TCN Quarterly Progress Report

TCN Name

Building a global consortium of bryophytes and lichens: keystones of cryptobiotic communities (GLOBAL)[1]

Person Completing the Report

Miranda Zwingelberg (GLOBAL Project Manager)

Share Progress in Digitization Efforts

This report covers progress completed during the period of January 1 – March 31, 2022.

Workflows, Equipment, and Personnel

Most GLOBAL institutions continued steady GLOBAL progress during 2022-Q1.

ALA's imaging, barcoding, and transcription of lichen and bryophytes is ongoing. They are still being affected by COVID, but are slowly gaining momentum. No specimens or labels were digitized in 2022-Q1 due to scheduling, but they hope to get more done in the next quarter.

ASU's routine workflow is now established, so imaging, barcoding, and transcription of lichen and bryophytes is ongoing. They had been previously much delayed by COVID, but productivity is now improving.

[1] 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

No BRY specimens or labels were digitized in the first quarter of 2022. However, students are lined up to re-start digitization May through September.

CINC & MU's imaging, barcoding, and transcription of CINC bryophytes is going well. Transcription of MU bryophytes is slowing down as they are down to difficult hand-written labels and labels in Cyrillic script.

COLO started the semester remote and the Museum was closed to the public most of January and February, with staff asked to work remote where possible. While still not where they want to be production-wise, March of 2022 was the most productive imaging month for the project even without imaging during spring break.

F continued imaging of lichens and bryophytes. They onboarded new interns to their team which will increase output for imaging and databasing.

FLAS's imaging is going strong, and they are excited to see the actual organism in photos. They are constructing an additional light-box from coroplast and LED's. Christian Wanamaker joined the FLAS team as their Project Manager to oversee the digitization work.

LSU's specimen imaging of bryophytes by a volunteer is in progress.

MICH recruited and trained one volunteer to contribute to bryophyte label transcription.

MSC is nearly complete with their digitization work. Their bryophytes are fully transcribed and some very complicated batches of lichens are almost completely imaged. These have spreadsheets, which will complete transcription when the imaging is done.

NY barcoding had slowed down as they worked through some lichen exsiccatae but they started barcoding bryophytes and that will continue in earnest through the rest of this year.

Preparations for a collection move at OSC has taken all of their curatorial time. The move is scheduled for May, and they hope to be unpacked and operational by July. They will make GLOBAL digitization their top goal once they are operational again this summer.

PH had only one work study student imaging about once a week, which caused a decrease in progress.

TENN briefly used old halogen lights for one of our imaging stations after the original LED lights they purchased stopped working for our needs. The halogen lights were too hot and

uncomfortable for the students and resulted in a different photo than our first imaging station, even after post-processing. After reaching out to the group for suggestions, they purchased two new LED panels, recommended by Eric Tepe (CINC). TENN hired and trained four undergrads for a “Herbarium Boot camp” over the Winter Mini-Term in January to work on GLOBAL imaging, databasing, and transcription. The herbarium has had 11 undergrads and 1 graduate research assistant (GRA) this semester who are almost all solely working on GLOBAL. 2022-Q1 was the most productive quarter at TENN by far.

After a long winter break at UC, campus was remote for the first two weeks of the semester. That did slow down their digitizing pipeline, but now the students are allowed to return to campus, so things should ramp back up. Lichen digitization and imaging is ongoing. They are nearing the end of the lichen collection, and within the next two quarters we will be moving on to the bryophytes.

WIS continued to image lichen specimens. Student hourly rate is increasing this last month.

Digitization

Eighteen institutions (ASU, CINC & MU, COLO, DUKE, F, FLAS, ILL & ILLS, LSU, MICH, MIN, MO, MSC, NY, PH, TENN, UC, WIS, and YU) reported progress on digitization deliverables, with a total of 59,793 specimens barcoded (40,236 bryophytes and 19,557 lichens), 75,398 labels imaged (37,664 bryophytes and 37,734 lichens), 69,012 specimens imaged (33,467 bryophytes and 35,545 lichens), 37,620 specimen records uploaded to the portal (26,450 bryophytes and 11,170 lichens), 44,691 skeletal records created (27,036 bryophytes and 17,655 lichens), 32,663 labels fully transcribed (24,410 bryophytes and 8,253 lichens), and 31,549 specimens georeferenced (18,595 bryophytes and 12,954 lichens) (See Table 1 & Figure 1). These quarterly totals are the highest yet for label and specimen imaging, as well as transcription and georeferencing (See Figure 2).

