Digitization Modules, Tasks, and Workflows

EMu SIG Workshop
Gil Nelson
7 October 2015
Integrated Digitized Biocollections
Florida State University

Preparing Infrastructure

Workflows and protocols

Selecting and installing a database
Specify
Symbiota
Custom

Design and purchase an imaging station
Copy stand and lighting
Light box

Search and select imaging workflow and processing software

Preparing for digitization
Pre-digitization curation

Consider and plan for data enhancement activities
Georeferencing

iDigBio
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Assessing Digitization Practices in Biological and Paleontological Collections

28 Collections
10 Museums
Spanning biological and paleontological collections
Insects and other invertebrates, plants, birds, mammals
Wet, dry

Five task clusters that enable efficient and effective digitization of biological collections

Gil Nelson, Deborah Paul, Gregory Riccardi, Austin R. Mast

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

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Acknowledgments

American Museum of Natural History
Botanical Research Institute of Texas
Florida Museum of Natural History
Florida State University
Harvard Herbarium
Museum of Comparative Zoology (Harvard)
New York Botanical Garden
Southeast Regional Network for Expertise and Collections
Specify Software Project (University of Kansas)
Symbiota Software Project (Arizona State University)
Tall Timbers Research Station and Land Conservancy
Tulane University Museum of Natural History
University of Kansas Insect Museum
Valdosta State University
Yale Peabody Museum

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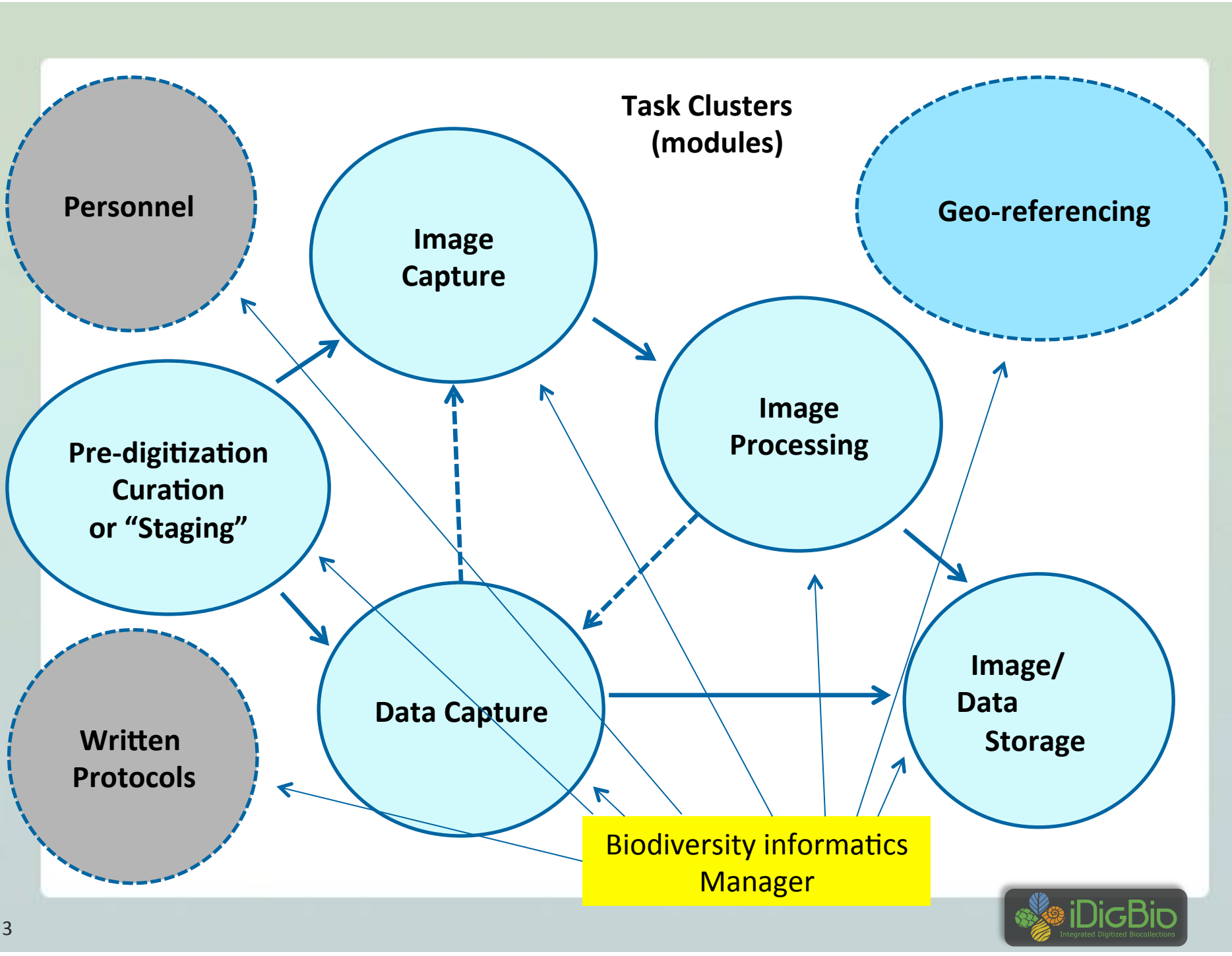
Task Clusters
(modules)
Personnel
Image
Capture
Geo-referencing
Image
Processing
Pre-digitization
Curation
or "Staging"
Written
Protocols
Data Capture
Image/
Data
Storage
Biodiversity informatics
Manager

Processes that have gained definition and currency in digitization workflows

- Linking genomic and other data to vouchers
- Crowd sourcing and public participation
- Remote annotation of specimen records
- Using digitized data for research
- Optical Character Recognition
- Proactive digitization

Proactive Digitization

Moving digitization ahead in the collecting process.
Same tasks, alternate timing.

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Commonalities across task clusters serve to encourage innovation and experimentation.

Distinct processes closely associated with particular organisms or preparation types.

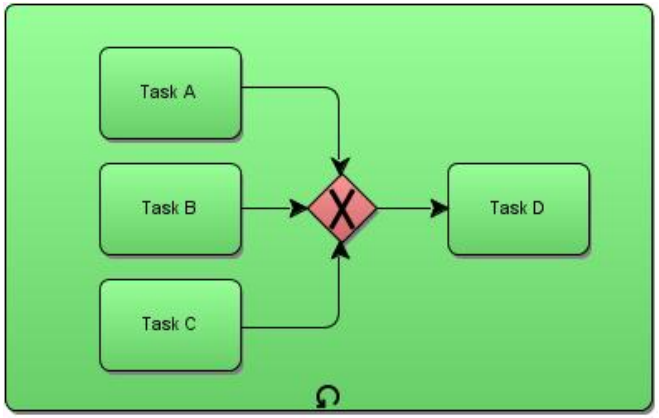
Vs.

Processes common across disparate preparation and collection types to foster serendipitous discoveries and knowledge transfer across domains.

