# 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 July 1 – September 30, 2024.

**Workflows, Equipment, and Personnel**

Most GLOBAL institutions continued steady GLOBAL progress during 2024-Q3.

Reorganization of lichen and bryophytes is in full swing at ALA. They are upgrading their boxes to store the lichen and bryophyte package in single file boxes, with two boxes per cubby in the cabinets. Minimal progress was made on imaging. Bryophylous fungi on mosses are being entered into the database and thus a connection between two distinct collections (mosses and fungi) is being made.

At ASU, specimen digitization is back to normal since students returned from summer break. For some annotated specimens two label images were uploaded, which explains the discrepancy of 301 specimen and 316 labels imaged.

[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, BISH = Bishop Museum, 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, PTBG = National Tropical Botanical Garden, TENN = University of Tennessee, Knoxville, UC = University of California, Berkeley, WIS = University of Wisconsin, YU = Yale University

At CINC, student availability for in-person work over the summer months was limited, so imaging rates were slower than usual, but transcription rates were up because students could work remotely.

COLO continued transcribing bryophyte specimens and barcoding and capturing images of bryophyte packets. Images and all skeletal data captured through 09/30/2024 have been uploaded to the portal and transcription continued. They are finding it increasingly difficult to staff student positions. They used to pay above the campus minimum, but with the campus going to a $16 minimum they do not have the budget to compete with higher paying campus and off campus jobs. Most of their work study students took other jobs over the summer and they did not have much progress over the summer. Fortunately, 2 students returned for the fall and they have hired one new student. They are still trying to hire 1-2 additional students.

DUKE barcoded 2,293 bryophyte specimens, imaged 2,684 labels and 170 plants in the third quarter of 2024. All images and skeletal data have been uploaded to the bryophyte portal. They fully transcribed 20 specimens, and georeferenced 1.

At F, the summer provided an opportunity to significantly increase digitization efforts of bryophytes with interns, partnering programs with local colleges and universities, including over 15,000 specimens imaged. This quarter they also had a team of summer interns for the lichen collection that barcoded 1,556 specimens, imaged 4,430 labels and specimens, created 889 skeletal records, and fully transcribed and georeferenced 1,864 specimens.

FLAS has reached genus beginning “Thy” in the mosses (all their mosses are alphabetized by genus). They should finish imaging mosses soon.

ILL & ILLS, LSU, MICH and MIN completed project activities with the end of their Year 4. They submitted their Final Annual Report and Project Outcomes Report to the NSF.

In 2024-Q3, MO barcoded 6,617 bryophyte specimens and imaged 13,458 bryophyte labels. They created 13,458 skeletal records and fully transcribed 301 labels. They also georeferenced 39 specimens.

In 2024-Q3 at OSC, 1,899 bryophyte images were merged with their label data, resulting in the full transcription of 1,899 specimens.

PTBG completed digitization of all of the mounted, databased lichen collections (with the exception of a very few oversize specimens).

TENN hired two new undergraduate technicians in July. TENN Project Manager assisted with completion of 2024-Q2 and Year 4 Reporting for the GLOBAL collaboration and Year 1 Reporting for the Hawaii PEN.

Activity at UC is picking up speed now that students are back from summer break. They hired additional students to make sure they can meet their imaging and transcribing goals.

Over the summer break, WIS trained a student volunteer to image lichens. This fall the student was hired to work on the project. She is an enthusiastic student and is working to revive the student botany club. She spoke to the group about the project. WIS collaborative georeferencing continues; newly transcribed records are loaded into communities for mapping; corrected localities are checked and completed csv files are being sent to snapshot collections.

YU continued transcribing label data. Volunteers generated 311 fully transcribed records.

**Digitization**

Thirteen GLOBAL institutions (ASU, CINC & MU, COLO, DUKE, F, FLAS, MICH, MO, NY, TENN, UC, WIS, and YU) reported progress on digitization deliverables, with a total of 25,400 specimens barcoded (23,143 bryophytes and 2,257 lichens), 56,877 labels imaged (36,777 bryophytes and 5,408 lichens), 37,677 specimens imaged (32,269 bryophytes and 5,408 lichens), 33,086 specimen records uploaded to the portal (28,300 bryophytes and 4,786 lichens), 37,482 skeletal records created (36,193 bryophytes and 1,289 lichens), 35,645 labels fully transcribed (24,171 bryophytes and 11,474 lichens), and 24,004 specimens georeferenced (15,577 bryophytes and 8,427 lichens) (See Table 1 & Figure 1).