Table 1: Digitization progress by GLOBAL collaborators in 2022-Q1, 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														
ASU	220	239	220	239	220	239			220	239	220	239	220	239
BRY														
CINC & MU	2,299	34	2,914	34	2,914	34	3,550	34	2,914	34	4,362	6		
COLO		4,525		4,525				4,525		4,525		1,612		
DUKE	1,782		2,096		885		2,981		1,782		150		10	
F	4,419	1,588	4,419	1,588	4,419	1,588	4,419	1,535	3,632	65	2,119			40
FLAS	5,670		1,165		1,165		1,165		18					
ILL & ILLS	3,765		3,765		3,765									
LSU	3	140	3	140	1,474		3	140	3	140	3	140	58	225
MICH	5,026	1,932	5,036	1,932	579	277	2,443		5,026	1,932	2,443		309	1
MIN		7,026		7,026		7,026					4,475			
MO	4,295		5,169		5,169				801		765		433	
MSC		3,582		3,582		3,582		680		3,582	1,099	3,582		3,582
NY	1,858	294	962	15,499	962	15,499			1,894	3,969	1,774	2,613	1,068	5,087
OSC														
PH		47		47		47		47		47		47		
TENN	8,839		9,855		9,855		9,829		8,805		6,899	14	1,812	6
UC		150		3,122		3,122				3,122				
WIS						4,131		4,209					14,685	3,774
YU	2,060		2,060		2,060		2,060		1,941		101			
Totals	**40,236**	**19,557**	**37,664**	**37,734**	**33,467**	**35,545**	**26,450**	**11,170**	**27,036**	**17,655**	**24,410**	**8,253**	**18,595**	**12,954**
B+L Totals		**59,793**		**75,398**		**69,012**		**37,620**		**44,691**		**32,663**		**31,549**

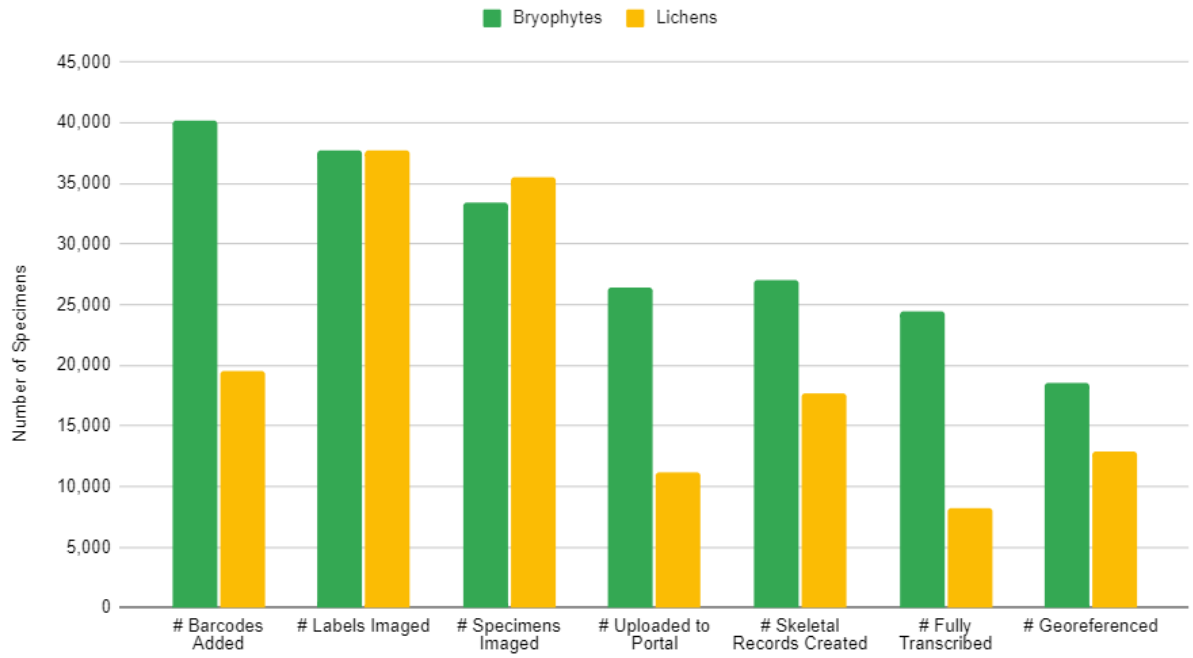

Figure 1: Digitization progress for the GLOBAL collaboration in 2022-Q1, separated by Bryophyte and Lichen specimens.

