# 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, 2025.

**Workflows, Equipment, and Personnel**

Most GLOBAL institutions completed their project work before or during 2025-Q3, but a few continued GLOBAL progress during this quarter.

At BISH, 463 lichen complete data records were created, 463 were barcoded, and 400 were imaged. 1,363 moss complete data records were created, 1,363 were barcoded, and 1,363 were imaged.

COLO captured 1,654 lichen packet images with skeletal records and 100 specimen images for the lichen collection. 1,654 lichen specimens were barcoded. 1,453 lichen transcriptions were completed. COLO captured 1,095 bryophyte packet images with skeletal records and 3,224 specimen images for the bryophyte collection. 3,224 bryophyte specimens were barcoded. 439 bryophyte transcriptions were completed. Images and all skeletal data captured through

[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

9/30/2025 have been uploaded to the portal.

In 2025-Q3, DUKE barcoded 2,706 bryophyte specimens. They imaged 3,156 bryophyte labels and 191 bryophyte plants. All images and skeletal data have been uploaded to the bryophyte portal. They fully transcribed 78 bryophyte specimens.

In 2025-Q3, F imaged both labels and specimens for almost 10,500 bryophyte and lichen specimens, accompanied by skeletal data. They also participated in the quarterly Collections Club in July 2025 that focused on curation of bryophytes that are prepared as part of the pipeline for the project. Teen volunteers and undergraduate students also participated throughout July and August, receiving training associated with digitization and curation.

No digitization took place at PTBG for this quarter as they have completed the digitization of their bryophyte and lichen collections.

TENN did not complete any digitization activities for GLOBAL during 2025-Q3 but continued to support the project by coordinating quarterly reporting and annual reporting for Year 5.

UC is now halfway through transcription of bryophytes. They hired four new work study students to help with this in the Fall and Spring.

YU continued transcribing label data. Volunteers generated 218 fully transcribed records.

**Digitization**

Five GLOBAL institutions (COLO, DUKE, F, UC, and YU) reported progress on digitization deliverables, with a total of 13,860 specimens barcoded (12,206 bryophytes and 1,654 lichens), 16,327 labels imaged (12,656 bryophytes and 1,654 lichens), 13,937 specimens imaged (11,820 bryophytes and 2,117 lichens), 6,096 specimen records uploaded to the portal (4,442 bryophytes and 1,654 lichens), 15,877 skeletal records created (12,206 bryophytes and 3,671 lichens), and 13,974 labels fully transcribed (12,521 bryophytes and 1,453 lichens) (See Table 1 & Figure 1).

PEN partners BISH and PTBG reported a total of 1,826 specimens barcoded (1,363 bryophytes and 463 lichens), 1,763 labels imaged (1,363 bryophytes and 400 lichens), 1,763 specimens imaged (1,363 bryophytes and 400 lichens), and 1,826 labels fully transcribed (1,363 bryophytes and 463 lichens).

Table 1: Digitization progress by GLOBAL collaborators in 2025-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 | | | | | | | | | | | | | | |
| BRY | | | | | | | | | | | | | | |
| CINC & MU | | | | | | | | | | | | | | |
| COLO | 1,095 | 1,654 | 1,095 | 1,654 | 3,224 | 100 | 1,095 | 1,654 | 1,095 | 1,654 | 439 | 1,453 | | |
| DUKE | 2,706 | | 3,156 | | 191 | | 3,347 | | 2,706 | | 78 | | | |
| F | 8,405 | | 8,405 | 2,017 | 8,405 | 2,017 | | | 8,405 | 2,017 | 5,685 | | | |
| FLAS | | | | | | | | | | | | | | |
| ILL & ILLS | | | | | | | | | | | | | | |
| LSU | | | | | | | | | | | | | | |
| MICH | | | | | | | | | | | | | | |
| MIN | | | | | | | | | | | | | | |
| MO | | | | | | | | | | | | | | |
| MSC | | | | | | | | | | | | | | |
| NY | | | | | | | | | | | | | | |
| OSC | | | | | | | | | | | | | | |
| PH | | | | | | | | | | | | | | |
| TENN | | | | | | | | | | | | | | |
| UC | | | | | | | | | | | 6,100 | | | |
| WIS | | | | | | | | | | | | | | |
| YU | | | | | | | | | | | 219 | | | |
| **Totals** | **12,206** | **1,654** | **12,656** | **3,671** | **11,820** | **2,117** | **4,442** | **1,654** | **12,206** | **3,671** | **12,521** | **1,453** | **0** | **0** |
| **B+L Totals** | | **13,860** | | **16,327** | | **13,937** | | **6,096** | | **15,877** | | **13,974** | | **0** |