PEN partners BISH and PTBG reported a total of 2,091 specimens barcoded (1,828 bryophytes and 263 lichens), 3,161 labels imaged (1,843 bryophytes and 1,318 lichens), 3,161 specimens imaged (1,843 bryophytes and 1,318 lichens), 1,953 skeletal records created (1,770 bryophytes and 183 lichens), and 2,091 labels fully transcribed (1,828 bryophytes and 263 lichens).

Table 1: Digitization progress by GLOBAL collaborators in 2024-Q3, 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 | | 301 | | 316 | | 301 | | 301 | | | | 301 | | |
| BRY | | | | | | | | | | | | | | |
| CINC & MU | 1,088 | | 1,088 | | 1,088 | | | | 1,088 | | 4,747 | | | |
| COLO | 2,481 | | 3,217 | | | | 3,217 | | 3,217 | | 807 | 733 | | |
| DUKE | 2,293 | | 2,684 | | 170 | | 2,854 | | 2,293 | | 20 | | 1 | |
| F | 7,650 | 1,556 | 15,841 | 4,430 | 15,841 | 4,430 | | | 9,820 | 889 | 3,702 | 1,864 | | 1,864 |
| FLAS | | | 2,962 | | 2,962 | | 2,962 | | | | 7,649 | | | |
| ILL & ILLS | | | | | | | | | | | | | | |
| LSU | | | | | | | | | | | | | | |
| MICH | | | | | | | 19,267 | 4,485 | 2,530 | | 2,612 | 1,085 | 222 | 125 |
| MIN | | | | | | | | | | | | | | |
| MO | 6,617 | | 13,458 | | | | | | 13,458 | | 301 | | 39 | |
| MSC | | | | | | | | | | | | | | |
| NY | 2,869 | | 8,421 | 273 | 8,421 | 273 | | | | | 3,548 | 7,178 | 1,761 | 2,274 |
| OSC | | | | | | | | | | | | | | |
| PH | | | | | | | | | | | | | | |
| TENN | | | | | | | | | | | 44 | 308 | 358 | 2 |
| UC | 145 | | 3,787 | | 3,787 | | | | 3,787 | | | | | |
| WIS | | 400 | | 400 | | 404 | | | | 400 | 430 | 5 | 13,196 | 4,162 |
| YU | | | | | | | | | | | 311 | | | |
| **Totals** | **23,143** | **2,257** | **51,458** | **5,419** | **32,269** | **5,408** | **28,300** | **4,786** | **36,193** | **1,289** | **24,171** | **11,474** | **15,577** | **8,427** |
| **B+L Totals** | | **25,400** | | **56,877** | | **37,677** | | **33,086** | | **37,482** | | **35,645** | | **24,004** |

