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 April 1 – June 30, 2022.

Workflows, Equipment, and Personnel

Most GLOBAL institutions continued steady GLOBAL progress during 2022-Q2.

The ASU undergraduate who was hired for routine digitization graduated and left the university. She focused on taking bryophyte images. They plan to employ two undergraduates in the fall semester who will hopefully speed up digitization of the specimens now that they have a routine workflow established.

BRY's undergraduate finished the semester in April, and they will be returning to digitization efforts at the start of the fall semester.

[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

Four of five CINC & MU student workers graduated at the end of April, so they are down to one student worker who images and transcribes. They were able to convert their vascular imaging station to image bryophytes there as well. This helped when multiple students were interested in imaging at similar times and provided them with more imaging progress. Most of MU's remaining non-North American specimens needing to be transcribed are in Cyrillic.

COLO continued imaging, skeletal data, and transcription.

DUKE's three undergraduates who were working on the project during the academic year finished at the end of the semester (beginning of May). They will be continuing at the start of the fall semester.

F continued imaging and transcription of lichens and bryophytes.

FLAS now has four staff (work-study and part-time) trained on both barcoding/imaging and their second imaging station is set up.

ILL & ILLS continued imaging and transcription of bryophytes. Through institutional funds, 2899 bryophyte specimens donated from EIU to ILLS were rehoused in archival packets.

LSU's efforts this quarter were in imaging bryophyte specimens and full label transcription of existing skeletal records in the portals. A volunteer continued working to image specimens. Some of these specimens include more than one image to capture all the content in the packet. Two undergraduates were trained to transcribe labels for the summer. Additionally, they verified geolocations where labels included coordinates.

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

MIN's four undergraduates who were working on the project during the academic year finished at the end of the semester (mid-May) so progress has slowed. They will be continuing at the start of the fall semester.

MO worked on barcoding, imaging, and skeletal data. They improved their process so that they can capture skeletal data (country and taxon) at the same time as imaging.

MSC completed imaging and transcription.

NY completed barcoding of entire general lichen collection, is continuing to barcode lichen exsiccati, and started barcoding bryophyte collection. Transcription continues ad hoc to

accommodate remote work schedules. Their first intern's position ended, and they are looking forward to hiring more interns to get imaging back to full time.

PH had two dedicated staff working nearly full time digitizing and transcribing lichen packets. A curatorial assistant continued to transcribe lichen packet images before retiring in early June. An undergraduate student imaged lichen packets and these images were uploaded to the portal. Imaging of the non-North American lichen packets was completed during this quarter.

TENN students continued barcoding, imaging, and transcribing bryophyte specimens. One herbarium intern was hired as an additional technician for the summer.

UC is nearly done with the lichen digitizing, and will be moving on to the bryophyte digitizing in the fall semester.

WIS's two students continued imaging specimens in house. They graduated in May, but they were able to hire them as data entry operators and they will continue to image and contribute to georeferencing efforts through the summer months. They received lichen exchange material and were able to image labels and will easily pull in transcription data through the duplicate function in Symbiota.

YU continued imaging bryophyte specimens, uploading images to the portal, and creating skeletal records.

Digitization

Nineteen institutions (ASU, BRY, 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 63,158 specimens barcoded (41,419 bryophytes and 21,739 lichens), 58,051 labels imaged (30,515 bryophytes and 27,536 lichens), 48,966 specimens imaged (30,577 bryophytes and 18,389 lichens), 34,685 specimen records uploaded to the portal (17,947 bryophytes and 16,738 lichens), 58,654 skeletal records created (36,617 bryophytes and 22,037 lichens), 27,277 labels fully transcribed (21,031 bryophytes and 6,246 lichens), and 39,706 specimens georeferenced (23,066 bryophytes and 16,640 lichens) (See Table 1 & Figure 1). These quarterly totals are the highest yet for barcoding, skeletal data, and georeferencing (See Figure 2).