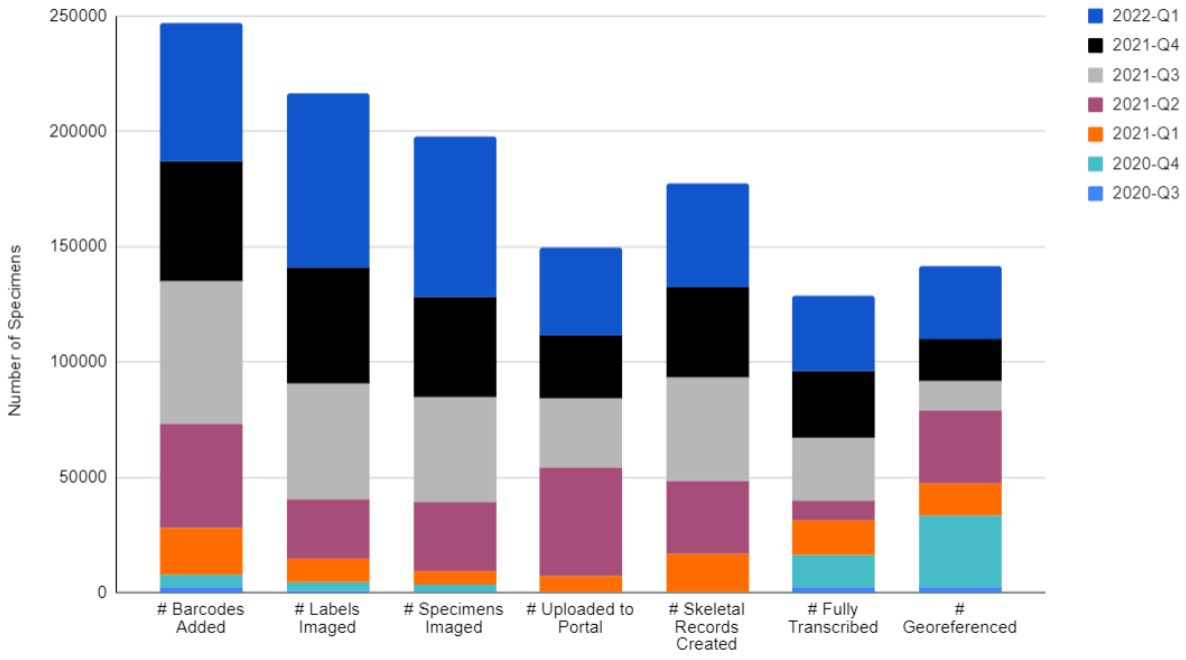

Figure 2: Cumulative digitization progress for the GLOBAL collaboration by quarter.

Share Best Practices, Standards, and Lessons Learned

Flexible Workflows

The GLOBAL teams continued to make use of flexible digitization workflows in 2022-Q1, including some use of virtual transcription work and prioritizing label imaging, while most collaborators were able to begin or continue on-site work.

Collaboration

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2022-Q1. New collaborators and students were given access to Basecamp group resources. The Outreach & Education Group met twice in preparation for the April WeDigBio event and to discuss the status of O&E activities. The Specimen Imaging Working group met in February. ASU PI Bungartz demoed the newly available program BCRWatcher, and the group discussed lighting and light-boxes with a new team member from FLAS. The Executive Committee (F, NY, TENN, UC) met in January with the IT Team to help visualize the GLOBAL interface, a web platform that will bring together but not replace the current Lichen and Bryophyte Portals, among others.

A Management Committee Meeting was held in February open to all GLOBAL team members to review quarterly grant progress. The GLOBAL Project Manager (TENN) began spring check-in meetings with collaborators, Zooming with MO, COLO, CINC & MU, DUKE, ILL & ILLS, YU, FLAS, LSU, BRY, F, MIN, WIS, ALA, MSC, MICH, ASU in March to discuss progress, concerns, and plans.

WIS continued its collaborative georeferencing with those institutions that have given permission and have transcribed label data available. In 2022-Q1 they worked with localities in Austria, France, Germany, Guam, Canary Islands, Palau, Norway, UK, Philippines, Malaysia, Thailand, China, Brazil, Switzerland. Germany and Austria are problematic as they often are older specimens and contain localities that are now part of Czech Rep, Slovakia, etc. They need to determine the best way to handle these records once they are in the CoGe framework.

Data Quality Control

MSC learned how to track transcription through the “Review/verify occurrence edits” function in Symbiota, which is very useful.

A review was undertaken of TENN Bryophyte and Lichen Portal records to clean up record statuses to ensure they move properly through the transcription and georeferencing workflows.

