



# TCN Quarterly Progress Report

## TCN Name

Building a global consortium of bryophytes and lichens: keystones of cryptobiotic communities (GLOBAL)<sup>1</sup>



## Person Completing the Report

Miranda Zwingelberg (GLOBAL Project Manager)

## Share Progress in Digitization Efforts

This report covers progress completed during the period of October 1 – December 31, 2022.

### Workflows, Equipment, and Personnel

Most GLOBAL institutions continued steady GLOBAL progress during 2022-Q4 and our final delayed collaborator (OSC) was able to begin digitization work.

ALA is reorganizing and incorporating several large loans while reorganizing the cryptogam collections. They continue to digitize and update metadata in ARCTOS, working with one curatorial assistant and support from a graduate student assistant.

At ASU, specimen digitization continued with their new student worker, currently focusing on ASU lichen specimens and progressing well.

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<sup>1</sup> Throughout this report, herbaria are referred to by their Index Herbariorum acronyms, which correspond to institutional names as follows: ALA = University of Alaska, Fairbanks, ASU = Arizona State University, BRY = Brigham Young University, CINC & MU = University of Cincinnati & Miami University, COLO = University of Colorado, DUKE = Duke University, F = The Field Museum, FLAS = University of Florida, ILL & ILLS = University of Illinois at Urbana-Champaign & Illinois Natural History Survey, LSU = Louisiana State University, MICH = University of Michigan, MIN = University of Minnesota, MO = Missouri Botanical Garden, MSC = Michigan State University, NY = New York Botanical Garden, OSC = Oregon State University, PH = The Academy of Natural Sciences of Drexel University, TENN = University of Tennessee, Knoxville, UC = University of California, Berkeley, WIS = University of Wisconsin, YU = Yale University



CINC & MU hired two additional student workers to replace students who left the project (one graduated and one got a full-time internship). They are nearing completion of the CINC “normal” specimens and have started preparing to image bound exsiccatae.

At COLO, digitization numbers for the quarter were similar to last quarter, but slightly down due to final exams and winter break in December. This was their second-best quarter for the project. They will train more students to contribute to transcription work to boost numbers during the upcoming quarter.

DUKE’s bryophyte team hired and trained three new work-study students, and two work-study students continued transcribing labels from previous semester. The lichen team re-mapped and/or deleted 270 “orphaned” lichen specimen photographs in Lichen Portal (i.e., photographs generated as part of the GLOBAL project which were attached to blank, “dummy” records in Lichen Portal).

At F, almost all of the undatabased lichen specimens on sheets have now been photographed. The last ones will be loaded onto the portal soon. They are working on photographing specimens that are already databased (15,000-20,000 estimated). They also continued bryophyte imaging and databasing.

ILL & ILLS continued transcribing bryophytes.

LSU trained an undergraduate to complete georeferencing of lichen and bryophyte records and continued to image bryophyte specimens.

MICH continued digitizing lichens and bryophytes. Two technicians and two undergraduate students worked in the herbarium on digitizing lichens this quarter.

MIN continued to image and transcribe label data for bryophyte specimens.

MO continued digitization work on their bryophyte specimens.

NY continued their focus on photographing lichens and skeletally digitizing the general collection of mosses and liverworts.

OSC was able to begin digitization work, barcoding and imaging bryophyte specimens.

PH had no students actively imaging. Progress was made, however, in new or updated lichen and bryophyte records by the collection manager and recently retired curatorial assistant.



TENN students continued barcoding, imaging, and transcribing bryophyte specimens. Four new undergraduate technicians were hired, trained, and began work during the Fall term. Four additional new undergraduates were interviewed and hired to begin training in January 2023. The table for one imaging stations was swapped with a different table to improve the ergonomics.

UC officially completed the lichen digitization and imaging, and are now working through barcoding and imaging the bryophyte collection. They plan to move to transcribing after imaging is completed.