A Few Examples

Fish vs. fluid preserved arthropods
Broader applications for whole-drawer digitization
Insect soups and unsorted fossils
Flat sheets, packets, invertebrate paleontology, and Odonates
Georeferencing
Imaging workflow software, e.g. Adobe Lightroom

Values of defined workflows



- Promote efficiency and automation of processes
- Facilitate routing and scheduling of activities
- Provide for balancing workloads
- Ensure that processes are visible and predictable
- Allow for escalations and notifications
- Enhance tracking of tasks
- Foster collaboration of all parties involved
- Stimulate the convergence of process and information
- Promote continuous evaluation and redesign

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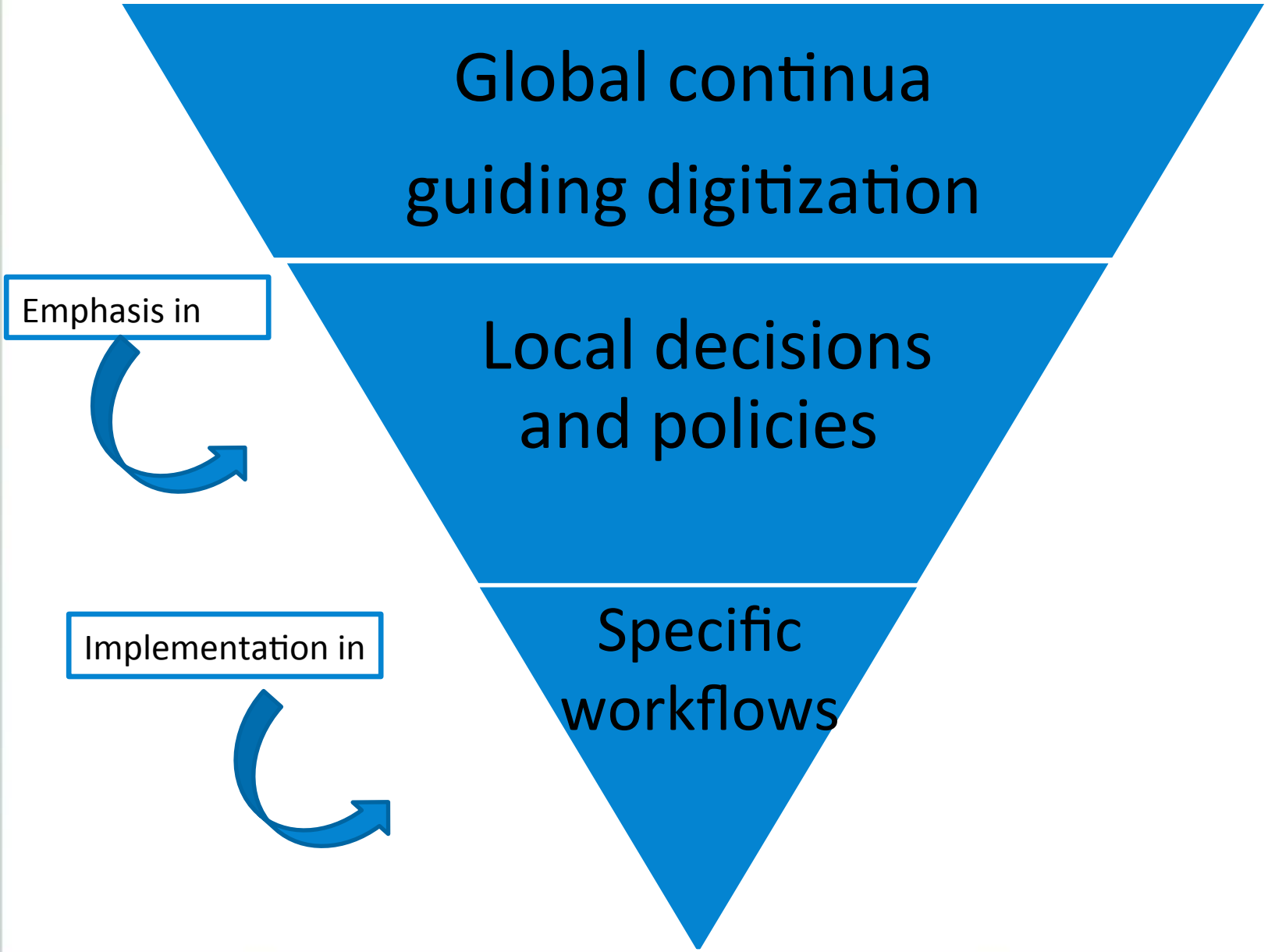
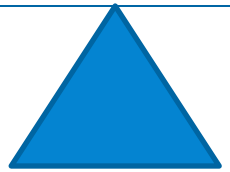

Global continua
guiding digitization
Emphasis in
Local decisions
and policies
Implementation in
Specific
workflows

Tracks to Digitization

- **Taking the inside track** is often based on stretching the institution's resources. Decisions are made to maximize resources available for user-initiated digitization by using solid baseline practices. The primary focus on the inside track is to get the job done quickly and to fill the user's request.
- **Taking the middle track** has the widest range of options, standards, and results. This is the most flexible of the tracks, where decisions often fall in gray areas.
- **Taking the outside track** focuses on the collections themselves. While users may initiate digitization, it is undertaken to deliver materials to a greater public. These decisions may lead to comprehensive digitization, such as an entire book, series, or collection. The goal is to create maximum access to special collections, using preservation and archival standards. This track usually involves a level of thought and planning that is more in-depth than the fulfillment of day-to-day digitization requests.

Scan and Deliver: Managing User-initiated Digitization in Special Collections and Archives, 2011
J. Schaffner, F. Snyder. S. Supple

Long view Short view



Taking the long view means developing doable, effective, and sustainable strategies for balancing long term goals with short term constraints, including a commitment to implementing future enhancements.

Pressures mitigating the long view

So much data, so little time.
Our collections are not getting smaller.
The funding agencies have high output expectations.
We only have 3 years to get this done.
All of our data and all of our specimens are important.
Let's just use the images!
We'll do the minimum now and enhance it later.