Share Identified Gaps in Digitization Areas and Technology

Image Uploading

ASU IT continued to facilitate the uploading of images into the Lichen and Bryophyte Portals. They are developing a new tool to allow users to batch ingest images directly through the portal rather than uploading them into Dropbox, where they are then transferred to portal servers by the data manager.

Barcode Renaming

ASU's progress in digitization was originally delayed because programmers at ASU were developing a program to capture image metadata as part of the routine imaging. The program BCRWatcher is now fully functional and has extensively been tested, so that routine imaging has picked up pace.

GLOBAL Interface

The discussion that began in 2021-Q4 to determine the best way forward for a combined Lichen and Bryophyte data portal interface continued in 2022-Q1. The Executive Committee (EC) met in January to review the grant proposal and discuss a vision for the GLOBAL interface. The results of this meeting were shared with the IT Team. A second meeting was held with the EC where the IT Team presented different practical options for the interface. We believe that the Symbiota API, which is under development, may best serve the purpose to query and integrate data sets across different portals, and began querying our collaborators for user scenarios to help direct the functionality of the interface.

Snapshot Dataflow

As not all of our collaborators are working Live in the portals, there are some ongoing challenges. Because MSC maintains a Specify database as well as the Lichen Portal, they need to create a workflow for separately uploading records into each. UC had to complete manual entry of lichen names not in their internal database system.

Transcription Challenges - Handwriting

Transcription of MU bryophytes slowed down as they are down to difficult hand-written labels and labels in Cyrillic script. This is a challenge faced by all collections to varying degrees due to a range of older, globally-collected specimens. Best practices for working through these labels are needed. A January meeting with F's Machine Learning Engineer Beth McDonald illustrated some possible future avenues. She reviewed her active projects using AI and Machine Learning to help decipher handwriting.

Share Opportunities to Enhance Training Efforts

The ASU team continued to develop documentation and training resources to be accessed on the Symbiota Docs website (https://biokic.github.io/symbiota-docs/) and the YouTube channel (https://www.youtube.com/channel/UC7glMVLRnTA6ES3VTsci7iQ).

The program BCRWatcher for routinely capturing image metadata as part of the digitization workflow is now fully functional, was announced on basecamp and has been made available via https://help.lichenportal.org/index.php/en/bcrwatcher/.

CINC & MU will be losing several of their undergrad GLOBAL workers at the end of the semester. One of their best will be staying on, fortunately, and they are considering moving her into a leadership/training role for new undergrad hires.

FLAS has 3 undergraduate students gaining experience with the specimen digitization process.

At ILL & ILLS, 2 undergraduate students have been trained in lichen and bryophyte packet refurbishing.

NY Lead Digitizer and Intern attended the Tuckerman Foray and were able to collect and learn lichen IDs.

The GLOBAL Project Manager (TENN) and Georeferencing Manager (WIS) continued compiling transcription and georeferencing resources during 2022-Q1 to share on Basecamp and all resources were posted to the project website (https://globaltcn.utk.edu). Students continued contributing to a shared document of Transcription tips and tricks available to student digitizers across the collaboration.

The GLOBAL Project Manager (TENN) hired and trained four new undergrads over a three week Winter Mini-term to work on the GLOBAL project and they all stayed on at varying levels during

the spring semester. TENN Collections Manager Oliver also trained two new herbarium interns for the spring semester. Experienced herbarium techs assisted with some of these training efforts.

WIS has students working together on georeferencing and sharing best practices and tips for moving more quickly through localities. One of their students has offered to help train incoming student hourlies, as she is graduating this semester.

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

As Domain 6 of iDigBio, the ASU team works closely with the other iDigBio domains. The Latin American version of the Lichen Portal, Consorcio de Herbarios de Líquenes en América Latina (https://lichenportal.org/chlal/), continues to be supported. As a result of this outreach towards Latin America, several new collections from the region are now available through the Lichen Consortium (e.g., the lichen collections from the Ecuadorian Base Nacional de Datos de Biodiversidad, https://bndb.sisbioecuador.bio/bndb/).

CINC (also processing MU and CMNH specimens) is part of the All-Asia TCN as well, and students working in the herbarium (on separate imaging stations) share tips and tricks.

COLO is also a member of the SoRo TCN and the All-Asia TCN, and continues to share info and technology between projects to help optimize workflows.

Collaboration is ongoing at MICH between PCC and GLOBAL TCNs, which share many resources at MICH 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.

GLOBAL Project Manager (TENN) and TENN GRA attended a session of the BRIT Armchair Botanist to help plan and prepare for their own transcription event.