WIS hired and began training three new student georeferencers. They are quickly picking up the basics and will continue when the semester resumes in January. They continued to image specimens from the WIS collection. Georeferencing Manager Smith spent time reviewing verifications that were completed up to this point. She began to send csv files with corrected coordinates to collection managers. They have arranged to have specimens shipped from WTU and Nebraska for digitizing.

YU continued digitization work on their bryophyte specimens.

## **Digitization**

Nineteen institutions (ALA, ASU, CINC & MU, COLO, DUKE, F, FLAS, ILL & ILLS, LSU, MICH, MIN, MO, NY, OSC, PH, TENN, UC, WIS, and YU) reported progress on digitization deliverables, with a total of 65,805 specimens barcoded (45,603 bryophytes and 20,202 lichens), 50,371 labels imaged (23,688 bryophytes and 26,683 lichens), 41,739 specimens imaged (24,004 bryophytes and 17,735 lichens), 30,681 specimen records uploaded to the portal (17,399 bryophytes and 13,282 lichens), 56,520 skeletal records created (39,641 bryophytes and 16,879 lichens), 27,884 labels fully transcribed (21,315 bryophytes and 6,569 lichens), and 13,223 specimens georeferenced (3,675 bryophytes and 9,548 lichens) (See Table 1 & Figure 1).



Table 1: Digitization progress by GLOBAL collaborators in 2022-Q4, separated by Bryophyte (B) and Lichen (L) specimens.

	# Barcodes Added		# Labels Imaged		# Specimens Imaged		# Uploaded to Portal		# Skeletal Records Created		# Fully Transcribed		# Georeferenced	
	B	L	B	L	B	L	B	L	B	L	B	L	B	L
ALA	250	2,215	250	2,215	250	2,215					6	1,820	6	1,820
ASU		689		689		689						689		
BRY														
CINC & MU	2,810		2,810		2,810		2,810		2,810		2,933			
COLO	667	7,006	167	8,006			167	8,006	167	8,006	90	2,757		
DUKE	1,741		2,294		278		2,572		2,491		617		14	
F	3,200		1,298	3,397	1,647	3,397	883	3,600						
FLAS	3,500		1,250		1,250		1,250							
ILL & ILLS	100								100		10,000			
LSU				39	2,150								661	1,832
MICH		3,203		3,203		384	1,785	257		3,203	1,318	186	90	2
MIN		2,009		2,009		2,009			2,147	2,009	3,229			
MO	3,188		5,027		5,027				4,653		325		53	
MSC														
NY	20,987	3,661	210	5,706	210	5,706	0	0	20,987	3,661	151	11	306	25
OSC	1,500		650		650									
PH											402	1,106		
TENN	4,268		5,022		5,022		4,940		4,021		2,244		1,039	
UC	400		1,718		1,718				1,718					
WIS						1,916							1,506	5,869
YU	2,992	1,419	2,992	1,419	2,992	1,419	2,992	1,419	547					
<b>Totals</b>	<b>45,603</b>	<b>20,202</b>	<b>23,688</b>	<b>26,683</b>	<b>24,004</b>	<b>17,735</b>	<b>17,399</b>	<b>13,282</b>	<b>39,641</b>	<b>16,879</b>	<b>21,315</b>	<b>6,569</b>	<b>3,675</b>	<b>9,548</b>
<b>B+L Totals</b>	<b>65,805</b>		<b>50,371</b>		<b>41,739</b>		<b>30,681</b>		<b>56,520</b>		<b>27,884</b>		<b>13,223</b>	