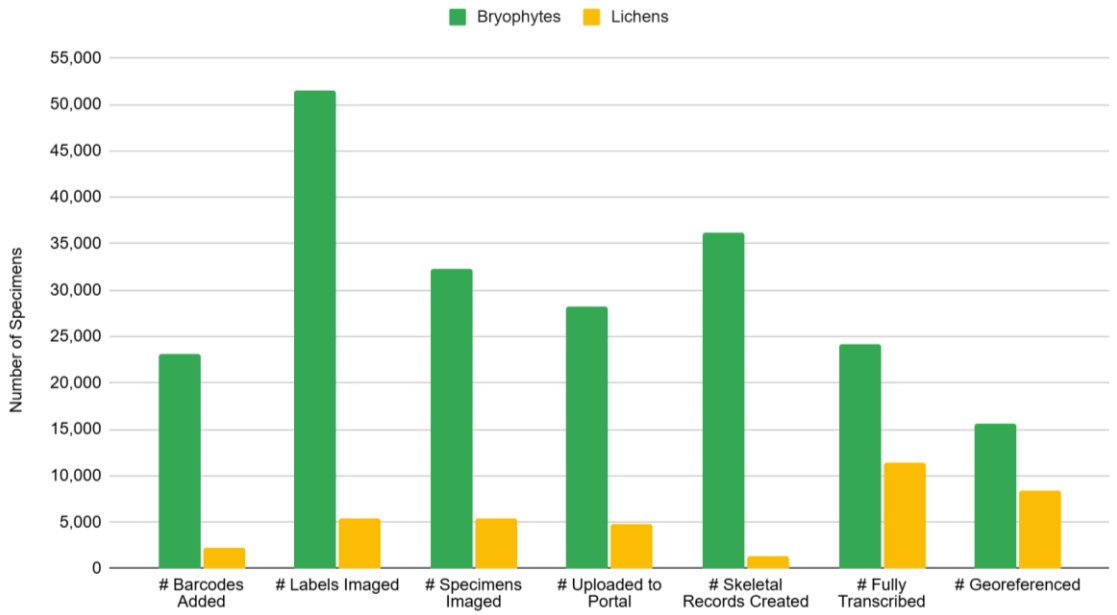


Figure 1: Digitization progress for the GLOBAL collaboration in 2024-Q3, separated by Bryophyte and Lichen specimens.

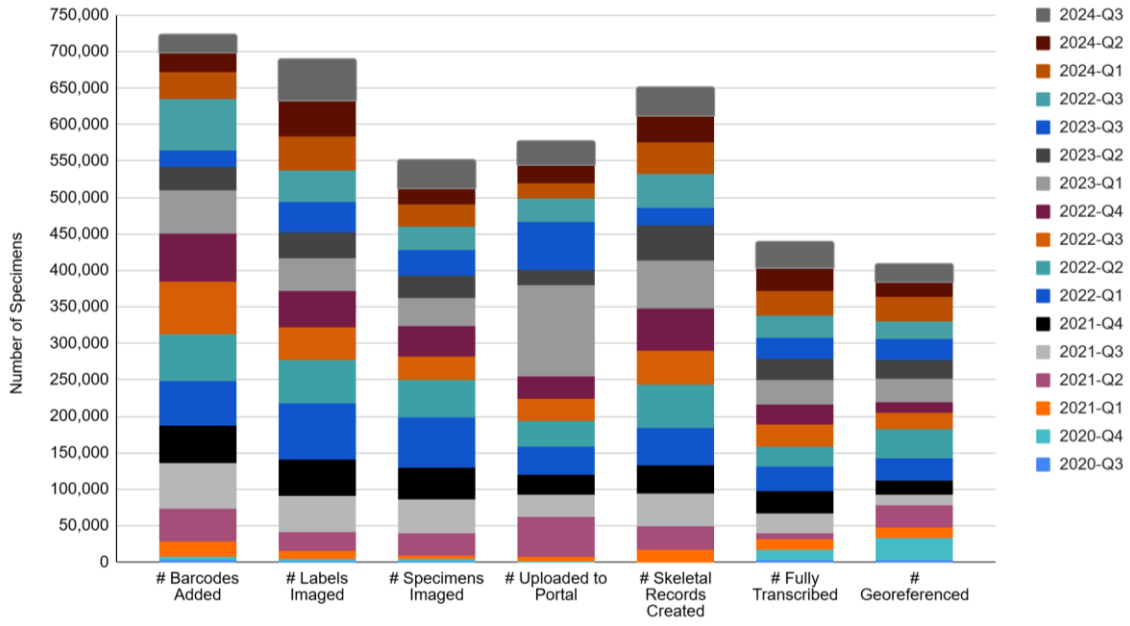


Figure 2: Cumulative digitization progress for the GLOBAL collaboration by quarter.

# Share Best Practices, Standards, and Lessons Learned

**Flexible Workflows**

The GLOBAL teams continued to make use of flexible digitization workflows in 2024-Q3, including a mixture of virtual and on-site work.

At COLO, since no transcription work was completed on their non-North American specimens before the project, they did not have records for the first wave of georeferencing work at WIS. They have been prioritizing records from Australia, Chile, England, Finland, France, Japan, Norway, Scotland, Sweden and Wales for transcription to build sets for georeferencing. They have now added Central America, South America and Africa to our focus regions. They are also transcribing specimens from Sweden for our Bryophytes as they are added to the database. They are continuing to work with the team at University of Michigan in the hope of incorporating VoucherVision into future transcription work. PM Allen used a backlog of vacation time over the summer leading to a less productive than normal June and July. COLO requested and was approved for a second no cost extension to focus on transcription and specimen images. The computer running the imaging station is no longer functional and they had to transfer the computer targeted for capturing specimen images to the packet station.