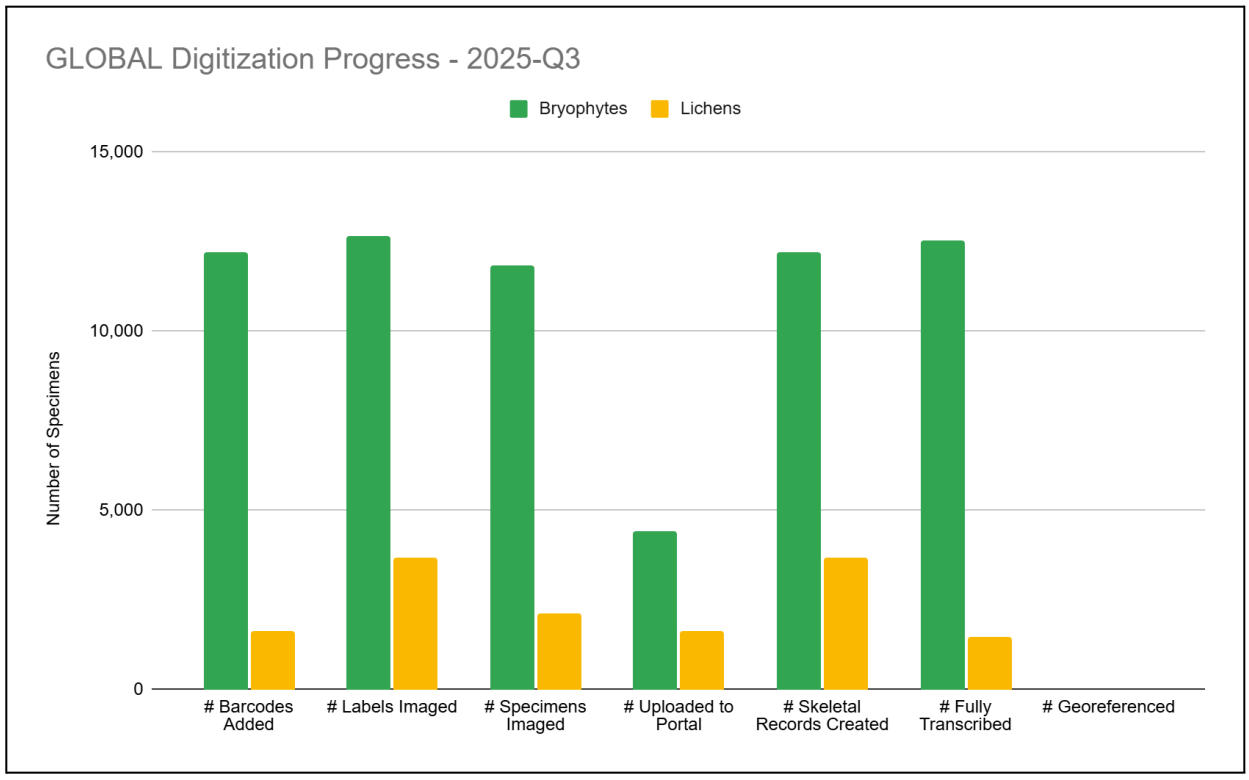


Figure 1: Digitization progress for the GLOBAL collaboration in 2025-Q3, separated by Bryophyte and Lichen specimens.