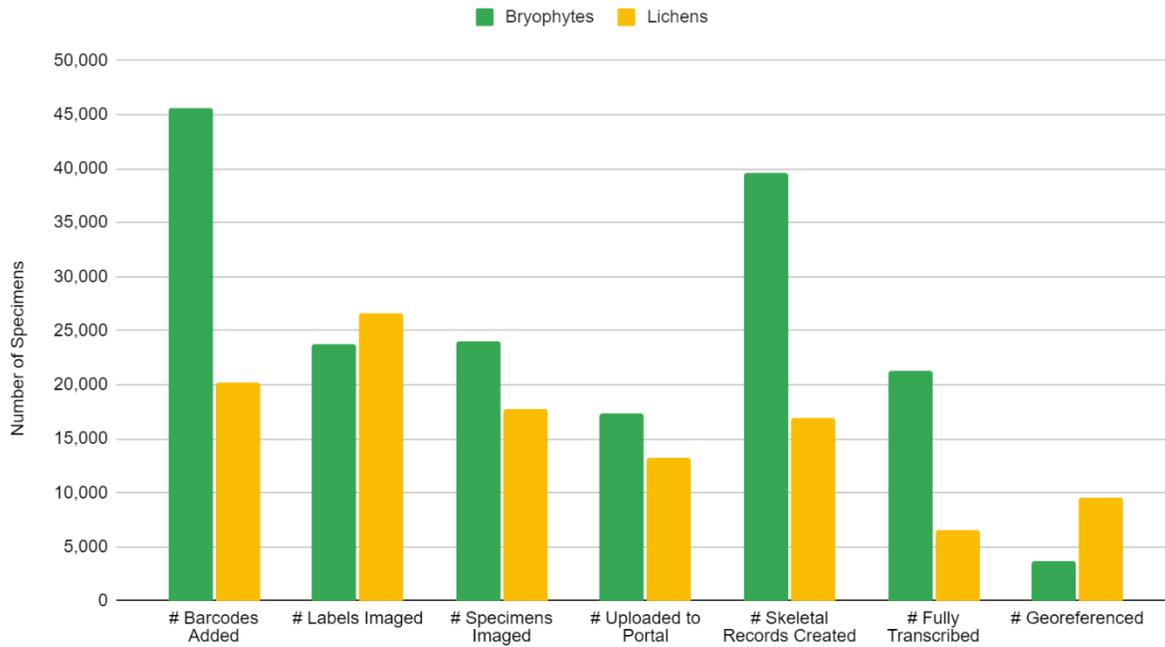


Figure 1: Digitization progress for the GLOBAL collaboration in 2022-Q4, separated by Bryophyte and Lichen specimens.