**Collaboration**

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2024-Q3. New collaborators and students were given access to Basecamp group resources. A Management Committee Meeting was held in August open to all GLOBAL members to review progress from 2024-Q2 and Year 4, and to provide an open forum to the GLOBAL team. A meeting with the IT and Taxonomy and Nomenclature Groups to discuss updating the taxonomic thesaurus in the Bryophyte and Lichen Portals was held in August and a follow-up meeting has been scheduled for November.

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.

WIS has found that transcription quality greatly determines georeferencing outcomes, thus more time could be spent correcting errors before loading records into communities into GeoLocate.

# Share Identified Gaps in Digitization Areas and Technology

**New Software Tools**

Version 3.1: In July 2024, version 3.1 of Symbiota was launched. This new version offering many new features was first rolled out in its beta testing phase for the Lichen Consortium and once critical bugs were ironed out recently also applied to the Consortium of Bryophyte Herbaria.

Here a summary of the new features available now in Version 3.1.

- Updated and unified icons & fonts (better scaling of the site, particularly on handheld devices such as tablet and phones)
- Advanced Search Page
- Additional fields in occurrence editor
- Leaflet maps instead of Google Maps
- Improved Map Search
- Extended Data Import
- Improved Linked Resources

The program Mytabolites is now available for download with detailed instructions from the Help & Resources site of the Consortium. The program is currently available only in English, but instructions in Spanish are available from the Ayuda y Recursos website of the Consorcio de Herbarios de Líquenes. How the program works will be presented at the XVI meeting of the Grupo Latinoamericano de Liquenólogos (GLAL) in October 2024.

**Taxonomic Thesaurus**

In July, the GLOBAL team had a meeting on how to improve management and updating the taxonomic thesaurus in both portals. The team discussed how to regularly apply updates to the Bryophyte Consortium using John Brinda's Bryophyte Nomenclator.

For the Lichen Consortium, fdex, a resource comparing fungal taxonomy from Index Fungorum and Mycobank, has recently been updated by its developer Dr. Scott Bates. Using the Index Fungorum API, data in fdex are now up-to-date as of September 3, 2024. The dataset from Mycobank is currently still being updated (the current version is from June 8, 2021). This unfortunately illustrates a dilemma: ideally the taxonomy of lichenized fungi should be updated more regularly. Currently the Taxonomic Name Cleaner in the Lichen Consortium links to fdex and it has not been possible to link the thesaurus either Mycobank or Index Fungorum directly. John Brinda submits regular versions of the Bryophyte Nomenclator to Checklistbank. Current versions of Index Fungorum and Mycobank are also available there. We are investigating, if

there are ways to use these resources to more efficiently and more regularly update the taxonomy used in the Lichen and Bryophyte Consortium. The next meeting of the GLOBAL Taxonomy Workgroup is planned for November.

**Literature Management**

Another challenge ASU has recently identified for better data management in the portal is a module missing that allows for management of literature and citations. Currently, literature records can only be added manually into the source field of the taxonomic thesaurus and/or the checklists. This simple text field is limited. Although the database infrastructure for managing literature has been integrated into the Symbiota MySQL database backend, a module to enter, cite and manage literature records online is not available. Adding this module goes beyond the scope of the current GLOBAL grant; thus we are investigating possible funding sources that would sponsor developing this resource.

## Share Opportunities to Enhance Training Efforts

The GLOBAL Project Manager (TENN) and Georeferencing Manager (WIS) continued compiling resources during 2024-Q3 to share on Basecamp and all resources were posted to the project website (https://globaltcn.utk.edu).

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. Updates to programs provided as part of the grant (BCRWatcher, Mytabolites) are regularly made available. Symbiota tutorials continue to be added to the Symbiota Documentation by the Symbiota Support Hub at https://biokic.github.io/symbiota-docs/.

For October 26-27, 2024 ASU Lichen Collections manager Dr. Bungartz will teach a workshop at the XVI International Meeting of the Grupo Latinoamericano del Liquenologos (GLAL) in Mexico City. This workshop will focus on using the Lichen Consortium to create species checklists in Latin American countries, using the recently published Ecuador Checklist as an example. A detailed workflow both in English and Spanish on using Symbiota portals to create advanced species checklists is available from the Help & Resources Site of the Consortium. This workflow has been shared also with the GLOBAL community.