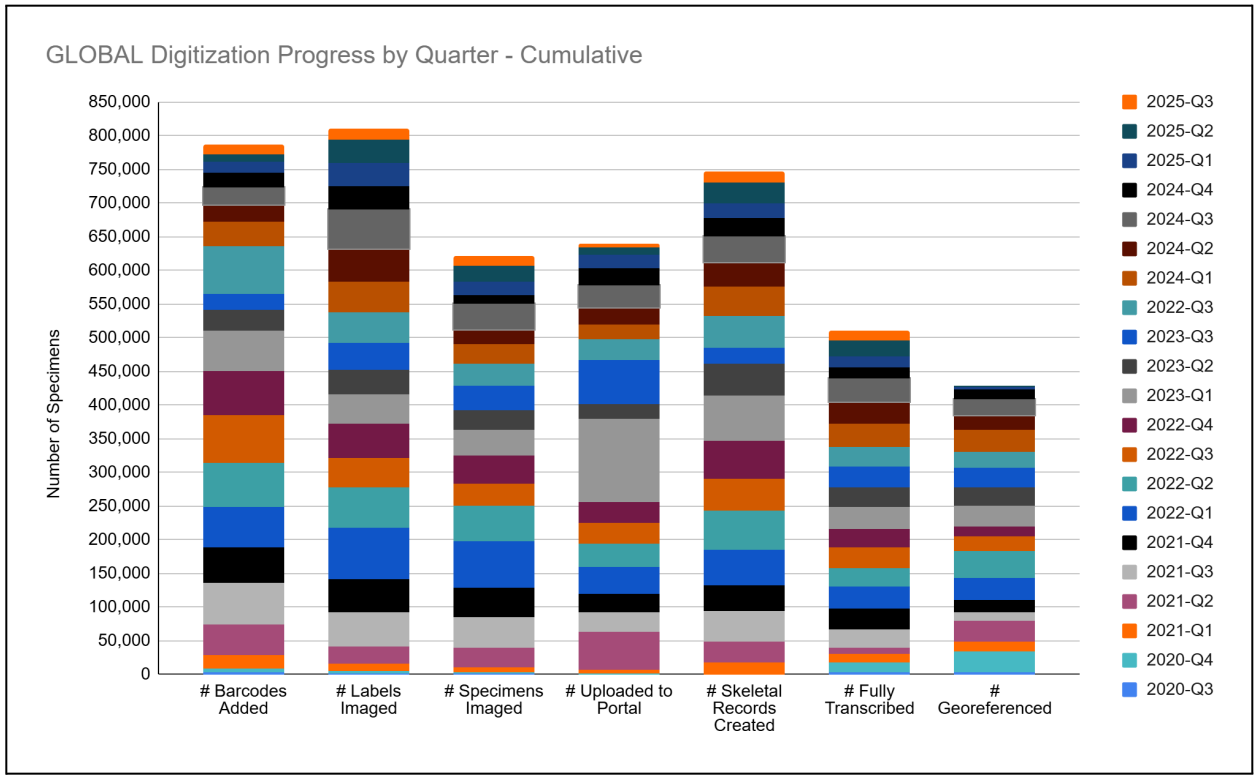


Figure 2: Cumulative digitization progress for the GLOBAL collaboration by quarter.

# Share Best Practices, Standards, and Lessons Learned

**Flexible Workflows**

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 started capturing raw images to create a stacked image for their cryptogams. The workflow in place involves capturing 8 images of each specimen. In a second step they will use depth compositing tools to combine these series into a single image. This should allow for a better-quality specimen image with all of the specimen in focus, but also takes more time than it takes to capture an image (4-5 minutes for 8 images to create the composite image), so it does not pair well within the imaging process. They are continuing to focus on getting as many image stacks as possible. They are still working on a process to automate the process to minimize the human time needed to process the bracket stacks into a single image.

COLO continued to find it increasingly difficult to staff student positions close to the pay rate proposed in the project. As of July 2025 the campus minimum is now $16.82, which only adds to the problem since they need to advertise above this to attract student help. Since no transcription work was completed on their non-North American specimens before the project started 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, Africa and Asia to our focus regions. They have also been adding transcriptions for Lichens from Polynesia, Micronesia, Melanesia. They are also transcribing specimens from Sweden and Norway and Asia for our Bryophytes as they are added to the database. Moving forward they are starting to target specimens from countries that have the fewest specimens with a goal of getting to 100% transcription for as many countries as possible. They are continuing to work with the team at University of Michigan in the hope that VoucherVision will be integrated into future transcription work and specifically advocating for a plugin that will work with Symbiota.