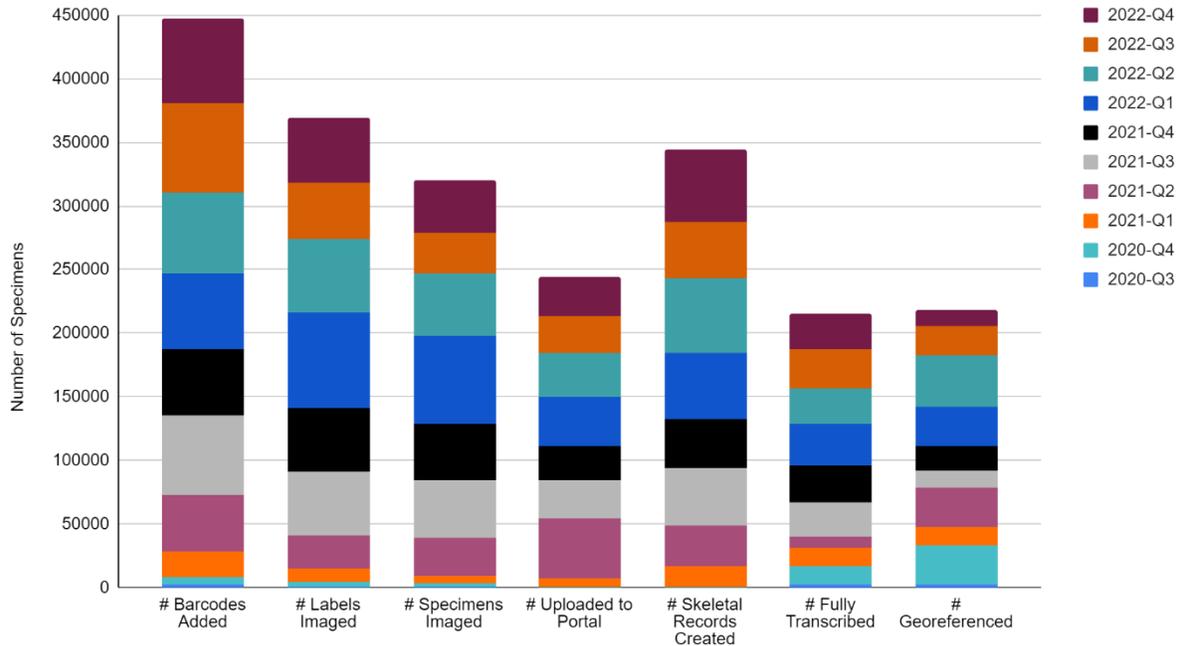


Figure 2: Cumulative digitization progress for the GLOBAL collaboration by quarter.



## Share Best Practices, Standards, and Lessons Learned

### Flexible Workflows

The GLOBAL teams continued to make use of flexible digitization workflows in 2022-Q4, including some use of virtual transcription work and prioritizing label imaging, while most collaborators were able to continue on-site work.

At COLO, based on preliminary work, the quality of specimen images is hampered by using a fixed imaging system to capture both packet/label data and specimens. They will most likely retake the specimen images later in the project when they have a system in place for capturing better specimen images. They are planning to capture both packets and specimens for the bryophyte collection in the same pass using two separate cameras and will circle back for lichen specimen images. Since no transcription work was completed on their non-North American specimens, they did not have records for the first wave of georeferencing work at WIS. They are prioritizing records from Australia, Chile, Finland, France, Japan, Norway and Sweden for transcription to build sets for georeferencing.

UC is trouble-shooting the idea of using “floating barcodes” so that the barcode can be part of the label and the specimen images. It is also useful for older specimens where the barcode was placed on the back of the packet.

### Collaboration

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2022-Q4. New collaborators and students were given access to Basecamp group resources. The Outreach & Education Group met in October to finalize preparation for the WeDigBio event. A Management Committee Meeting was held in November open to all GLOBAL members to review 2022-Q3 grant progress and provide an open forum to the GLOBAL team.

The TENN Project Manager completed routine check-in’s with collaborating teams at ASU, CINC & MU, COLO, DUKE, FLAS, ILL & ILLS, LSU, MICH, MIN, MO, and PH to discuss project status, updates, and concerns.

WIS continued its collaborative georeferencing, creating new communities in the CoGe interface and georeferencing as fully transcribed records become available. The GLOBAL



Georeferencing Manager (WIS) and Portal Manager (ASU) continued to consult on georeferencing workflows, especially those involving GEOLocate CoGe.

## Share Identified Gaps in Digitization Areas and Technology

### Taxonomy

At COLO, the taxonomic dropdown for the ImagingWorkflow application was missing many of the names they use in our collection. Last fall they worked with Portal Manager Katie Pearson to get an export of the lichen taxonomic thesaurus and Ryan Allen reformatted this list so it could be added to the application. It is difficult to quantify the impact since every imaging session is different, but most specimens do not require manual entry.

### Database Compatibility

A broken Symbiota connector in DUKE's institutional Specify 6 database continued to be a problem. They were not able to update their data for a year. Upgrading to Specify 7 was recommended by both Symbiota and Specify teams. The DUKE IT team encountered issues with the upgrade. For now, they are not able to send updates to either of the two portals.

F did not report several thousand images taken of specimens only. These are in a holding stage and will be reconciled with partially databased records prior to the current project and need careful coordination so they do not disrupt the workflow between EMu and Symbiota. When this is reconciled they will update their regular statics accordingly.

MICH's uploading to the project Symbiota portals has been reduced this quarter due to an impediment with their institutional IPT export from Specify. They are optimistic that this issue will be resolved soon.