Table 1: Digitization progress by GLOBAL collaborators in 2022-Q2, 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASU	101	0	101	0	101	0	0	0	101	0	101	0	101	0
BRY	0	0	0	0	0	0	0	0	150	0	0	0	0	0
CINC & MU	2,362	0	2,992	74	2,992	74	2,179	0	2,362	74	3,436	28	0	0
COLO	0	4,755	0	6,255	0	0	0	6,255	0	6,255	0	2,473	0	0
DUKE	558	0	689	0	461	0	1,150	0	558	0	255	0	9	0
F	6,125	3,750	3,837	4,692	3,837	4,692	3,837	0	4,934	123	0	0	0	0
FLAS	3,160	0	2,147	0	2,147	0	2,745	0	0	0	0	0	0	0
ILL & ILLS	2,272	0	2,272	0	2,272	0	0	0	0	0	194	0	0	0
LSU	0	0	0	0	1,550	0	0	0	0	0	706	1,095	724	175
MICH	1,400	6,000	1,400	6,000	140	600	834	79	1,400	6,000	834	79	95	2
MIN	0	2,995	0	2,995	0	2,995	0	0	0	2,995	2,558	0	0	8,110
MO	4,503		5,368		5,368		0		4,950		298		69	
MSC	0	763	0	763	0	763	0	3,976	0	763	0	614	0	614
NY	10,791	1,124	1,022	2,354	1,022	2,354	0	0	10,794	1,124	3,705	1,111	863	474
OSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PH	0	2,352	0	2,352	0	2,352	0	2,352	0	2,352	0	766	0	0
TENN	5,878	0	6,418	0	6,418	0	6,384	0	6,405	0	8,944	0	5,368	0
UC	0	0	0	1,760	0	1,760	0	0	0	2,060	0	0	0	0
WIS	0	0	0	291	0	2,799	0	4,076	0	291	0	80	15,837	7,265
YU	4,269	0	4,269	0	4,269	0	818	0	4,963	0	0	0	0	0
Totals	**41,419**	**21,739**	**30,515**	**27,536**	**30,577**	**18,389**	**17,947**	**16,738**	**36,617**	**22,037**	**21,031**	**6,246**	**23,066**	**16,640**
B+L Totals		**63,158**		**58,051**		**48,966**		**34,685**		**58,654**		**27,277**		**39,706**

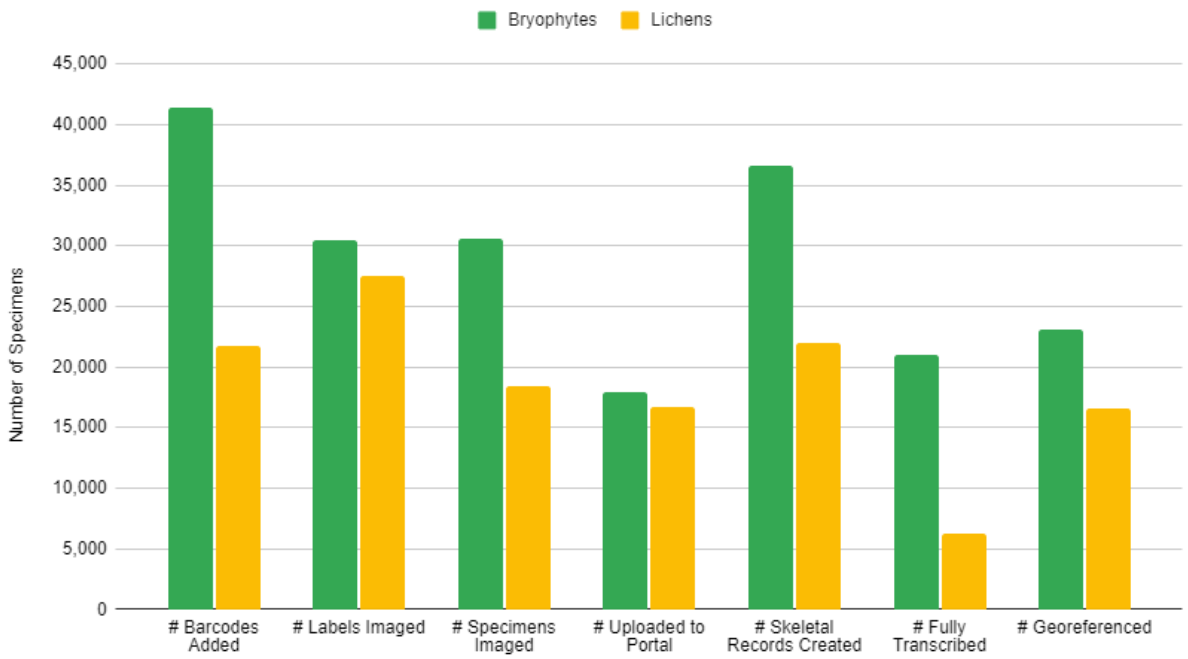

Figure 1: Digitization progress for the GLOBAL collaboration in 2022-Q2, separated by Bryophyte and Lichen specimens.