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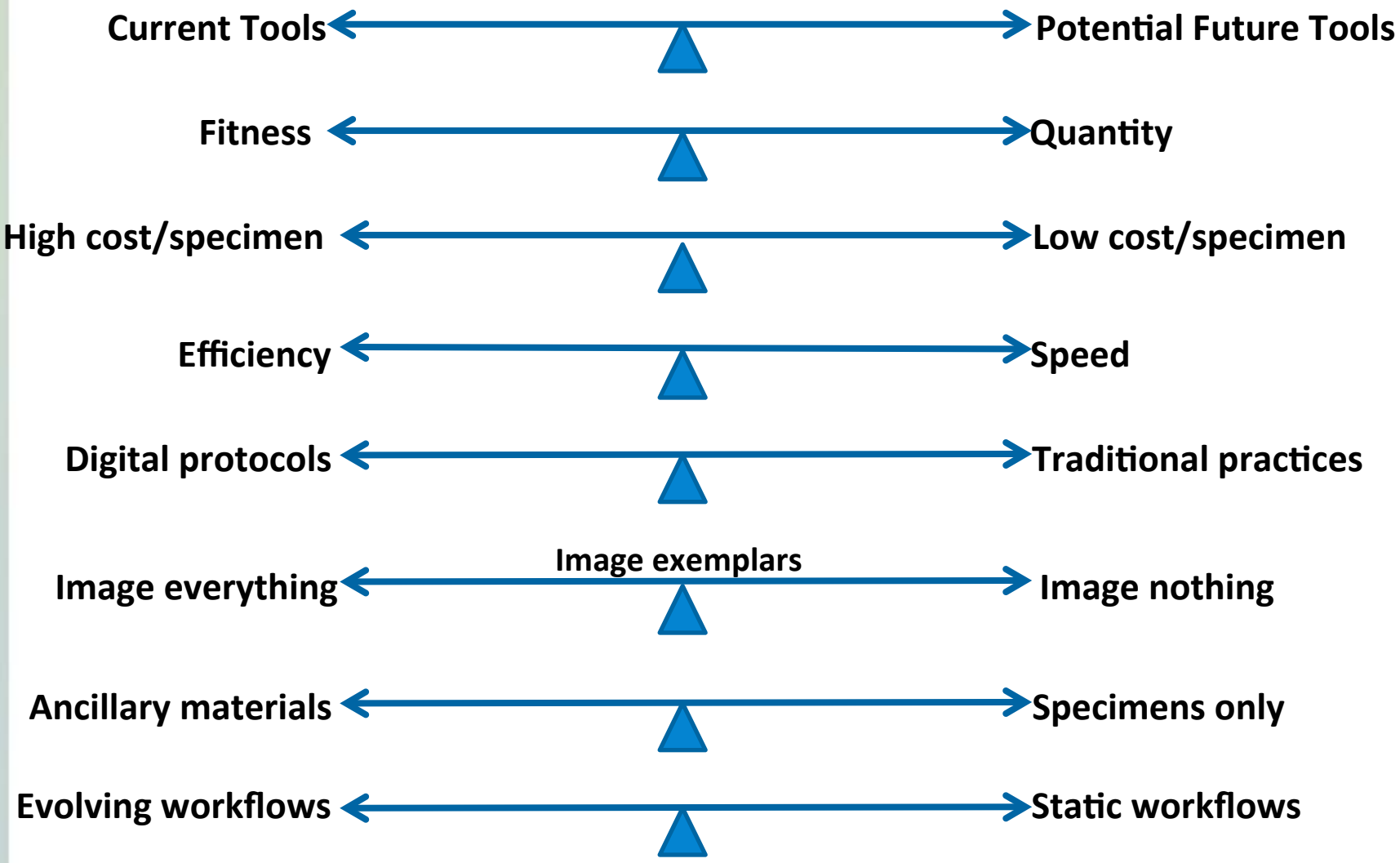
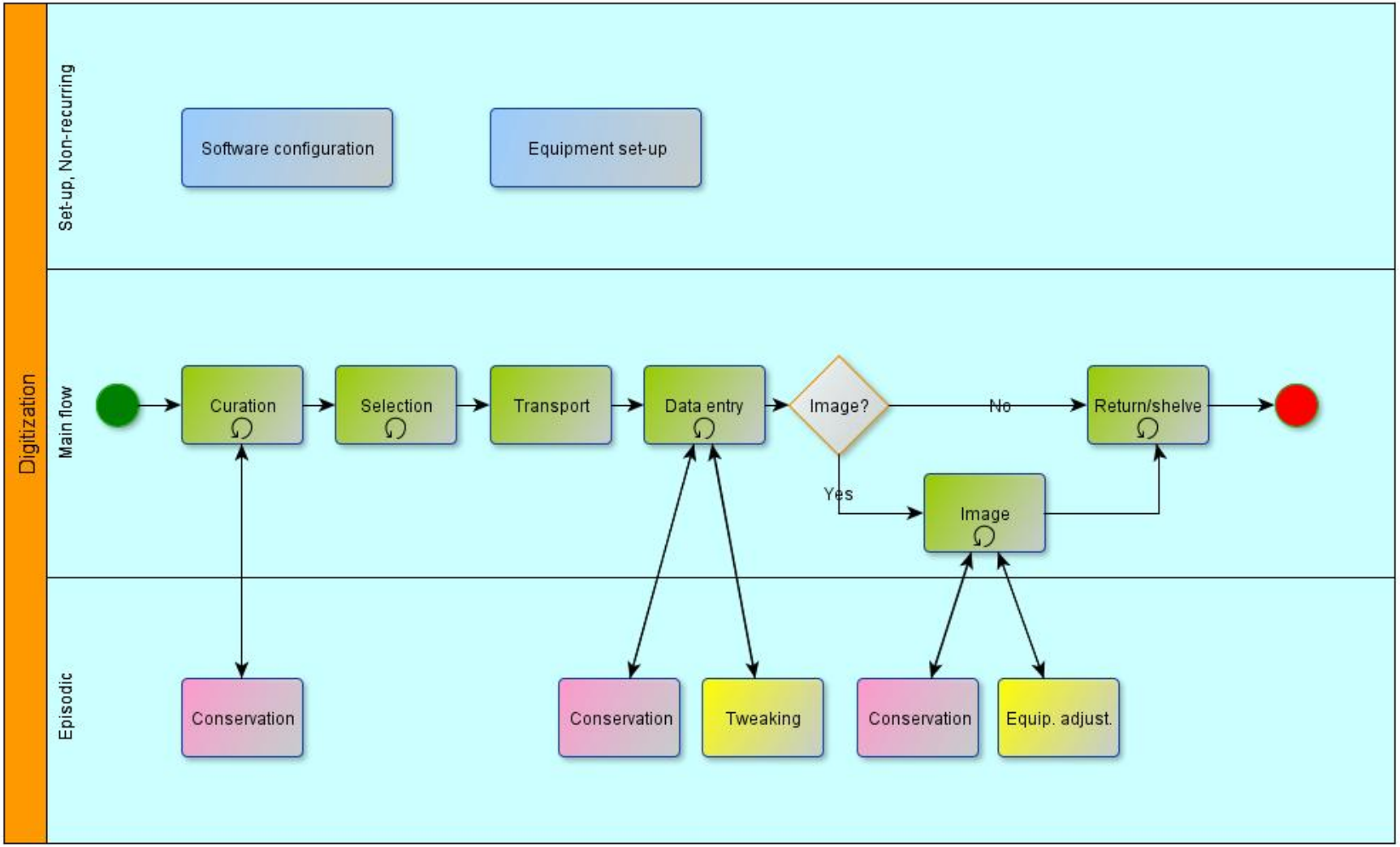
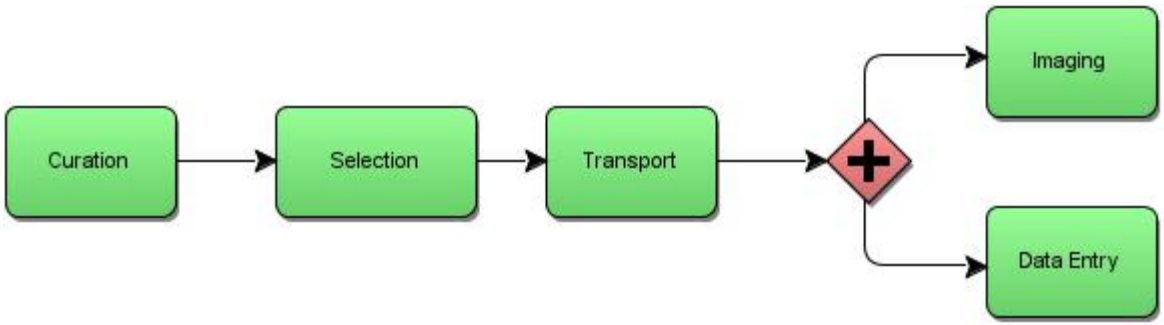
Global Digitization Continua

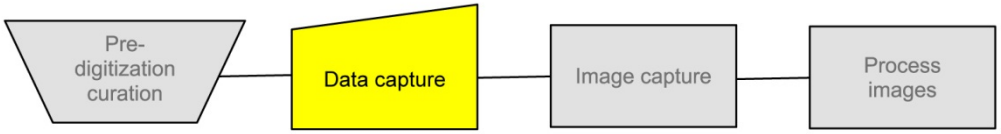



Digitization
Set-up, Non-recurring
Software configuration
Equipment set-up
Main flow
Curation
Selection
Transport
Data entry
Image?
No
Return/shelve
Yes
Image
Episodic
Conservation
Conservation
Tweaking
Conservation
Equip. adjust.