## Share Opportunities to Enhance Training Efforts

The GLOBAL Project Manager (TENN) and Georeferencing Manager (WIS) continued compiling resources during 2022-Q4 to share on Basecamp and all resources were posted to the project website (<https://globaltcn.utk.edu>), including WIS's updated imaging workflow, an image-stacking protocol from NTBG, and a training course on bryophytes and lichens shared by the UCONN Herbarium.



ASU continued to provide regular user support through the Symbiota Support Hub. [Monthly Monday meetings](#) by the Support Group are open to all members of the Symbiota community and generally well attended. More tutorials have been added to the Symbiota Documentation by the Symbiota Support Hub at <https://biokic.github.io/symbiota-docs/>. Student workers and volunteers at ASU continue to be trained in routine image acquisition, specimen curation and data management.

A completely new version of a program facilitating the analysis of lichen secondary metabolites will soon be released via the Lichen Consortium Help & Resources site. This new program called Mytabolites will replace the current program called WinTab. The new version now not only contains a huge database of 800+ secondary metabolites, but it directly displays which lichen taxa contain particular metabolites, receiving/downloading that information directly from the online database of the Consortium.

F and DUKE are planning a joint bryophyte and lichen workshop at Oak Spring Garden Foundation in Virginia. Blanka Aguero, Matt Von Konrat, and Todd Widhelm will be going there in April 2023 to teach a class of around 20 participants the basic biology and bryophytes and lichens and how to find them in the field.

NY Digital Asset Manager presented GLOBAL-specific photography and photo processing in a BioDigiCon presentation.

The TENN Project Manager attended the Symbiota Support Hub meeting to learn more about creating and using keys in the portals. She also completed a number of Diversity and Inclusion trainings during 2022-Q4.

The three new WIS students hired to assist in georeferencing used the training course that was created by Katie Pearson for CCH2. It quickly introduced them to the basic concepts and GeoLocate interface and has been a tremendous asset. It reduces the time to explain the best practices required for the project.

## **Share Collaborations with other TCNs, Institutions, and/or Organizations**

Ongoing collaboration between GLOBAL teams and other TCN projects occurring concurrently at their sites continued. CINC is part of the All-Asia TCN (also processing MU collections) and these projects occur at separate imaging stations, but in the same space so training is shared,



especially regarding label transcription) between the two projects, and students share tips and tricks. COLO is also a member of the SoRo TCN and the All-Asia TCN and continued to share info and technology between projects to help optimize workflows. F collaborated with the new Africa TCN focusing on flowering plants and continued collaboration with the ongoing Pteridophyte TCN project as well. At MICH, ongoing collaboration continued between the PCC and GLOBAL TCNs, which share many resources including facilities, digitization and management staff, training, some equipment, and workflow. Though the grant objectives and specimens being imaged are separate, much of the institutional infrastructure is shared between the projects. NY continued ongoing internal collaboration with All Asia TCN and an NSF Collaborative Research grant (award number 2115190).

ASU's collaboration with the community of Latin American lichenologists continues. Jesús Hernandez developed a user survey and is planning interviews with key collaborators to investigate how the Latin American community can be better served.

As a case-study how to make use of existing tools to establish best practices for sharing biodiversity information, a checklist of [Lichenized and Lichenicolous Fungi](#) has been developed by ASU in close collaboration with international researchers and scientists from Ecuador (Grupo Ecuatoriano de Liquenología). A publication discussing these best practices and outlining the advantages of using Symbiota as the platform for establishing dynamic species checklists has been submitted for peer review.

The project by ASU undergraduate student Erin Eggenberger has been successfully completed and several Latin American lichen checklists have been added to the database of the Lichen Consortium.

TENN Project Manager participated in the quarterly iDigBio Internal Advisory Committee Meeting in November with other TCN participants.

TENN PI and Project Manager reviewed the drafted image-stacking procedure from prospective PEN partner NTBG.

TENN Project Manager contacted the Harvard Index of Botanists and Bionomia about adding the signature images compiled as part of the project to botanist records online. She shared the document with the Harvard team and met virtually with David Shorthouse of Bionomia to be trained to begin adding images of signatures to Wikidata entries.