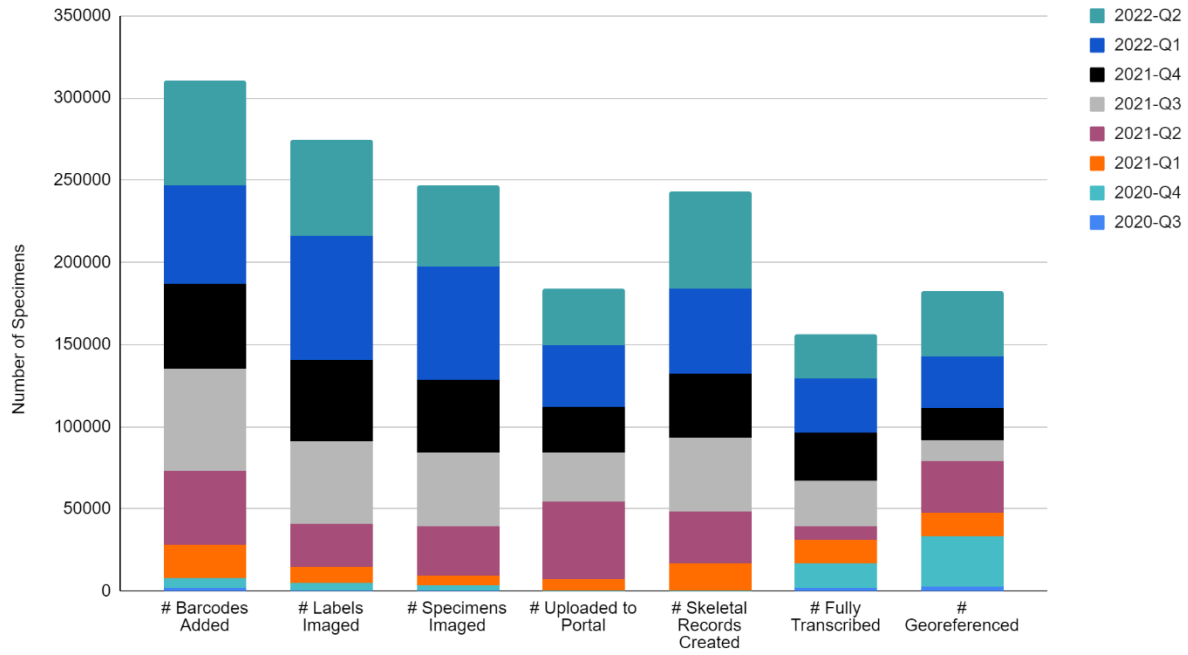

Figure 2: Cumulative digitization progress for the GLOBAL collaboration by quarter.

Share Best Practices, Standards, and Lessons Learned

Flexible Workflows

The GLOBAL teams continued to make use of flexible digitization workflows in 2022-Q2, including some use of virtual transcription work and prioritizing label imaging, while most collaborators were able to begin or continue on-site work.

Taxonomy

ASU integrated two taxonomic resources, F-dex (for fungal species) and BryoNames (for bryophyte species) into the taxonomic cleaning tool in both CNABH and CNALH. This will leverage the taxonomic work of these resources and enable the addition of new lichen and bryophyte names into these portals' taxonomic thesauri.

Collaboration

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2022-Q2. New collaborators and students were given access to Basecamp group resources. The Outreach & Education Group met in preparation for the April WeDigBio event. The IT Team met in June to share updates on deliverables and priorities, new and upcoming tools / developments.

A Management Committee Meeting was held in May open to all GLOBAL team members to review quarterly grant progress. The GLOBAL Project Manager (TENN) competed spring check-in meetings with collaborators which began in 2022-Q1, Zooming with MICH and PH in April to discuss progress, concerns, and plans.