At DUKE, a REU undergraduate student was trained in herbarium curation techniques and specimen digitization.

At F, the project continued to train a significant number of high school and undergraduates, including underrepresented students in science. The project has also collaborated with Field Museum high school internships such as the Digital Learning Internship - a high school intern program focusing on digital tools.

PTBG held a 3-day moss identification workshop with help from the Kauai Community College and led by Jim Shevock of CAS. Attendees included staff from the USFWS; Kauai Invasive Species Committee; State of Hawaii Department of Land and Natural Resources; The Nature Conservancy-Kauai; Plant Extinction Prevention Program, Pacific Cooperative Studies Unit, University of Hawaii-Manoa.

TENN trained their two new student technicians via a Herbarium Bootcamp in July. This format helps onboard students before classes begin.

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

Collaborations with international collections continued at ASU. In July, ASU received copies of 60,000+ specimen images from the Private Lichen Collection of Dr. Felix Schumm (Wangen, Germany). Dr. Schumm kindly also shared his collection database with them, which is now featured in the Lichen Consortium; 30,700+ of these images have so far been uploaded. All images are linked to specimens of Dr. Schumm's personal collection. This search will return all specimen records with illustration: lichenportal.org/portal/collections/list.php?db=235&hasimages=1. The images are a fantastic contribution, because not only are they macrophotos documenting the specimens, but also many microscope images and even some images of secondary metabolite crystals and of thin-layer chromatography plates (chromatograms). Here an example: https://lichenportal.org/portal/collections/individual/index.php?occid=5659024&clid=0. These chromatograms are all also available through the glossary, and as part of Mytabolites.

ASU also continues its outreach to Latin American Lichen Collections in collaboration with the Grupo Latinoamericano del Liquenologos (GLAL). And they continue to support Ecuador's National Biodiversity Database, a Symbiota Biodiversity Data Portal developed in collaboration with Ecuador's Instituto Nacional de Biodiversidad.

CINC was part of the All-Asia TCN, which ended (for CINC) this past Aug. 31. Students on the two projects regularly shared techniques, expertise, and best practices.

# Share Opportunities and Strategies for Sustainability

**Portal Management**

The Symbiota Support Hub at ASU continued to provide portal management and maintenance, including uploading and linking images to GLOBAL collections, updating snapshot data from international partners to facilitate duplicate matching and import, and providing assistance with data cleaning and other issues. The Symbiota Support Hub continued to provide regular training sessions, documentation and tutorials.

As of September 2024, the Symbiota Support Hub team has moved to the University of Kansas. Until now, both the Lichen and Bryophyte Consortium continue to be hosted and supported at ASU and they are closely collaborating with the Support Hub to assure long-term sustainability and support. Discussions are underway with the GLOBAL community and the American Bryological and Lichenological Society (ABLS).

# 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.

The ASU Lichen Herbarium regularly attends to visitors interested in learning about the collection as the largest and most representative lichen herbarium in the Southwest. Mexican student Eduardo Gutierrez got accepted into the masters program at ASU and will start his MS at ASU in January 2025.

CINC gave tours to Hort Club (14 students), and the local interest group The Greater Cincinnati Herb Society (21 attendees).

Outreach activities at F connecting collections is having a broader impact beyond natural history collections and biologists extending to education, learning and especially higher education professionals. This is evident by a paper accepted for publication (yet to be published by the end of September reporting period entitled: From Spectators to Stewards: Transforming Public Involvement in Natural History Collections. The paper includes NSF funded TCNs and their significance in connecting the general public to natural history collections.

The project continues to participate in a number of outreach and education activities including families, the general public, educators, and students. Bryophytes and lichens were showcased in all these events. Specifically, educators have mapped lesson plans to Next Generation Science Standards improving previous iterations - these have finally been published and a suite of resources are available at https://www.fieldmuseum.org/educators/learning-resources.

PTBG held a 3-day moss identification workshop with help from the Kauai Community College and led by Jim Shevock of CAS. Attendees included staff from the USFWS; Kauai Invasive Species Committee; State of Hawaii Department of Land and Natural Resources; The Nature Conservancy-Kauai; Plant Extinction Prevention Program, Pacific Cooperative Studies Unit, University of Hawaii-Manoa.