GLOBAL imaging protocols were shared with Colleen Hatfield from CSU-Chicago.



An External Advisory Committee (EAC) group was created on Basecamp and all members of the EAC and Executive Committee were invited to join to share resources and discuss topics related to the GLOBAL project.

## Share Opportunities and Strategies for Sustainability

### Portal Management

ASU continued to host and maintain the Bryophyte and Lichen Portals, including nightly backups, regular software updates, adjustments to portal configurations and layout, etc. They have also continued to support image uploading, regularly update snapshot collections from international collections monthly, and troubleshoot any import issues that accompany this procedure. The Symbiota Support Hub continues to provide regular training sessions, documentation and tutorials.

The [Global IUCN Red-Lists of Lichens](#) continued to be regularly updated in the Consortium of Lichen Herbaria.

Merging several different platforms (North American, Latin America, Arctic Lichens) into a global, single Consortium of Lichen Herbaria provides opportunities to reduce maintenance, improve functionality and facilitate regular updates to better reflect the international character of the information being managed. Accordingly, a single Consortium of Bryophyte Herbaria will integrate the current North American and the *Frullania* data portal. Tools using the API to facilitate access to the data from different Symbiota portals are under development. The Symbiota Support Hub at ASU is enacting the portal changes requested by the Executive Committee to make the Lichen and Bryophyte Portals more global in scope, including updating text on pages, making styling changes, etc. The Hub is also updating the Symbiota code to make it more responsive (i.e., mobile friendly) and aesthetically pleasing.

### Taxonomy

ASU continued regular updates of the taxonomic thesaurus continue with support of Gary Perlmutter, Jason Hollinger, and Alan Fryday. As part of uploading the North American Checklist ca. 6,000+ taxon names have been reviewed; as part of establishing an Ecuadorian Checklist ca. 3,000+ names have been reviewed. In the process of this work, 1,000+ of names previously not part of the thesaurus have been added and accepted names and their synonyms have been linked.



MO's dataset that forms the bryophyte taxonomic thesaurus is now included in the Catalogue of Life and is freely available at doi: 10.48580/dfqt-8zmp.

### **Back Ups**

COLO's raw images and JPGs continue to be uploaded to the University of Colorado Research Computing. These images are in addition to the local copies housed in the CU Herbarium. The hope is that these images will never need to be accessed, but to serve as a catastrophic backup if they have a computer or hard drive failure. Monthly backups of the COLO database in the Lichen and Bryophyte Portals are made on the first working day of the month. These files are housed locally and will be archived on Research Computing in case they ever need a point in time backup of their data.

## **Share Education, Outreach, Diversity, & Inclusion (EODI)**

### **Activities**

The GLOBAL TCN website (<https://globaltcn.utk.edu>) was maintained and updated with additional links to developed protocols and workflows. Social media accounts belonging to collaborators continued using #GlobalTCN as a way to share progress with the community.

CINC held herbarium tours for two classes and a sent a loan of specimens to the Lloyd Library and Museum for display in an exhibit entitled "Visions of Nature Across Time and Place."

DUKE's Scott LaGreca participated in Darwin Day at the NC Museum of Natural Sciences, Raleigh, NC, on November 12, 2022. The theme for the Darwin Day was "Fungi" and their exhibit table was entitled "The Secret Life of Lichens." A total of 3,579 people visited the museum that day. He also gave a Lichen Herbarium Tour on November 17, 2022 for 11 undergraduate students. In addition, Duke's Lichen Herbarium was featured in an article in the Duke Research Blog, Fall 2022: [https://researchblog.duke.edu/2022/09/19/what-are-lichens-and-why-does-duke-have-160000-of-them/?fbclid=IwAR0gvVvYTr4R8FaoilLNU793h2PyR0oBZKN\\_2lzSvCZMmcc\\_35Z9JxTjWlmw](https://researchblog.duke.edu/2022/09/19/what-are-lichens-and-why-does-duke-have-160000-of-them/?fbclid=IwAR0gvVvYTr4R8FaoilLNU793h2PyR0oBZKN_2lzSvCZMmcc_35Z9JxTjWlmw).