WIS continued its collaborative georeferencing, creating new communities in the CoGe interface and georeferencing as fully transcribed records become available. The GLOBAL Project Manager also facilitated a meeting between the GLOBAL Geoferencing Manager (WIS), Portal Manager (ASU), and the team at MIN to coordinate their centralized georeferencing plans.

Share Identified Gaps in Digitization Areas and Technology

Barcode Renaming

ASU provided support & troubleshooting for the BCRwatcher software that renames image files with their barcode and captures skeletal metadata for upload to the portal. Upon request by a user the next version of the software will allow to capture some additional metadata like verbatimCoordinates, identifiedBy, etc. Staff at MSC assisted in testing new versions of BCRWatcher imaging software.

Transcription Challenges - Handwriting

Handwriting and non-English languages / alphabets 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. F continued developing and adding to a document aiding with collectors handwriting. This is shared with all transcribers to help with handwritten labels.

Georeferencing

WIS Georeferencing through the CoGe interface has shown that duplicate records transcribed slightly differently will require separate treatment. Verbatim transcription and standardizing higher geographies may help. TENN Project Manager met with the GLOBAL Georeferencing Manager in May to discuss progress and challenges, including some limitations in CoGe. Some follow up and helpful tools in development were discussed during the GLOBAL IT Meeting. TENN Project Manager manually copied coordinates for TENN locality duplicates from a number of countries in an excel export, but this process would be quicker if it could be more automated.

Share Opportunities to Enhance Training Efforts

ASU's Symbiota Help and Documentation has significantly improved with the launch of a new documentation website by the SupportHub team: https://biokic.github.io/symbiota-docs/, which was announced to the GLOBAL group via Basecamp.

As part of the overhaul of the character matrix for lichenized fungi in the Lichen Consortium at ASU, several collaborators have been trained and joined efforts in updating taxonomy and

taxon profiles of lichen species, such as K. Knudsen (Acarospora), A. Fryday (southern subpolar lichens), G. Perlmutter (North Carolina), etc. G. Perlmutter, J. Holinger and A. Fryday joined the team of taxonomy editors, helping to update the taxonomic thesaurus in the lichen portal.

The GLOBAL Project Manager shared Georeferencing resources and gave a basic overview training on Geolocate to University of Tennessee Professor Dr. Charlie Kwit and four undergraduate students from his class in May.

WIS worked on creating Help Sheets for georeferencers for difficult countries. They continue to work on the best strategy to effectively verify georeferences and track corrections and progress.

The GLOBAL Project Manager (TENN) and Georeferencing Manager (WIS) continued compiling transcription and georeferencing resources during 2022-Q2 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.

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

Ongoing collaboration between GLOBAL teams and other TCN projects (including PCC, All-Asia, and SoRo) occurring concurrently at their sites continued at CINC & MU, COLO, MICH, NY, and WIS, where personnel, resources, and learnings were often shared between projects.

Katie Pearson, the Portal Manager for the Lichen and Bryophyte Portals, now also works as a member of the Symbiota Support Hub and has been actively involved in developing the documentation resources at: https://biokic.github.io/symbiota-docs/.

The Field Museum and the GLOBAL TCN supported iDigBio with the conference Digital Data 2022: Enhancing & advancing the quality of digitized data in May.

TENN PI and Project Manager, along with CINC's Eric Tepe and FLAS's Alan Franck, continued communications with the Bishop Museum herbarium (BISH) staff to facilitate their upcoming PEN proposal, in conjunction with the University of Hawaii (HAW) and the National Tropical Botanical Garden (PTBG).

TENN PI and Project Manager, along with DUKE's Blanka Aguero met virtually with Karen Golinski and Cassandra Bradshaw from the University of British Columbia herbarium to share information and advice about crowdsourcing in the Symbiota portals.

Digitization resources and workflows compiled during the GLOBAL project were shared with Diego Knop Henriques, a Brazilian Bryologist working at the Federal University of Parana on a project aiming to create a network of Brazilian Bryological Collections.

TENN Project Manager participated in the quarterly iDigBio Internal Advisory Committee Meeting in May and demoed the GLOBAL project website https://globaltcn.utk.edu/ for the other TCN participants.

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 portals like the Lichen and Bryophyte Consortium have for a long time facilitated publishing data directly to the Global Biodiversity Information Facilities (GBIF). Symbiota is now officially recognized as an Associate Participant of GBIF. DUKE Personnel Aguero continued assisting the Portal Manager in bryological matters of Bryophyte portal management.