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

The GLOBAL project website, https://globaltcn.utk.edu, was utilized by 252 users during 2024-Q3, including 35 from Europe, 15 from Asia, 8 from South America, 4 from Africa, 2 from Central America, and 1 from the Middle East (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. 9,200 users visited the Bryophyte Portal, and 23,000 users visited the Lichen Portal during 2024-Q3 (see Figures 4 & 5).

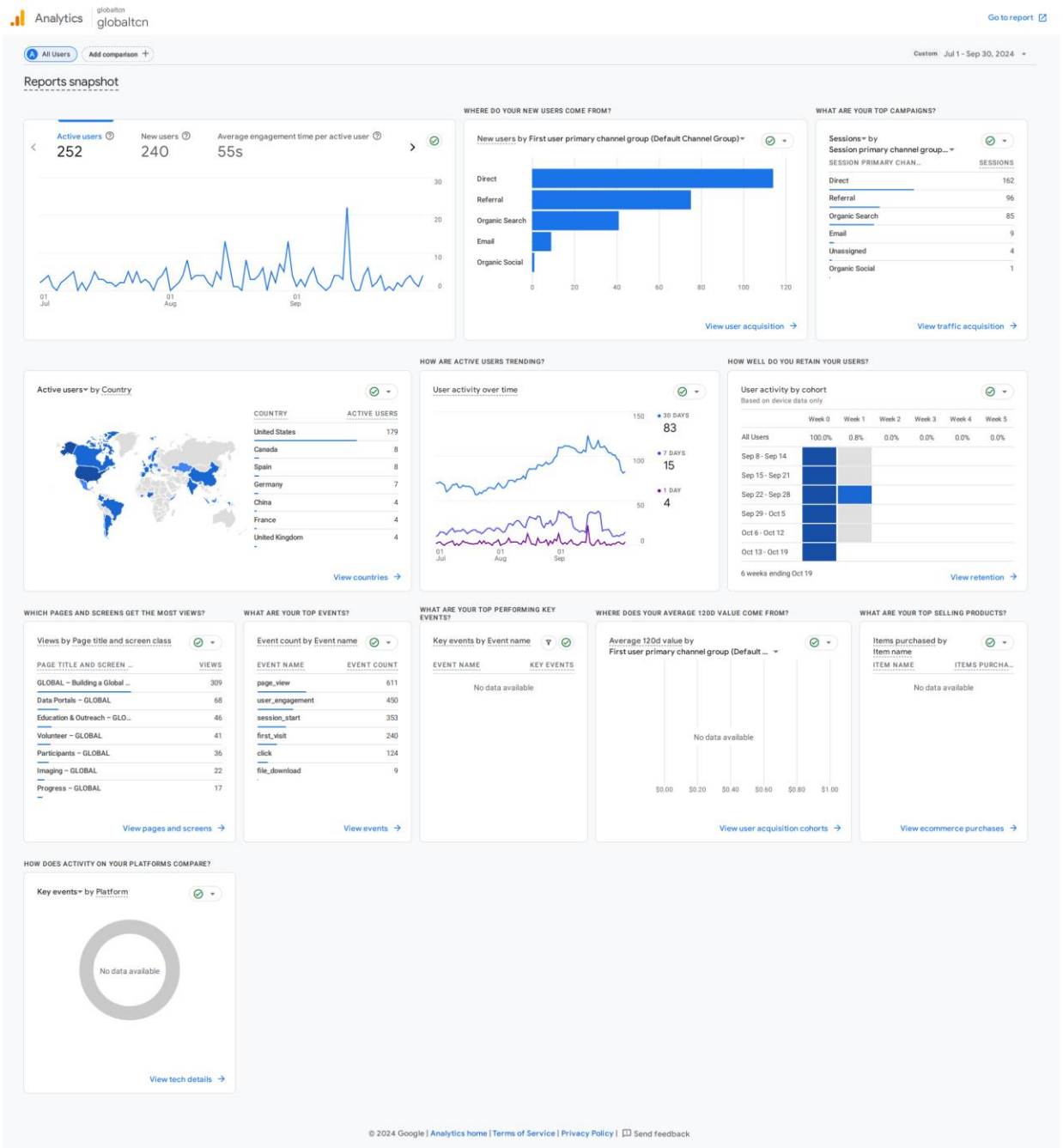


Figure 3: Use metrics for the GLOBAL project website (https://globaltcn.utk.edu) from July 1 – September 30, 2024.