F is refining their standards for implementing large language models as part of the transcription process.

At UC, work study students have helped to identify images that are blurry or missing. They are now going back through to reimage these specimens.

**Collaboration**

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2025-Q3. New collaborators and students were given access to Basecamp group resources. A Management Committee Meeting was scheduled but due to scheduling conflicts was not held in person. Summary slides reviewing progress from 2025-Q2 and Year 5

were shared with all collaborators.

## Share Identified Gaps in Digitization Areas and Technology

**Taxonomic Thesaurus**

DUKE staff have been manually updating Bryophyte Portal thesaurus to add newly published taxa and editing synonymies as requested by users.

**Imaging Workflow Application**

COLO noticed that the taxonomic dropdown for the ImagingWorkflow application was missing many of the names they use in their collection. In Fall of 2021, COLO worked with 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. COLO has been exploring a new version of the ImagingWorkflowApp that can run without JAVA. Sully Harrer has been working on this with the hope of including the option of populating the collector field like they add taxonomy to make the app more functional.

## Share Opportunities to Enhance Training Efforts

The GLOBAL Project Manager (TENN) continued compiling resources during 2025-Q3 to share on Basecamp and all resources were posted to the project website (https://globaltcn.utk.edu).

A workshop on building advanced checklists using the Symbiota tools built into the Lichen Consortium was taught by ASU's Frank Bungartz at the annual meeting of the Botanical Society of America (Botany 2025: July 26 to 30).

PTBG's digitization technician applied (accepted Sept 4) to iDigBio's Introduction to Biodiversity Specimen Digitization course. Their moss guide is nearing completion.

UC provided a tour and digitizing demonstration to an undergraduate course on Natural History Collections.

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

A lichen workshop led by Dr. Cliff Smith and BISH staff was held on August 2, 2025 and attended by sixteen members of the conservation community.

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

PTBG's Herbarium curator attended the lichen workshop hosted by HAW and BISH.

## Share Opportunities and Strategies for Sustainability

**Back-Ups**

At COLO, raw images and JPGs are being 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.

**Outreach Videos**

TENN PI and Project Manager continued plans to upload GLOBAL outreach videos to the TENN Herbarium YouTube Channel, to increase searchability and provide a secondary location after the end of the formal project period.

## 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.

DUKE's Jon Shaw taught a week-long course "Sphagnum Mosses: Ecology, Diversity, and Identification" at Eagle Hill Institute in Maine in June. Shaw taught a week-long Sphagnum Ecology & ID Workshop for the Botanical Club of Wisconsin at Kemp Natural Resources Station in August. Shaw gave a lecture about bryophytes for The Finger Lakes Native Plant Society in September.

F participated in the quarterly Collections Club in July 2025 that focused on curation of bryophytes that are prepared as part of the pipeline for the project. Teen volunteers and undergraduate students also participated throughout July and August, receiving training associated with digitization and curation.

As mentioned above, TENN PI and Project Manager continued plans to upload GLOBAL outreach videos to the TENN Herbarium YouTube Channel, to increase searchability and provide a secondary location after the end of the formal project period.

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

The GLOBAL project website, https://globaltcn.utk.edu, was utilized by 338 users during

2025-Q3, including 114 from Asia, 36 from Europe, 17 from South America, 13 from Africa, 3 from Oceania, 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. Bot activity and portal outages impacted usage numbers for July, but more accurate data for August-September shows 9,600 users visited the Bryophyte Portal, and 16,000 users visited the Lichen Portal during that period (see figures 4 & 5).