Example Processes (Modules), their Cycles and Dependencies

Process	Cycle	Dependency
Software configuration	Once/non-recurring	
Equipment set-up	Once/non-recurring	
Specimen curation	Recurring	
Specimen selection	Recurring	Pre-digitization curation
Specimen transport	Recurring	Specimen selection, imaging, data entry
Conservation	Episodic	Curatorial processes, imaging, data entry
Data entry	Recurring/tasks iterative	Specimen transport
Imaging	Recurring/tasks iterative	Specimen transport
Equipment adjustment	Episodic	Data entry/imaging
Software update/tweaking	Episodic	QC
Specimen return/shelving	Recurring	Imaging or data entry





Guiding Principles

Follow a modular approach

- "Plug and play" modules are preferred.
- Simple modules involving a limited number of tasks are easier to troubleshoot and maintain.
- Divide large modules into sub-modules.
- Modules are generally self-contained but tangential.
- There is no consensus workflow, virtually all workflows are customized.

Assign roles deliberately

- Adjust to strengths of each technician--using students and volunteers requires flexibility in role assigned to personnel rather personnel assigned to role.

Create task lists

- Complete.
- Clear.
- Succinct.
- Ordered.
- Reusable.

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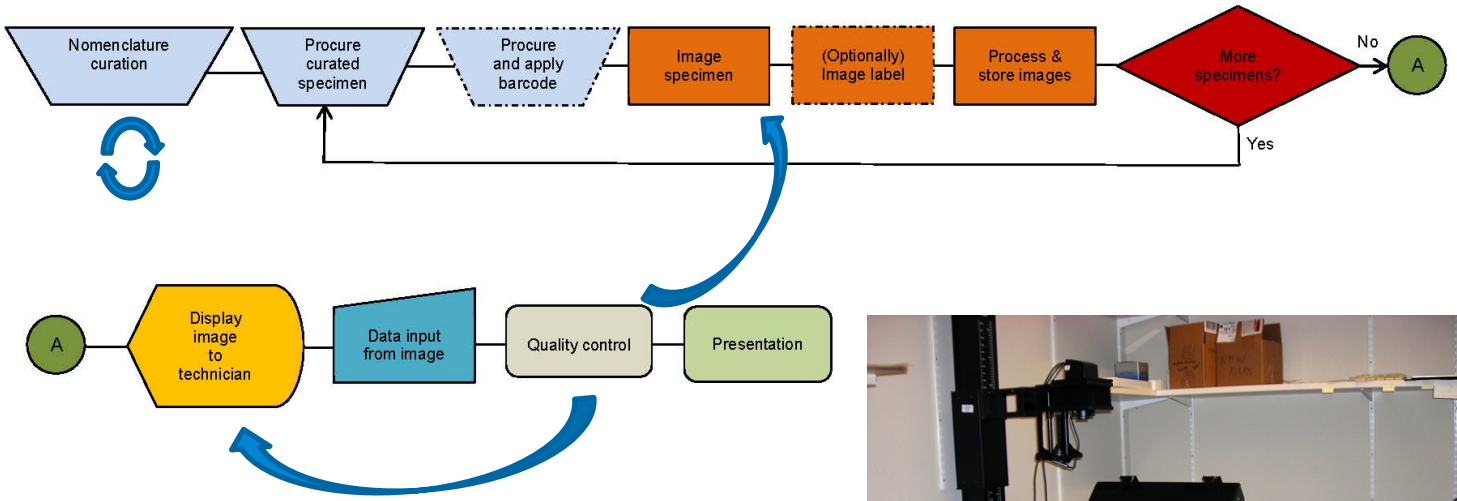
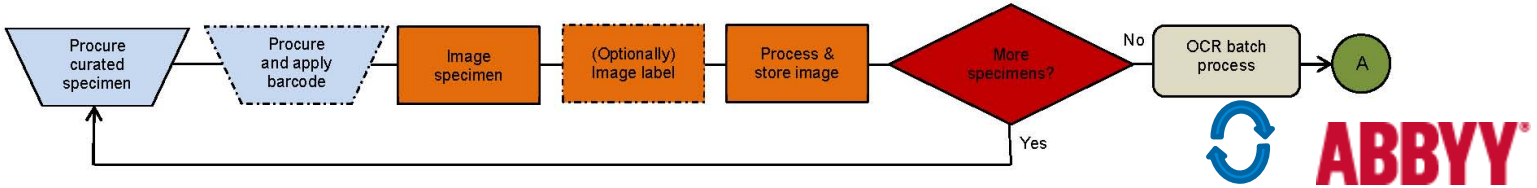
O2I2D(2)—Existing Specimen Workflow: Object to Image to Data

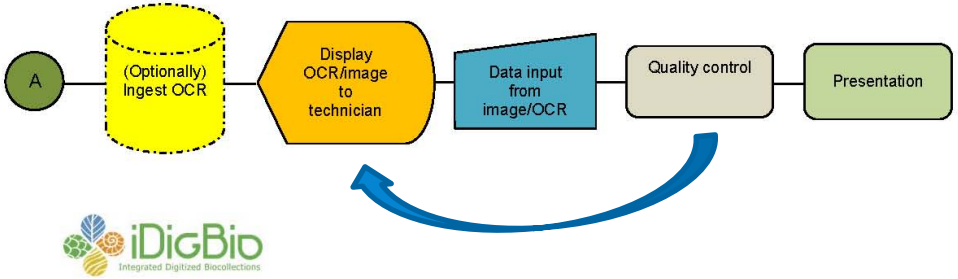
This workflow is designed for capturing images of existing specimens and using these images as the basis for data capture. Depending upon preparation type, barcodes are sometimes applied inline as the step immediately previous to imaging (shown optionally below) and other times en masse within an independent step during which several dozen or several hundred barcodes are applied in preparation for imaging. Pre-digitization curation and annotation is particularly important in this workflow to ensure that the current nomenclature to be used in data entry is obvious and clearly visible in the image.