TENN PI Budke was contacted by both Clemson University (CLEMS) and the Bishop Museum (BISH) about joining our group as PEN's. While the North American collection at CLEMS was not in scope, discussions began with the team at the Bishop Museum. Resources were shared and a virtual meeting was held in March to discuss plans for a PEN submission. GLOBAL collaborators Eric Tepe (CINC) and Alan Franck (FLAS) offered advice from their successful prior PEN

experiences. The Bishop Museum, along with the University of Hawaii (HAW) and the National Tropical Botanical Garden (PTBG), hope to submit a proposal in April.

TENN PI Budke and the GLOBAL Project Manager were connected with Andrew Hipp from the Morton Arboretum by Jennie Kluse (LSU). They met virtually to discuss georeferencing and project management advice for the proposed Tree TCN.

Lauren Cohen from iDigBio was given access to the GLOBAL Basecamp group and attended one of our working group meetings.

The GLOBAL Lead PI and Project Manager (TENN) participated in the February iDigBio Quarterly IAC meeting to connect with other active TCN's.

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.

ASU transferred all images that were previously housed on the storage.idigbio server to ASU servers. After de-duplication, these images will replace the existing image links so that image hosting does not rely on iDigBio's IT infrastructure in the future. Stephen Sharnoff has now generously accepted to make his entire slide collection of outstanding lichen macro-photos available directly through the Lichen Consortium; images will be linked directly to their corresponding voucher specimens [at CNAL and SBBG (collections transferred from UCR)]. They already received a first batch of 7,541 images; images previously not scanned are currently being digitized. Linking these images to their specimens and serving them through the portal will assure that these image links no longer break, when the taxonomy changes or specimen IDs change.

FLAS hopes to unite their collections into one home source and IPT to various Symbiota.

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.

ASU is coordinating a workshop on the Latin American Lichen Consortium (https://lichenportal.org/chlal/) planned for July 30-31 at the XV meeting of the Grupo Latinoamericano de Liquenólogos (GLAL) in Argentina.

CINC gave a tour of the herbarium to collaborators among the staff of the Lloyd Library and Museum.

DUKE gave a tour of their lab and herbarium for an adult volunteer.

The Gantz Family Collections Center at F hosted a short but sweet event for Collections Club on Friday, January 21st for plant enthusiasts. The event continued its virtual format which brought in volunteers across the United States and Canada. 26 community scientists collectively contributed to curating 1,029 bryophyte records. Volunteers worked on transcribing specimen labels of bryophytes and lichens that were collected outside of North America.

LSU held 4 tours of the herbarium with elementary children from LSU Laboratory School demonstrating bryophytes vs. vascular plants (~400 students and 16 teachers total).

NY staff worked on imaging specimens and writing short biographical pieces on several women collectors for Women's History Month, these were published on The Hand Lens. They also participated in several Women's History Month events at NYBG, a dinner banquet and a

breakfast, where they showcased specimens from this TCN (and other herbarium specimens) collected by various women.

TENN began hosting a weekly online transcription event in February to engage volunteers to help with transcribing GLOBAL specimens from multiple partners. During 2022-Q-1, 26 participants were trained on transcribing skeletal data in the Bryophyte and Lichen crowdsourcing modules and they added skeletal data to 939 records. Many of the events featured presentations including a GLOBAL overview, TENN Graduate RA Julia Butler's Masters project on Fissidens, TENN PI Budke's work with *Palamocladium leskeoides*, and TENN graduate student Eric Shershen's PHD moss project. TENN Collection Manager Oliver gave a virtual tour of herbarium specimens from TENN and a demo of specimen imaging. Georeferencing Manager Smith (WIS) gave a demo of georeferencing. Recordings of most presentations have been made available on the project website.

TENN shared Georeferencing resources with Dr. Charles Kwit, a professor in Department of Forestry, Wildlife and Fisheries at the University of Tennessee, for use in a class project.

TENN ordered GLOBAL logo stickers to distribute to students, volunteers, and at outreach events.

The GLOBAL Project Manager (TENN) attended a number of EODI Trainings during 2022-Q1 including, "Barriers to Inclusion: Service Dog Handlers in Science Laboratories," "Advancing Equity-Minded Structures of Support", and "Just Sustainabilities in Policy, Planning, and Practice."

WeDigBio

Five GLOBAL collaborators (DUKE, COLO, CINC & MU, F, TENN) agreed to participate in the April 2022 WeDigBio. They held two WeDigBio Planning Meetings in March to discuss scheduling, roles, presentations, and advertising. The team from F will again help host and manage the registration for the event, with assistance from the GLOBAL team. It was decided to hold a GLOBAL-specific day on Thursday, while including GLOBAL records throughout the four day event.