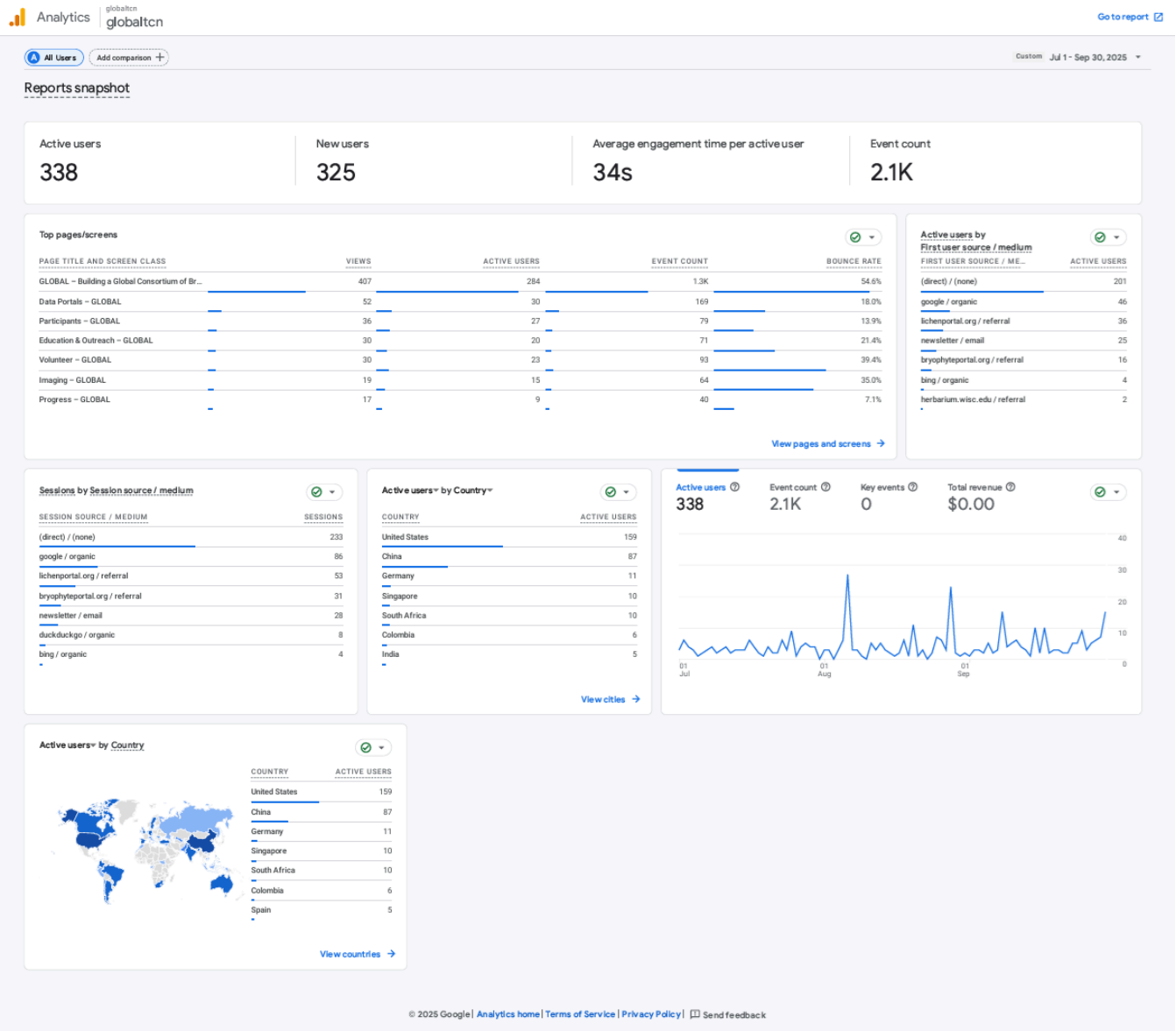


Figure 3: Use metrics for the GLOBAL project website (https://globaltc.utk.edu) from July 1 – September 30, 2025.