O2I2D(1)—Existing Specimen Workflow Using Optical Character Recognition: Object to Image to Data

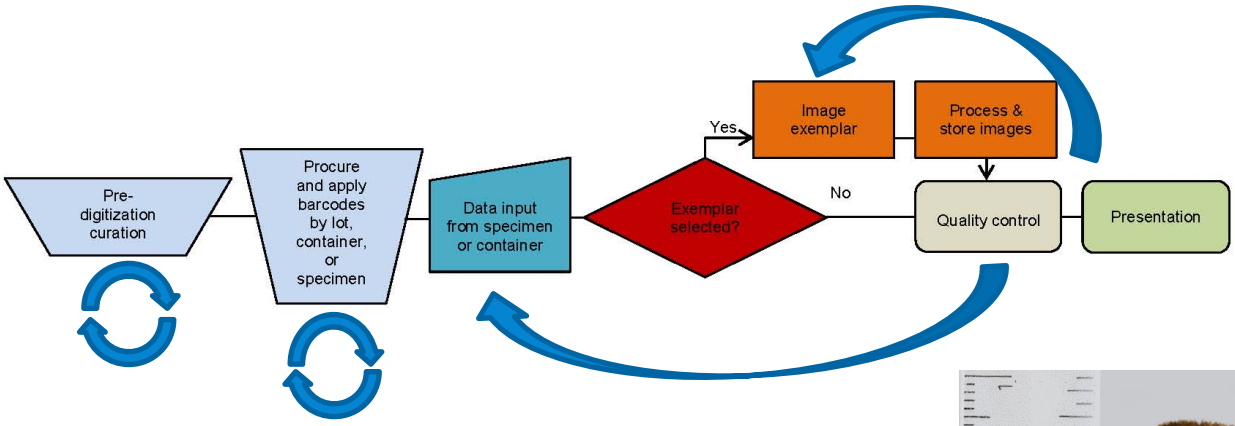
This workflow is designed to capture images of existing specimens, pass the images through optical character recognition (OCR) software, and use the combination of image and OCR output to capture data. There are variations on this workflow. For example, depending on preparation type, barcodes are sometimes applied inline as the step immediately previous to imaging (shown optionally below) and other times en masse within an independent step during which several dozen or several hundred barcodes are applied in preparation for imaging. OCR may also occur in various ways: 1) in batch (as shown below), with numerous images being processed following the close of one or more imaging sessions, 2) "on the fly" as a record and its associated image are loaded for data entry, or 3) one image at a time as a step immediately following the imaging of each specimen. OCR output may be ingested into a field in the database (shown optionally below), stored as individual text files within the computer's file system, or virtually processed at the time the image is presented to the data entry technician. The presentation of images and OCR to data entry technicians occurs in a single interface in which database fields, OCR output, and specimen image are simultaneously visible. Pre-digitization curation and annotation is particularly important in this workflow to ensure that the current nomenclature to be used in data entry is obvious and clearly visible in the image and/or OCR output.





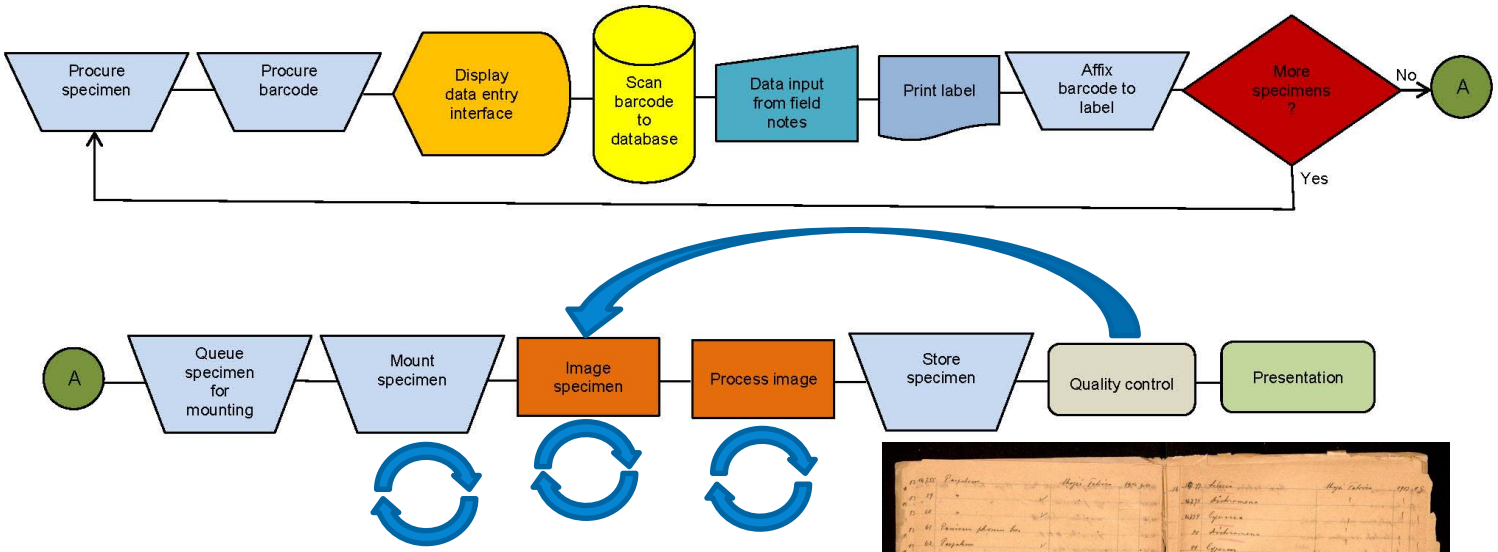
O2D2EI—Existing Specimen Workflow: Object to Data to Exemplar Images

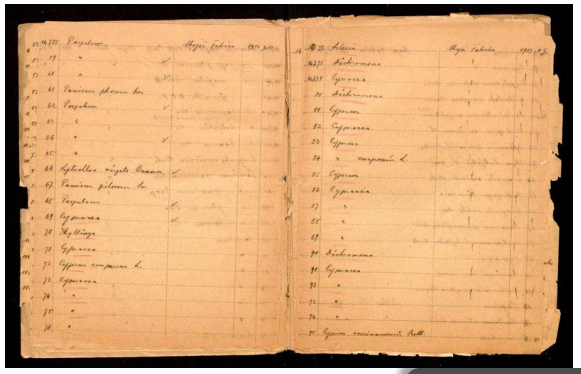
This workflow is in use for collections that capture data in specimen lots, collecting events, taxon container, or other aggregates, but capture images only for exemplar specimens. Data capture is effected from specimen labels. Depending upon preparation type, barcodes are usually applied inline—often to the containing tray or container—as the step immediately preceding data entry. Hence, barcodes may designate a single specimen or an aggregate of specimens, such as a unit tray within an insect drawer or ethanol-filled container in a wet collection. Barcode application is executed prior data entry and image capture usually follows data entry. Pre-digitization curation, including nomenclatural annotations and specimen organization, is usually important in this workflow.



FN2D2I—New Specimen Workflow: Field notes to data to image

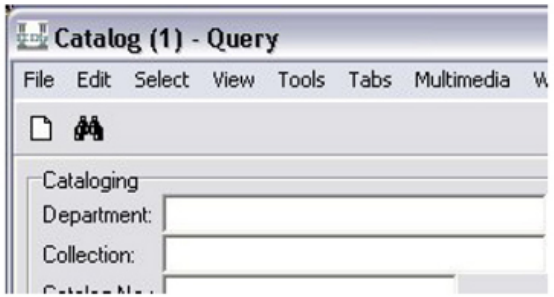
This workflow is designed for actively growing collections in which new specimens are regularly added. Collectors, especially in herbaria, typically keystroke label data from field notes, store the label with the specimen, and queue the specimen for mounting. Following mounting, the specimen is treated as an existing specimen with the data entered into the database by a technician, who re-keys the data previously keyed by the collector. The workflow proposed here eliminates the second keying of label data by capturing label data into the database as the label is prepared, allowing the label to be printed from the database immediately following data entry. The workflow assumes a database management system with functionality for printing labels, as well as a strategy that includes the application of bar codes to the newly printed label rather than to the specimen sheet.





Documentation and Instructions

- **Written Protocols**
  - Essential!
  - Include screen shots and pictures.
  - Attention to detail (leave nothing to the imagination).
  - Express limits on technician authority.