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 PI Bungartz will teach a workshop about the Lichen Consortium (in Spanish) at an international meeting of the Grupo Latinoamericano de Liquenólogos (GLAL XV), to take place virtually in Argentina at the end of July. As part of revising the lichen identification character matrix F. Bungartz is finalizing the glossary definitions of lichen characteristics which we plan to share through the Lichen Consortium in the fall. Once these resources become available, the portal will become a more attractive resource for species identification and learning about lichens.

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

In April 2022, DUKE Personnel Aguero hosted a two-session class on mosses and liverworts at Duke Gardens for 14 participants. One tour of the lab and the herbarium given in May. Aguero also taught a week-long seminar on liverworts at Eagle Hill Institute for 12 participants in June 2022. Bryophyte portal was demonstrated and frequently used during the seminar.

F participated in, led or co-led many education and outreach activities ranging from participatory events to behind the scenes tours. For example: 1) April 2022: WeDigBio (Worldwide Engagement for Digitizing Biocollections) (see more below); May 2022: WeDigBio strategic planning; Onsite school visit from Northside Prep including a 4 hour event ranging from hands on work to tours; Began a new fieldwork program in Nachusa Grasslands focusing on bryophytes and lichens enabling to train students and researchers from the field to the Field; Participated in the annual iDigBio Digital Data conference, including presentations, workshops, behind the scenes virtual tour, and mentoring program; June 2022: Summer Camp behind the scenes tours; Collaborating with Learning Center and Digital Learning high school students developing online tools showcasing the significance of herbaria, research collections and different plant groups; Reviewing and wrapping up lesson plans that includes bryophytes and lichens; Published in *Research Ideas and Outcomes*: People-Powered Research and Experiential Learning: Unravelling Hidden Biodiversity - connecting digitized bryophyte (liverwort) images to youth, educators, the general public - receiving widespread media coverage e.g.,

https://www.chicagotribune.com/news/environment/ct-community-science-field-museum-20220630-pf7eipu6vngz7i7lzwijwu27pa-story.html

PI von Konrat (F) presented "People-powered research and experiential learning: Unraveling hidden biodiversity" at the Digital Data Conference, a virtual conference hosted by the Field Museum and the University of Florida, May 23-25, 2022.

LSU gave four herbarium tours to elementary children from the LSU Laboratory School which included basic science lessons to distinguish between a plants and fungi, and included bryophyte and lichen examples. These tours included 8 teachers and nearly 200 children. The LSU Herbarium display case in the Life Sciences Building was rotated in May, concluding a 1-year focus on bryophtyes.

The NY Herbarium's tours for new staff and for internal outreach have consistently featured bryophytes and lichens. Several new pieces for *The Hand Lens* featuring cryptogams, cryptogam collectors, and specialists have been published.

TENN continued hosting the GLOBAL weekly transcription event on Fridays during 2022-Q2. Thirteen community science volunteers from five countries participated (US, Canada, UK, China, Pakistan) and transcribed skeletal data for over 700 specimens. Volunteers were also able to see presentations on bryophyte / lichen topics by visiting researcher Dr. Jenna Ekwealor (Biodiversity Genomics Postdoctoral Fellow, Smithsonian Institution), Julia Butler (Graduate student, TENN), and a number of "Specimen Spotlight" presentations on specimens and collectors compiled by the TENN GLOBAL Project Manager. One transcription event volunteer, June Novalich, was featured in an article in the Journal for the CSA Fraternal Life June 2022 Journal: https://csalife.com/doc/journal/June.pdf?v=33.

The TENN Herbarium hosted "Collections & Cones" on April 20, an event sharing herbarium tours and information about the herbarium's projects and services - and ice cream - with students, faculty, and staff in the Ecology and Evolutionary Biology department.

UC started a cryptogram volunteer program, which is helping to prepare more global bryophyte specimens for accessioning and digitizing.

WeDigBio

Five GLOBAL collaborators (DUKE, COLO, CINC & MU, F, TENN) participated in the April 2022 WeDigBio. The team from F again helped host and manage the event with assistance from the GLOBAL team. Over four days 141 community scientists databased 4,174 specimens, including

early land plants, lichens, and insects. The GLOBAL day, April 7, included presentations from TENN PI Budke on bryophytes and a tour of the COLO herbarium.