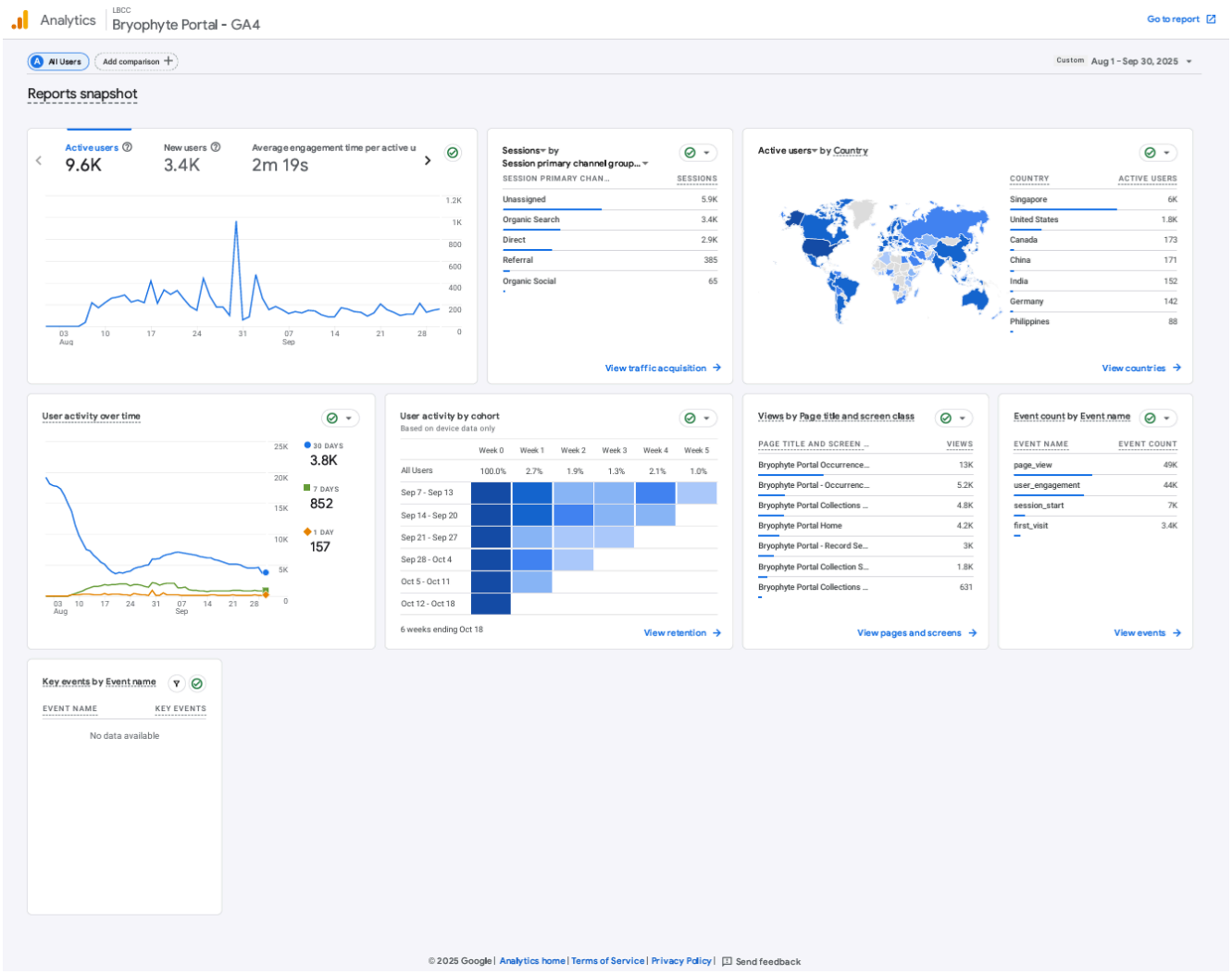


Figure 4: Use metrics for the Bryophyte Portal (https://bryophyteportal.org/portal/) from August 1 – September 30, 2025.