- **Feedback Loops**
  - Technicians: best source of efficiency adaptations, either by show or tell.
  - Easy methods for receiving feedback.
  - Personal copies of the protocol.
  - Master copy available via Google docs or other shared storage for updates and suggestions.

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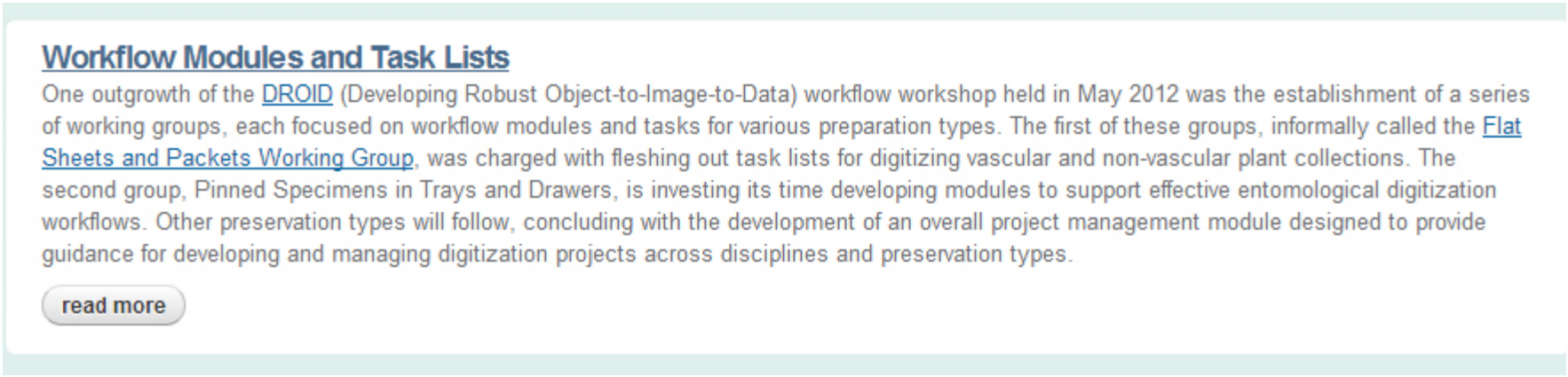
Idigbio.org->Digitization->Documentation->Workflow and Protocols->Workflow Modules and Task Lists

https://www.idigbio.org/content/workflow-modules-and-task-lists



Workflow Modules and Task Lists

One outgrowth of the DROID (Developing Robust Object-to-Image-to-Data) workflow workshop held in May 2012 was the establishment of a series of working groups, each focused on workflow modules and tasks for various preparation types. The first of these groups, informally called the Flat Sheets and Packets Working Group, was charged with fleshing out task lists for digitizing vascular and non-vascular plant collections. The second group, Pinned Specimens in Trays and Drawers, is investing its time developing modules to support effective entomological digitization workflows. Other preservation types will follow, concluding with the development of an overall project management module designed to provide guidance for developing and managing digitization projects across disciplines and preservation types.

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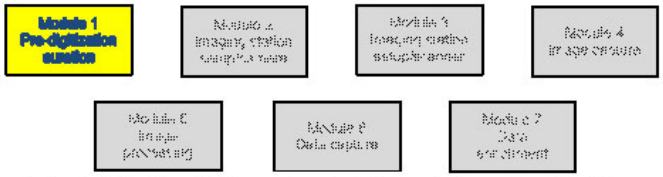
Workflow Modules and Task Lists



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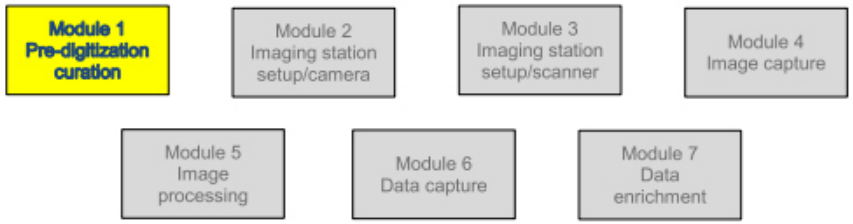
We have chosen a modular approach for presenting our results in order to accommodate the broad range of workflow implementations within the collections community. We recognize that there is no consensus workflow that fits all situations, even within a single preservation type. In light of this, we have attempted to assemble orderly, comprehensive task lists to serve as foundations from which institutionally specific workflows can be created. Not all institutions will use every task, but we hope that the lists we have developed encompass all relevant digitization tasks. We also hope that those in the collections digitization community will provide feedback on these lists, either through forum posts or e-mails to Gil Nelson, alerting us to deficiencies and oversights.

Links to published modules as they are completed are provided below:

Flat Sheets and Packets Working Group - Vascular and Non-vascular Plants

- Module 1 Pre-digitization Curation Tasks
- Module 2 Selecting Components for an Imaging Station
- Module 3 Imaging Station Setup Camera/Copy Stand
- Module 4 Imaging Station Setup Light box
- Module 5 Image Station Setup Scanner
- Module 6 Imaging

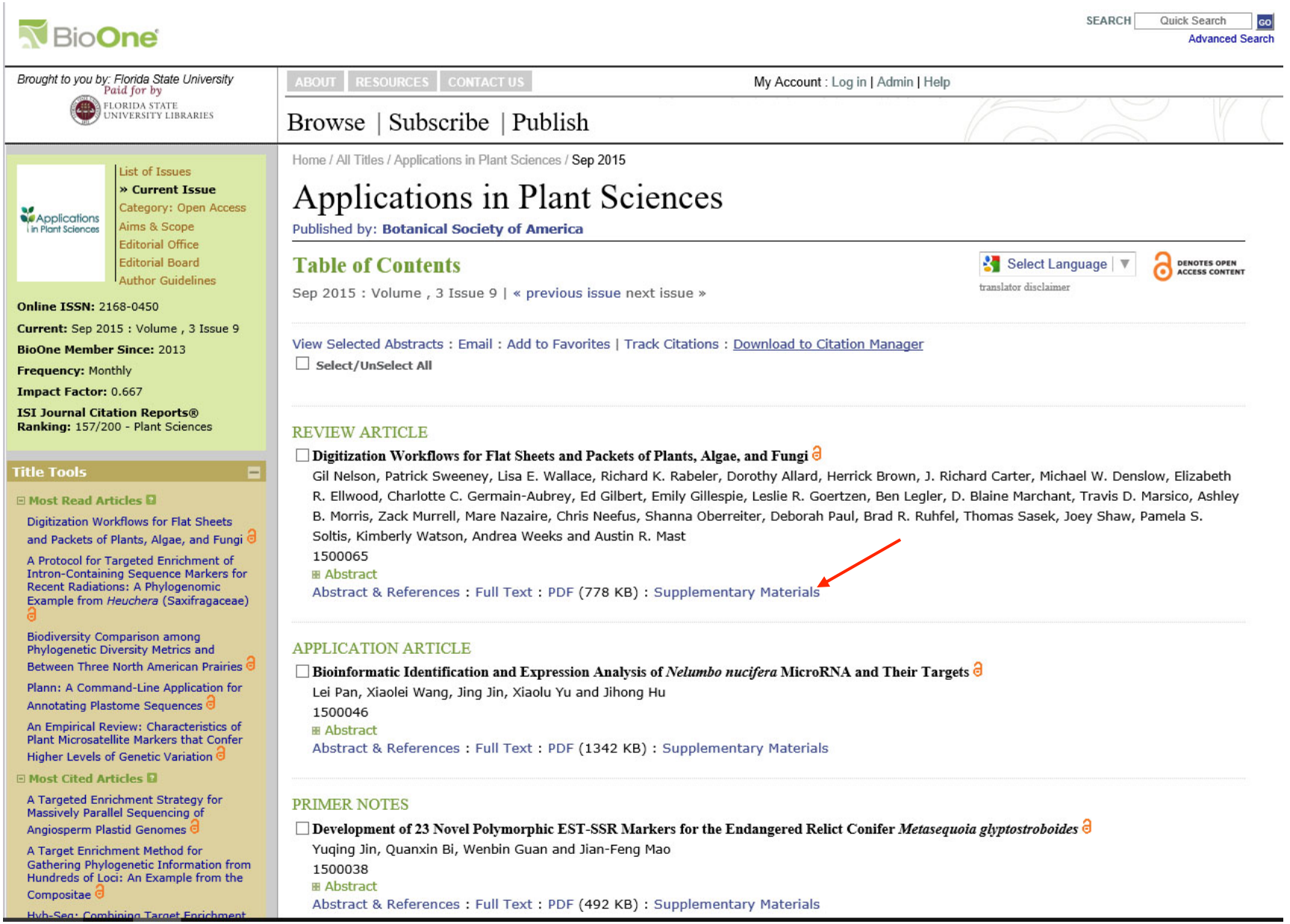
Workflow Detail: Pre-digitization Curation (for flat sheets and packets)