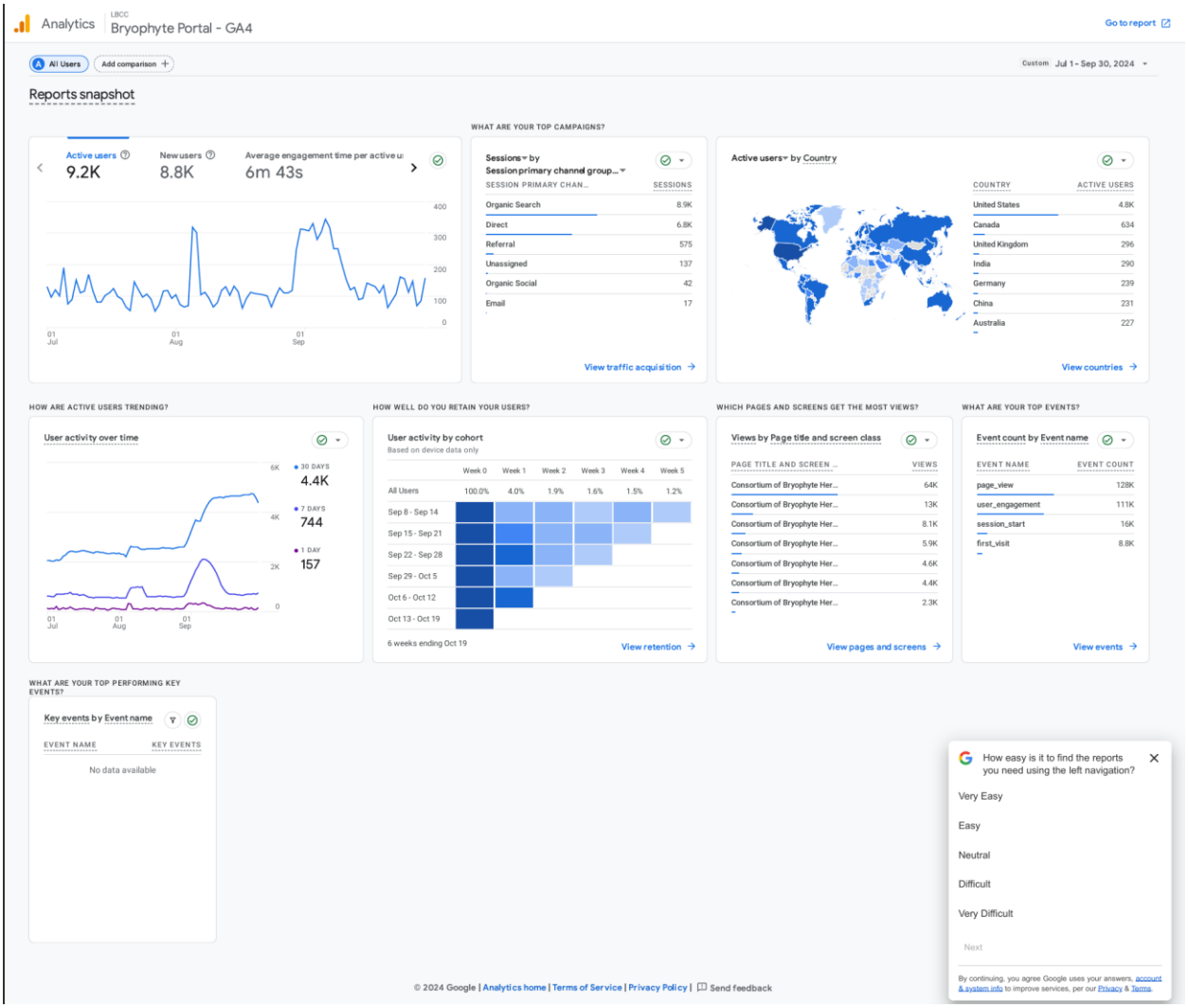


Figure 4: Use metrics for the Bryophyte Portal (https://bryophyteportal.org/portal/) from July 1 – September 30, 2024.

