-modules-and-task-lists
- iDigBio Digitization Resources: https://www.idigbio.org/wiki/index.php/Digitization_Resources
- NYBG Herbarium Specimen Digitization Equipment https://docs.google.com/document/d/1KtEEZYMM193jOUCQ7sfTtEBoWVGUE1UHjfw8TNhBzgw/edit?usp=sharing

Please contact the Digital Asset Manager, Leanna McMillin with any questions:
lmcmillin@nybg.org

National Science Foundation
WHERE DISCOVERIES BEGIN

NYBG
NEW YORK BOTANICAL GARDEN