Module 1: Pre-digitization Curation Task List

Task ID	Task Description	Explanations and Comments	Resources
T1	Apply storage locator barcodes to storage locations (rooms, cabinets, shelves, folders, drawers, etc).	Most useful when systematically digitizing an entire collection. Otherwise potentially helpful with herbarium inventory. May be less helpful for collections that are digitizing in random order or only portions of the collection related to specific projects, or with significant separation between the pre-digitization curation, databasing, and image capture modules.	Barcodes, QRcode, DataMatrix.
T2	Select specimens to digitize.	For herbaria, this often includes all specimens. Where this is not the case, selection should follow the institution's pre-determined digitization policies or project management plan.	Digitization policy manual or project management plan.
T3	Associate/insert machine readable barcodes/documents with/into folders.	Some institutions create machine readable documents to gather data at the cabinet and/or folder level. Documents might contain such information as family, higher geography, and current identification ("filed-as name"). These data will be read and associated with individual collection records in Module 4, T1 or Module 7. Tasks T2 or T3 might also include determining whether specimens are out on loan or	QRcodes, DataMatrix, 1D barcode, or OCR-readable documents for insertion into specimen folders.

http://www.bioone.org/toc/apps/3/9



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Digitization Workflows for Flat Sheets and Packets of Plants, Algae, and Fungi
Gil Nelson, Patrick Sweeney, Lisa E. Wallace, Richard K. Rabeler, Dorothy Allard, Herrick Brown, J. Richard Carter, Michael W. Denslow, Elizabeth R. Ellwood, Charlotte C. Germain-Aubrey, Ed Gilbert, Emily Gillespie, Leslie R. Goertzen, Ben Legler, D. Blaine Marchant, Travis D. Marsico, Ashley B. Morris, Zack Murrell, Mare Nazaire, Chris Neefus, Shanna Oberreiter, Deborah Paul, Brad R. Ruhfel, Thomas Sasek, Joey Shaw, Pamela S. Soltis, Kimberly Watson, Andrea Weeks and Austin R. Mast
1500065
Abstract
Abstract & References : Full Text : PDF (778 KB) : Supplementary Materials

APPLICATION ARTICLE

Bioinformatic Identification and Expression Analysis of *Nelumbo nucifera* MicroRNA and Their Targets
Lei Pan, Xiaolei Wang, Jing Jin, Xiaolu Yu and Jihong Hu
1500046
Abstract
Abstract & References : Full Text : PDF (1342 KB) : Supplementary Materials

PRIMER NOTES

Development of 23 Novel Polymorphic EST-SSR Markers for the Endangered Relict Conifer *Metasequoia glyptostroboides*
Yuqing Jin, Quanxin Bi, Wenbin Guan and Jian-Feng Mao
1500038
Abstract
Abstract & References : Full Text : PDF (492 KB) : Supplementary Materials