Share Information About Your Website and/or Portal Usage

The GLOBAL project website, https://globaltcn.utk.edu, was utilized by 302 users during 2022-Q2, including 37 from Europe, 31 from Asia, 2 from Africa, and 1 from Oceania (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 7,000 users visited the Bryophyte Portal (a major increase over the 3,700 from the prior quarter) and over 20,100 users visited the Lichen Portal during 2022-Q2 (see Figures 4 & 5).

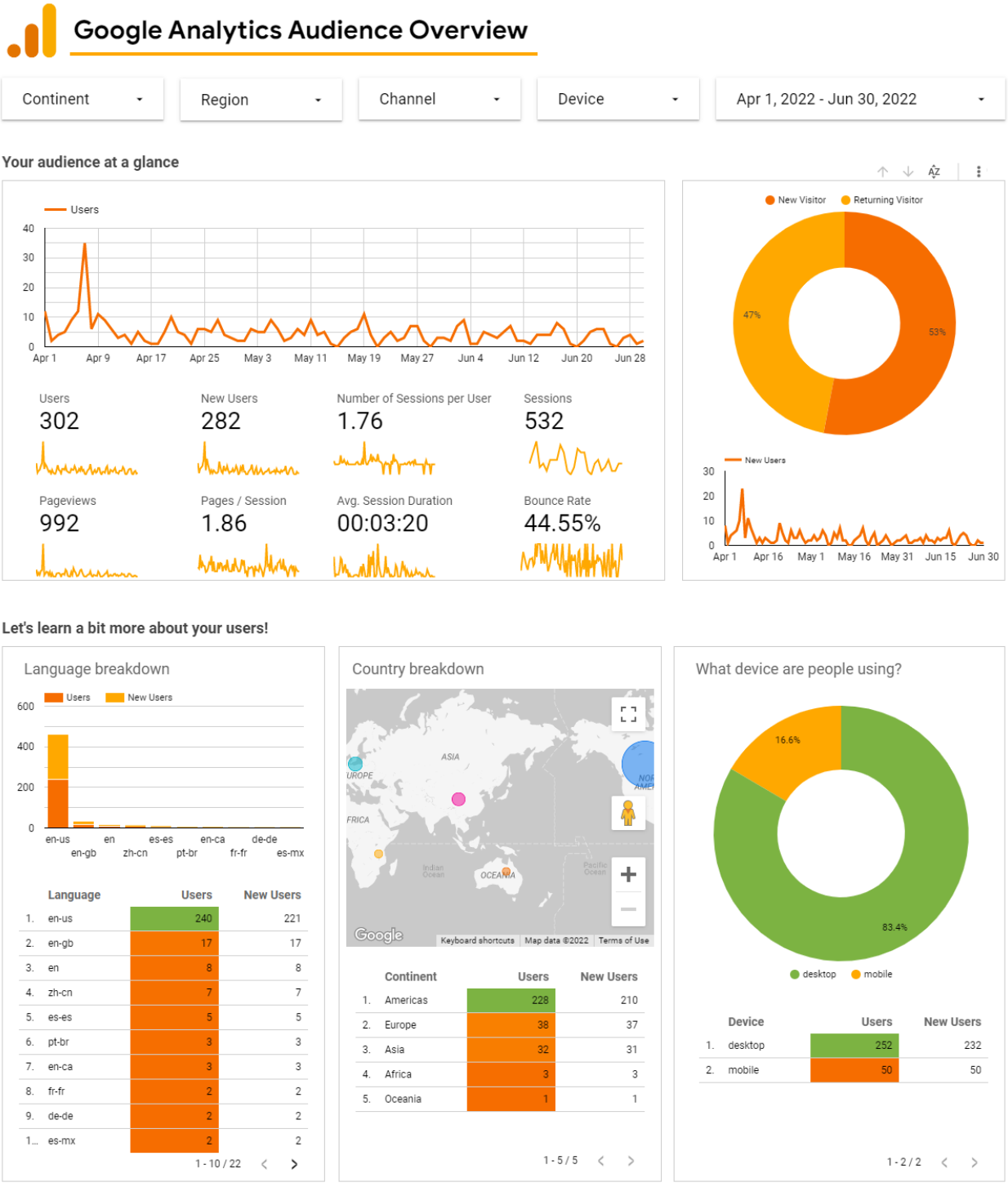

Figure 3: Use metrics for the GLOBAL project website (https://globaltcn.utk.edu) from April 1 – June 30, 2022.