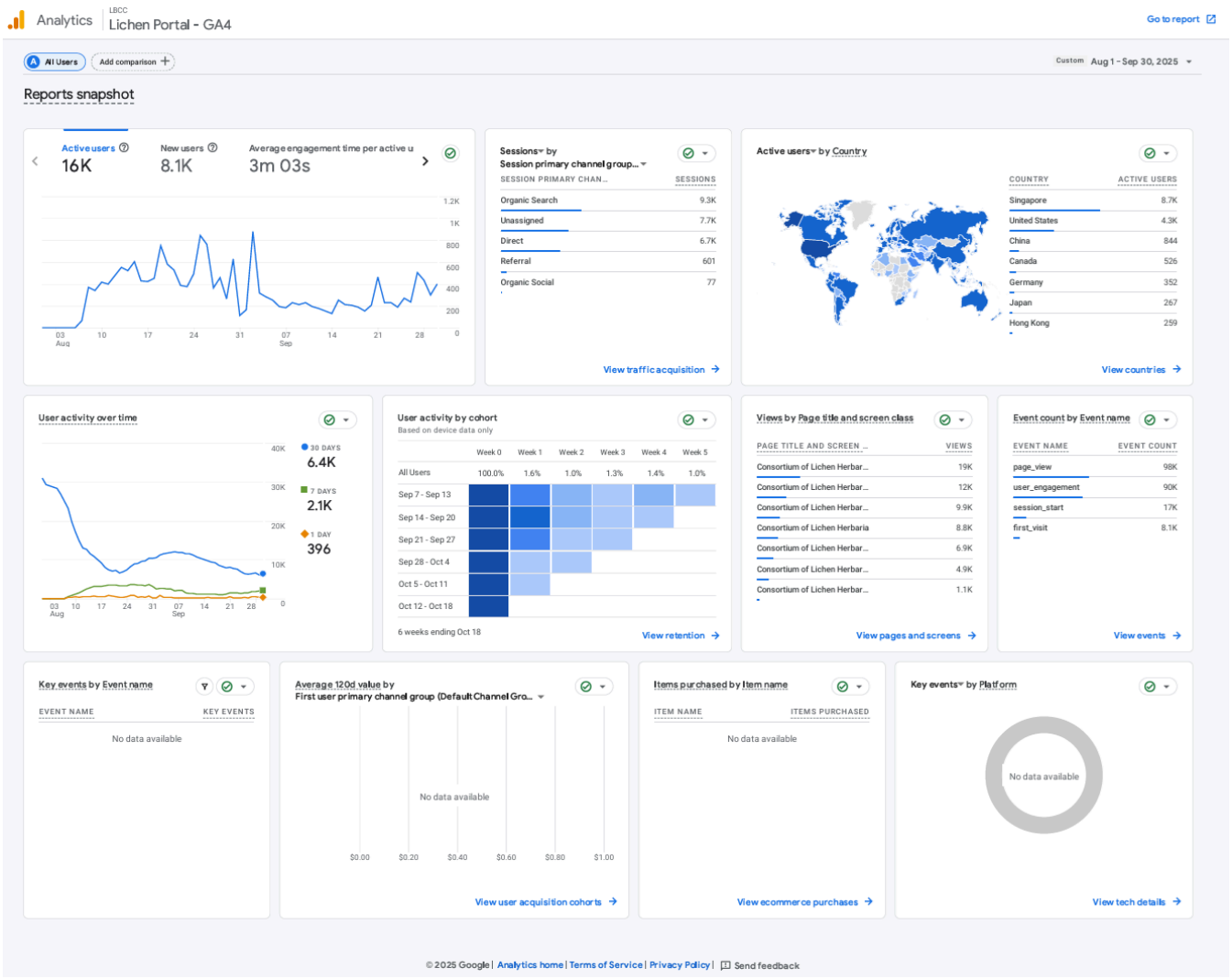


Figure 5: Use metrics for the Lichen Portal (https://lichenportal.org/cnalh/) from August 1 – September 30, 2025.

## Share Other Activities and/or Progress

Dr. Cliff Smith, Professor emeritus at the University of Hawaii is transferring his significant Lichen collection to the Bishop Museum from his personal collection stored at the University of Hawaii campus. Dr. Smith continues to identify both BISH collections and his personal collections slowly being accessioned into BISH.

COLO requested and received approval to continue GLOBAL work into a Year 6 no-cost extension.

F is continuing to improve a pipeline for implementing large language models to accelerate transcription, supported by free credits from Amazon Web Services. This includes implementation of validation and quality control measures.

Dr. Cliff Smith continues to make progress in the identification of the PTBG lichen collection. NTBG staff is working on identification of their moss collection.

TENN requested and received approval for a final Year 6 no-cost extension to assist the remaining collaborators with completing remaining GLOBAL activities.

UC received approval for a Year 6 no-cost extension, which is great since they still want to complete transcribing and hopefully georeferencing!