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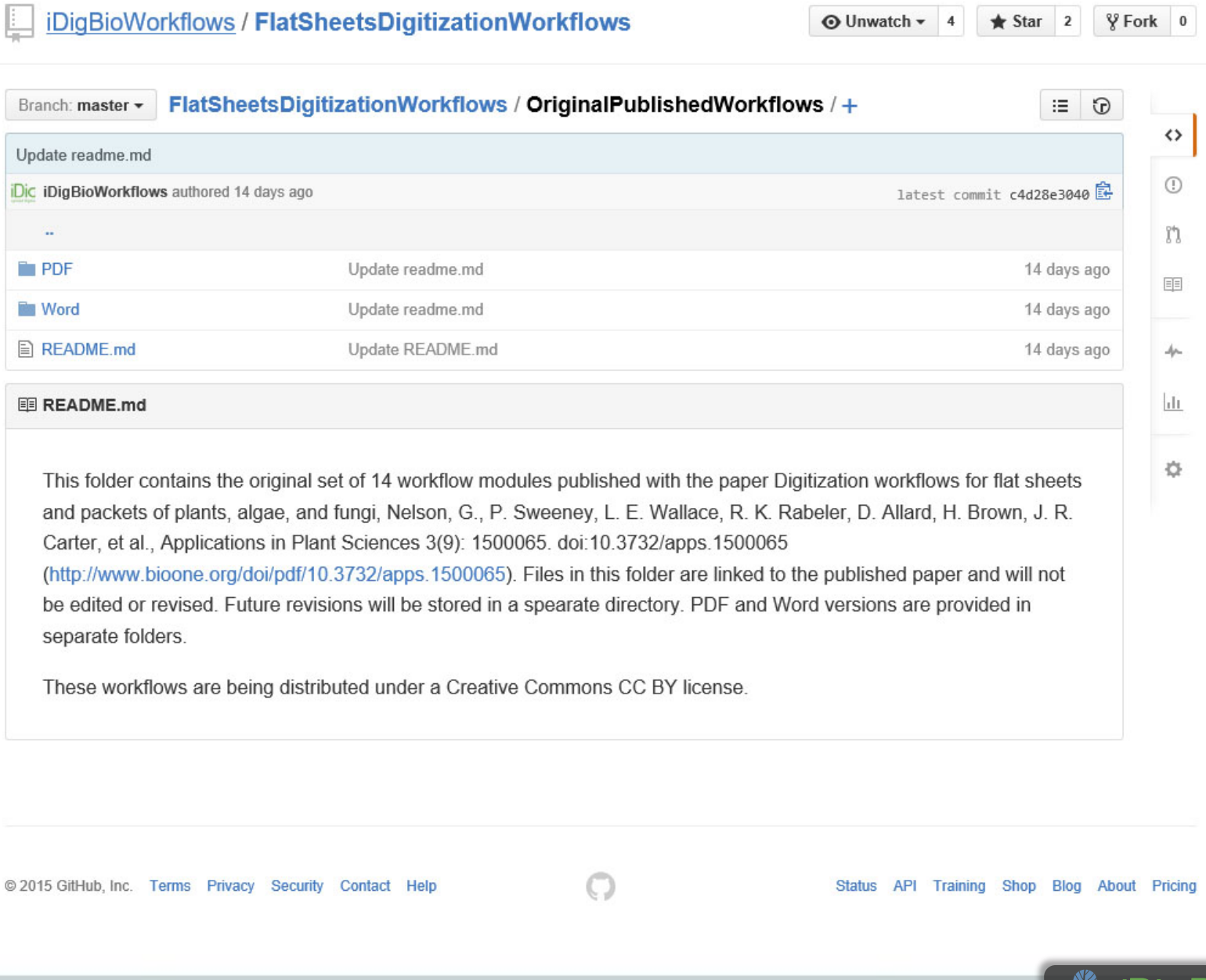
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FlatSheetsDigitizationWorkflows / OriginalPublishedWorkflows / +
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latest commit c4d28e3040
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This folder contains the original set of 14 workflow modules published with the paper Digitization workflows for flat sheets and packets of plants, algae, and fungi, Nelson, G., P. Sweeney, L. E. Wallace, R. K. Rabeler, D. Allard, H. Brown, J. R. Carter, et al., Applications in Plant Sciences 3(9): 1500065. doi:10.3732/apps.1500065 (http://www.bioone.org/doi/pdf/10.3732/apps.1500065). Files in this folder are linked to the published paper and will not be edited or revised. Future revisions will be stored in a spearate directory. PDF and Word versions are provided in separate folders.
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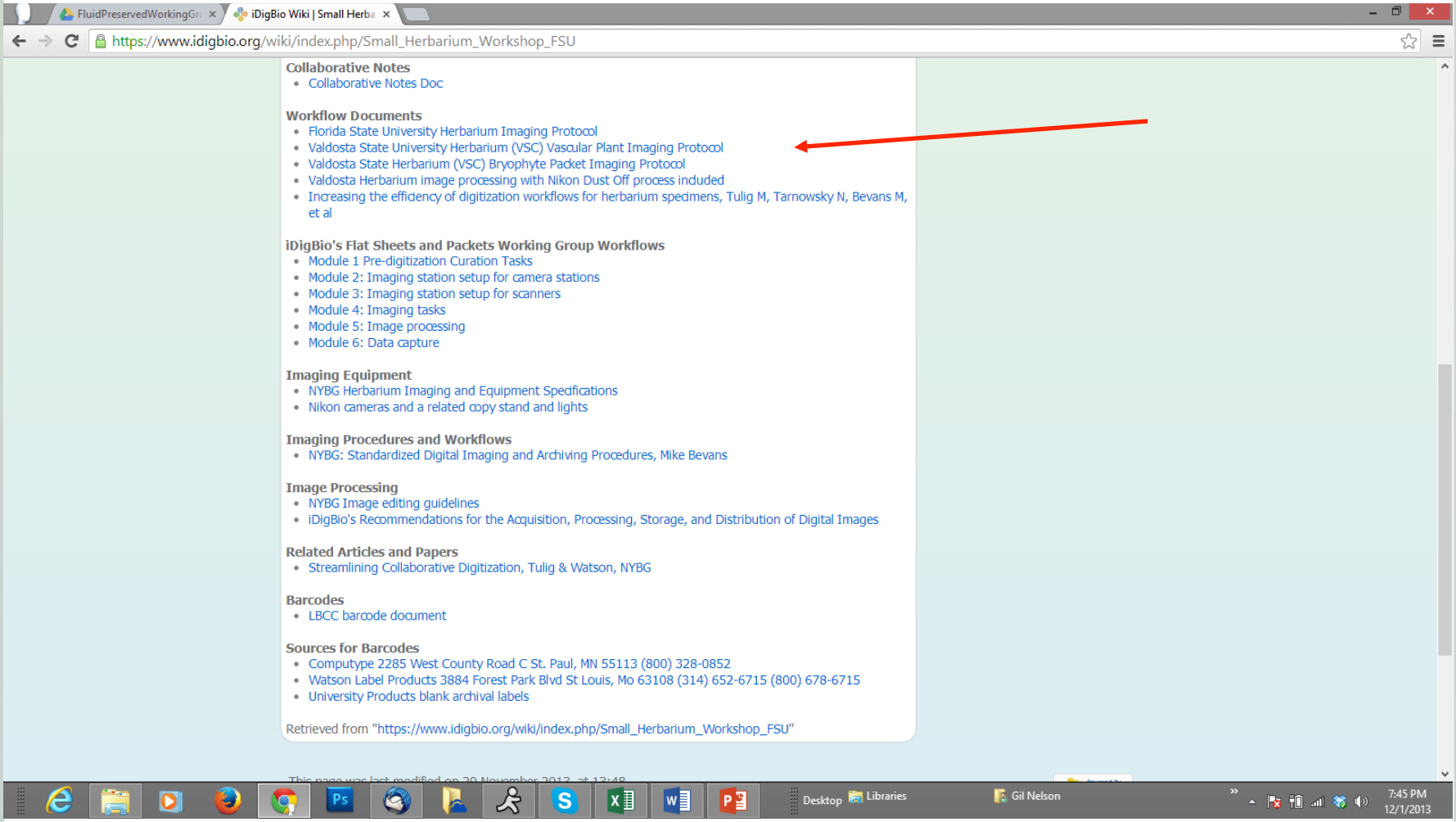
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Collaborative Notes Doc
Workflow Documents
Florida State University Herbarium Imaging Protocol
Valdosta State University Herbarium (VSC) Vascular Plant Imaging Protocol
Valdosta State Herbarium (VSC) Bryophyte Packet Imaging Protocol
Valdosta Herbarium image processing with Nikon Dust Off process included
Increasing the efficiency of digitization workflows for herbarium specimens, Tulig M, Tarnowsky N, Bevans M, et al
iDigBio's Flat Sheets and Packets Working Group Workflows
Module 1 Pre-digitization Curation Tasks
Module 2: Imaging station setup for camera stations
Module 3: Imaging station setup for scanners
Module 4: Imaging tasks
Module 5: Image processing
Module 6: Data capture
Imaging Equipment
NYBG Herbarium Imaging and Equipment Specfications
Nikon cameras and a related copy stand and lights
Imaging Procedures and Workflows
NYBG: Standardized Digital Imaging and Archiving Procedures, Mike Bevans
Image Processing
NYBG Image editing guidelines
iDigBio's Recommendations for the Acquisition, Processing, Storage, and Distribution of Digital Images
Related Articles and Papers
Streamlining Collaborative Digitization, Tulig & Watson, NYBG
Barcodes
LBCC barcode document
Sources for Barcodes
Computype 2285 West County Road C St. Paul, MN 55113 (800) 328-0852
Watson Label Products 3884 Forest Park Blvd St Louis, Mo 63108 (314) 652-6715 (800) 678-6715
University Products blank archival labels
Retrieved from "https://www.idigbio.org/wiki/index.php/Small_Herbarium_Workshop_FSU"
Desktop
Libraries
Gil Nelson
7:45 PM
12/1/2013

Continuous Workflow Improvement

Develop written workflows that reflect actual practice

Continuous evaluation of written and actual workflows by:

- Technicians
- Workflow managers
- Collections managers

With particular attention to:

- Bottlenecks
- Redundancy
- Handling time
- Varying rates of productivity

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Integrated Digitized Biocollections