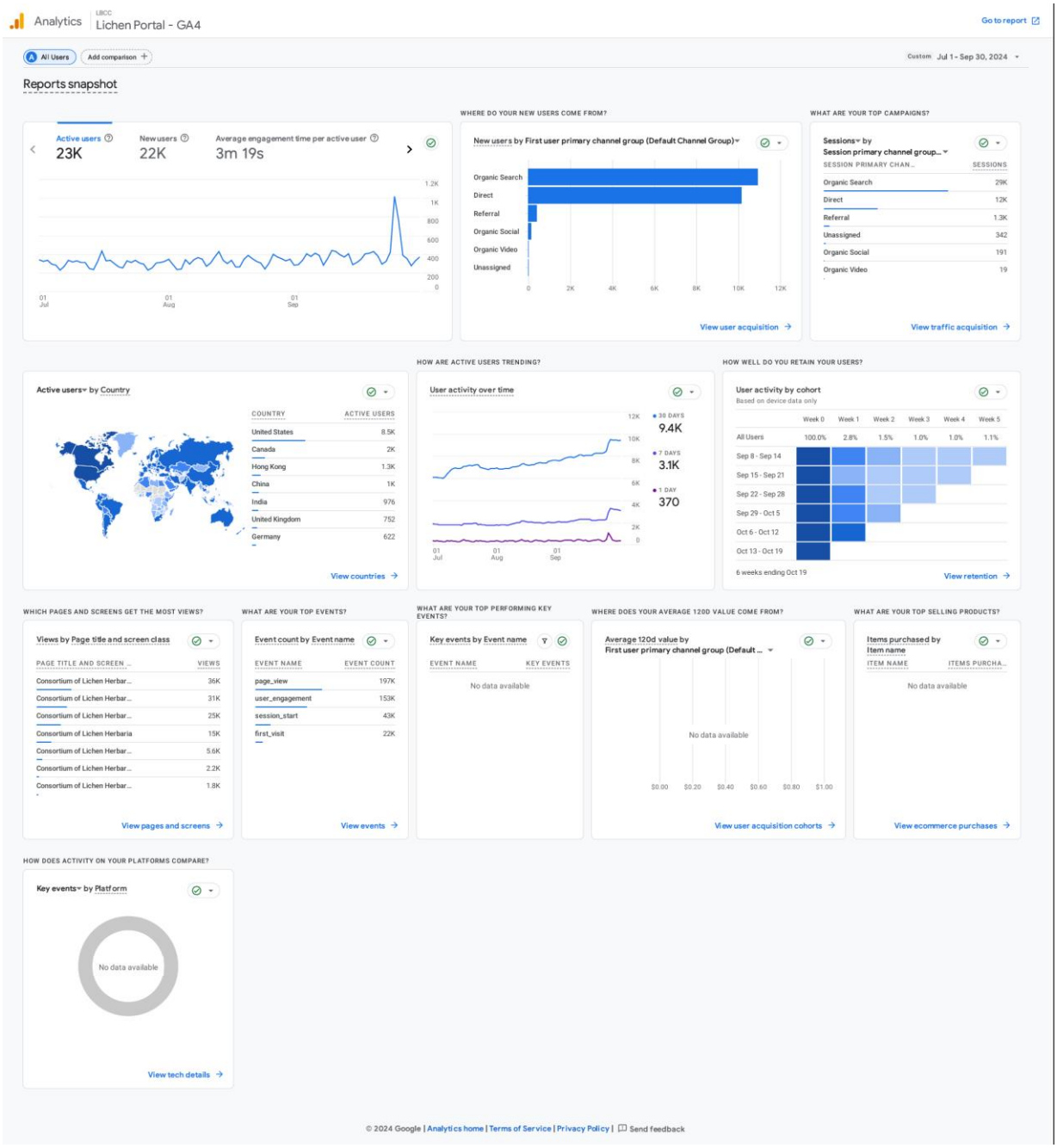


Figure 5: Use metrics for the Lichen Portal (https://lichenportal.org/cnalh/) from July 1 – September 30, 2024.

# Share Other Activities and/or Progress

**No-Cost Extensions**

Most GLOBAL collaborators requested a second no-cost extension to continue GLOBAL work into a Year 5. TENN Project Manager updated reporting sheets for the Year 5 extension for most collaborators.