F's digitization projects have continued to reach out to broader audiences and contributed to outreach and education programs, including numerous behind-the-scenes tours involving Field Museum members, school classes, educators and the general public – all achieved and adapted to a virtual experience as well as onsite and in-person. F has become a leading institution with WeDigBio, with the PI serving on the Board, and helping with global event organization. Beyond



WeDigBio, the project continues to participate in several virtual public transcription events. In collaboration with educators and the Field Museum Learning Center, lesson plans were finalized during the reporting quarter for elementary and middle school on 1) Plant biomimicry; 2) Plant Structure & Function; 3) Biodiversity & Ecosystems. These are in accordance with Next Generation Science Standards (MS-ETS1-1; 4-LS-1; MS-LS2-51).

GLOBAL staff members at NY wrote several outreach pieces for The Hand Lens, including a series celebrating cryptogam specialists from Latin America for Hispanic Heritage Month.

OSC Hosted a WeDigBio event and Herbarium Open House on October 13, 2022.

The TENN Herbarium held a “Cupcakes and Collections” open house in November for students, staff, and faculty on campus which included tours of the herbarium and our newly installed compactors (and a gross of mini-cupcakes).

TENN continued hosting the GLOBAL weekly transcription event on Fridays during 2022-Q4. Eight community science volunteers from three countries participated (US, Canada, Sweden) and transcribed skeletal data for over 500 specimens. Volunteers were also able to see a number of “Specimen Spotlight” presentations on specimens and collectors compiled by the TENN GLOBAL Project Manager.

Plans progressed for producing the GLOBAL educational videos in conjunction with the team at ALA. The participating individuals and dates were selected for May 2023.

UC conducted several herbarium tours which included a tour and demo of the digitizing lab and process.

## **WeDigBio**

Members from seven GLOBAL collaborators (CINC & MU, COLO, DUKE, F, FLAS, MSC, TENN) participated in the October 2022 WeDigBio. The team from F again helped host and manage the event with assistance from the GLOBAL team. Over 40 community scientists participated on each of the two GLOBAL days. A hybrid event, the virtual volunteers (including participants from across the globe) databased over 2,700 records and those in-person barcoded over 6,000 specimens. The event included three student presentations: Madison Winter (CINC) "Where do specimen images come from? A demonstration at the University of Cincinnati Herbarium," Karn Imwattana (DUKE) "Tracing history of plants using field and herbarium collections: genetic



structure of some circumboreal peat mosses (*Sphagnum*)," and Stephanie Maari (F) "Mosses as Bioindicators."

## Share Information About Your Website and/or Portal Usage

The GLOBAL project website, <https://globaltcn.utk.edu>, was utilized by 247 users during 2022-Q4, including 23 from Asia, 14 from Europe, and 7 from South America (see Figure 3).