Share Information About Your Website and/or Portal Usage

The GLOBAL project website, https://globaltcn.utk.edu, was utilized by 386 users during 2022-Q1, including 33 from Europe, 27 from Asia, 14 from Oceania, and 7 from Africa (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. Over 3,700 users visited the Bryophyte Portal and over 18,800 users visited the Lichen Portal during 2022-Q1 (see Figures 4 & 5).

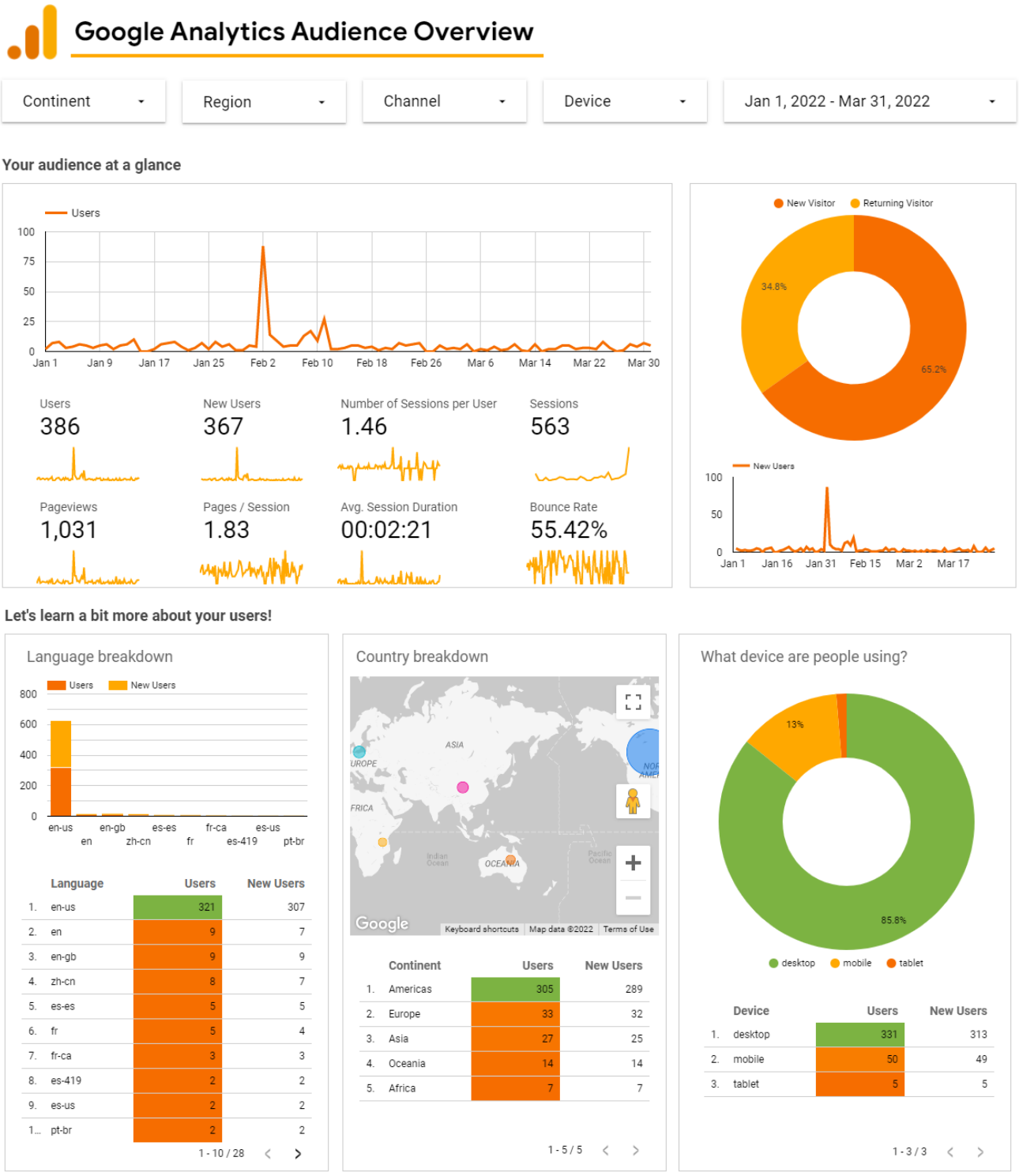

Figure 3: Use metrics for the GLOBAL project website (https://globaltcn.utk.edu) from January 1 – March 31, 2022.