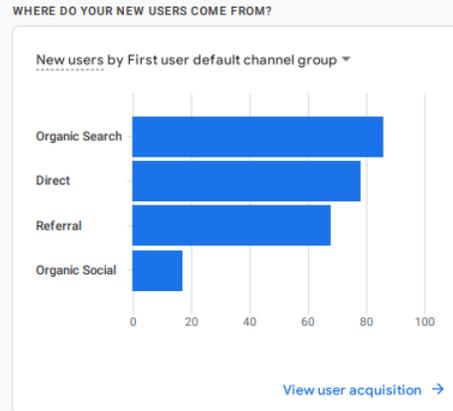
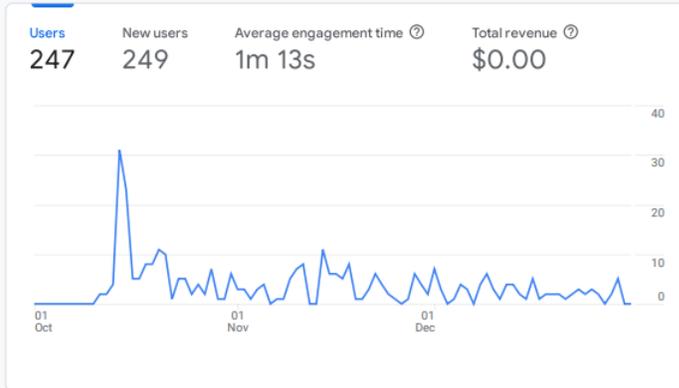
The Bryophyte and Lichen Portals, created as part of the original LBCC grant, host new images and data produced by the GLOBAL collaborators. 254 users visited the Bryophyte Portal and 1,086 users visited the Lichen Portal during 2022-Q4 (see Figures 4 & 5). Totals are dramatically lower than previous quarters, but are likely a more accurate representation of true usage. Increased security measures were enacted on the portals during this quarter, protecting against bots and malicious IP addresses.



All Users [Add comparison](#)

Custom Oct 1 - Dec 31, 2022

Reports snapshot



WHAT ARE YOUR TOP CAMPAIGNS?

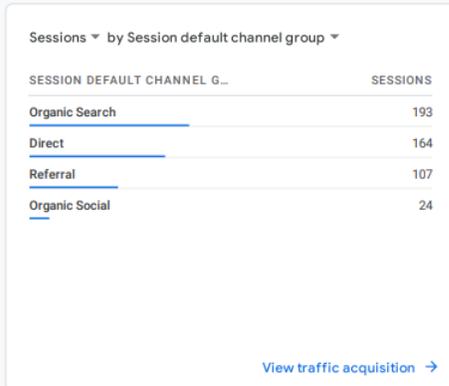


Figure 3: Use metrics for the GLOBAL project website (<https://globaltcn.utk.edu>) from October 1 – December 31, 2022.

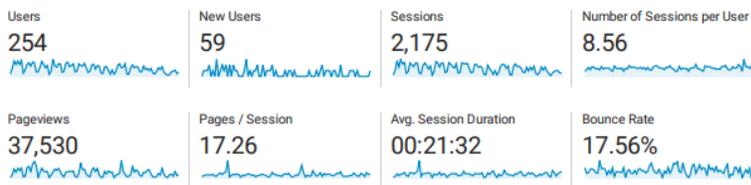


**Audience Overview**

All Users  
100.00% Users

Oct 1, 2022 - Dec 31, 2022

Overview



Language	Users	% Users
1. en-us	174	68.50%
2. en-gb	11	4.33%
3. fr	7	2.76%
4. es-es	6	2.36%
5. en-ca	5	1.97%
6. fr-fr	5	1.97%
7. id-id	3	1.18%
8. nl-nl	3	1.18%
9. de	2	0.79%
10. de-de	2	0.79%

Figure 4: Use metrics for the Bryophyte Portal (<https://bryophyteportal.org/portal/>) from October 1 – December 31, 2022.



Audience Overview

All Users  
100.00% Users

Oct 1, 2022 - Dec 31, 2022

Overview



Language	Users	% Users
1. en-us	428	39.16%
2. es-es	67	6.13%
3. en-gb	57	5.22%
4. de	42	3.84%
5. ru-ru	37	3.39%
6. fr	28	2.56%
7. fr-fr	25	2.29%
8. es-419	24	2.20%
9. de-de	23	2.10%
10. zh-cn	23	2.10%

Figure 5: Use metrics for the Lichen Portal (<https://lichenportal.org/cnalh/>) from October 1-December 31, 2022.



## Share Other Activities and/or Progress

### Image Tagging

Progress has been made at ASU on the character revision for tagging and identification keys. The glossary with 2,000+ terms is in the process of being linked to the key characters. Chemical characters have been revised and a program for the analysis of secondary metabolites can access this information directly from the portal (see Best Practices, Standards, and Lessons Learned).