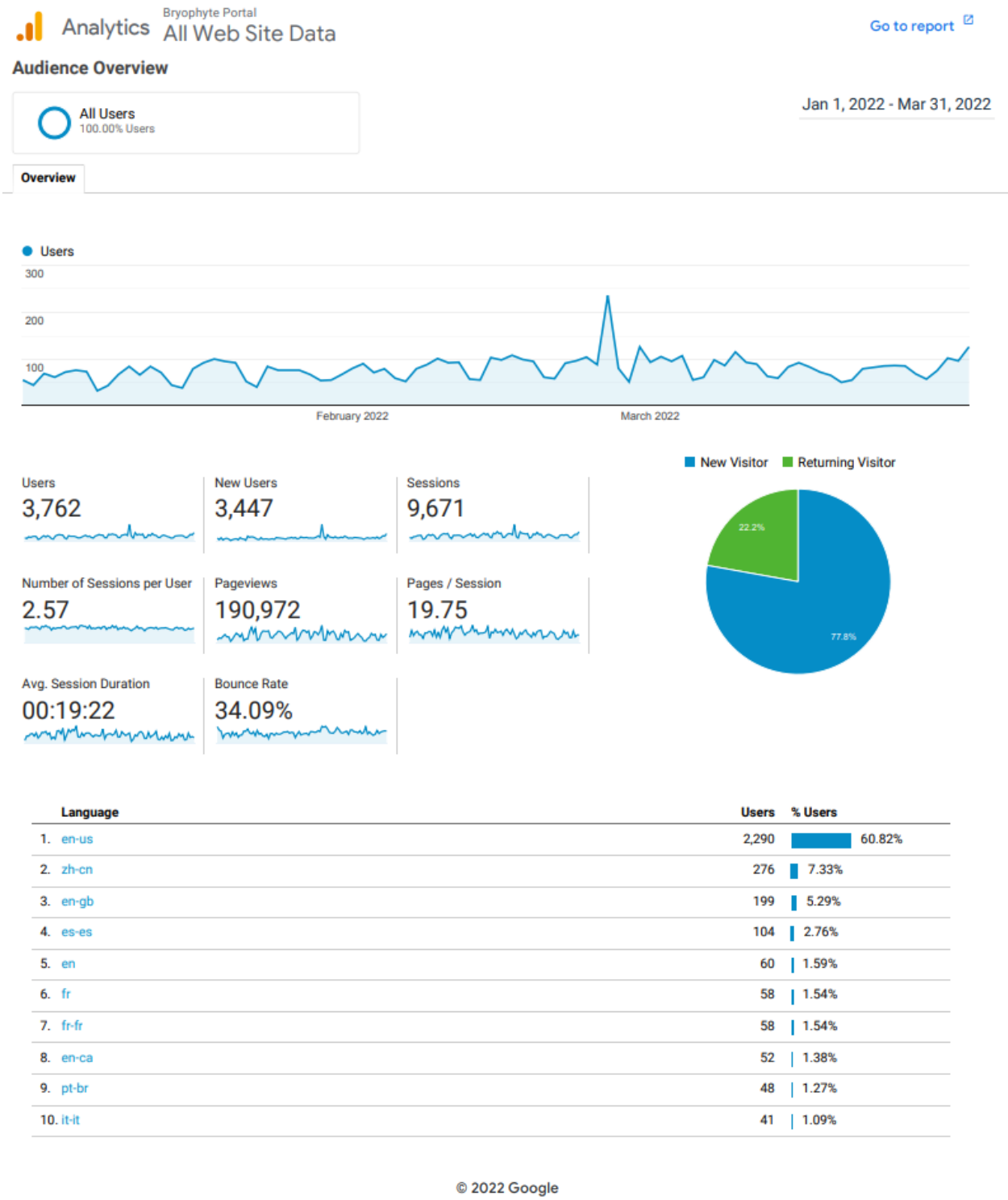

Figure 4: Use metrics for the Bryophyte Portal (https://bryophyteportal.org/portal/) from January 1 – March 31, 2022.

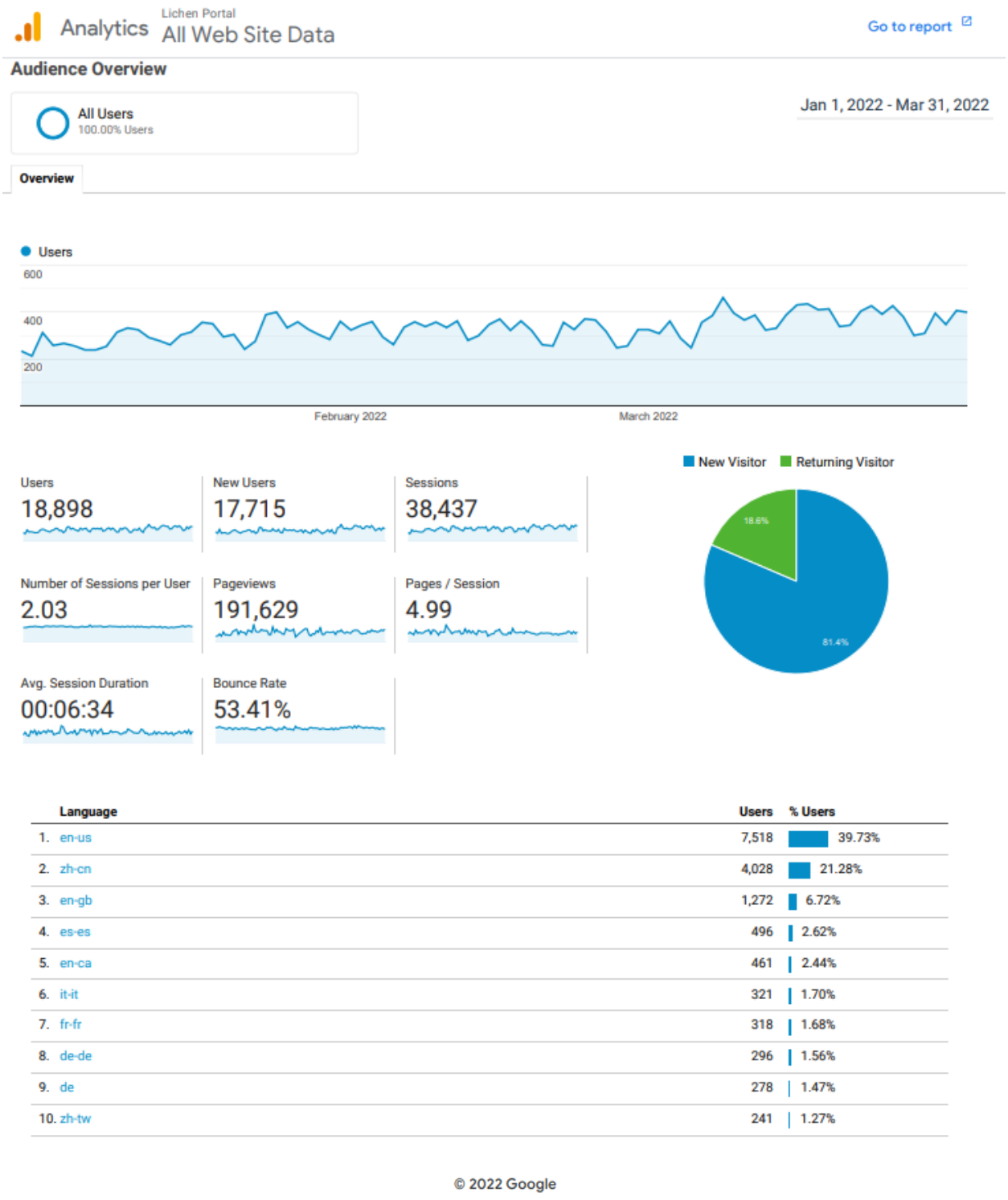

Figure 5: Use metrics for the Lichen Portal (https://lichenportal.org/cnalh/) from January 1 – March 31, 2022.

Share Other Activities and/or Progress

Image Tagging

For the Lichen Consortium, ASU PI Bungartz continued to work on the glossary, the lichen character database, and a controlled vocabulary for routine image tagging. ASU is also developing Mytabolites, a program for the analysis of lichen secondary metabolites via thin-layer chromatography (TLC). The prototype of this program (ver. 0.9.8.3) now includes the updated data from Jack Elix's fifth edition of the Catalog of Lichen Secondary Metabolites. It connects to the Lichen Consortium online and can be used to match TLC data against lichen taxa from which these substances have been reported.

Curation

Over 2800 bryophyte packets at ILLS were updated to archival paper (funded through institutional funds).

MSC created a semester project for one of their undergraduate students to work through some very complicated lichen specimens. They had multiple collection numbers in each packet, but only the first one was listed on the front of the packet, so they had to create and track numerous drop tags, as well as create additional annotations with descriptions for all the secondary collection numbers.

Specimen Exchange

COLO made use of Basecamp to share duplicate lichen and bryophyte specimens from their long-time, former curator, William A. Weber with several of our collaborating herbaria around the country.