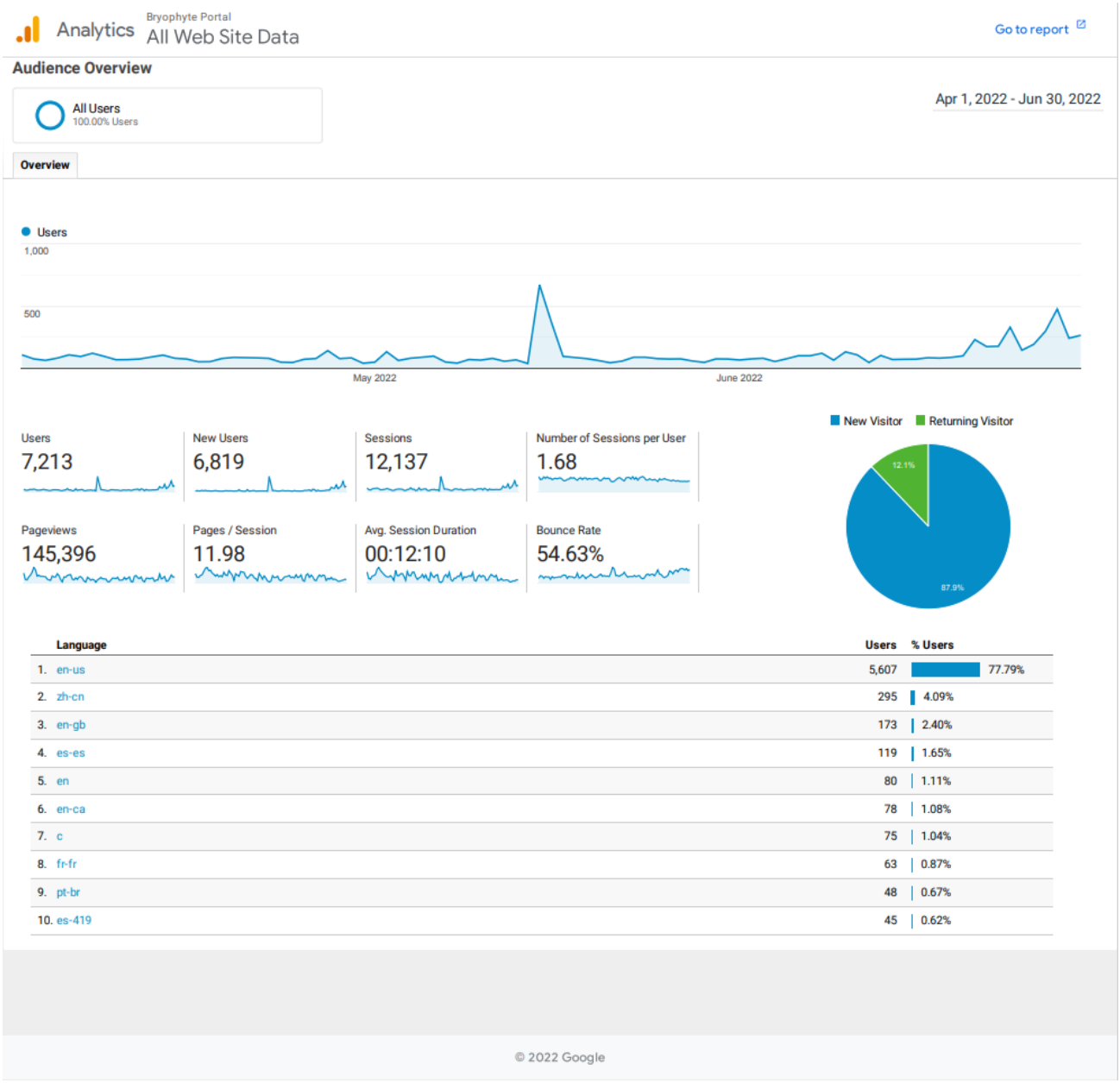

Figure 4: Use metrics for the Bryophyte Portal (https://bryophyteportal.org/portal/) from April 1 – June 30, 2022.

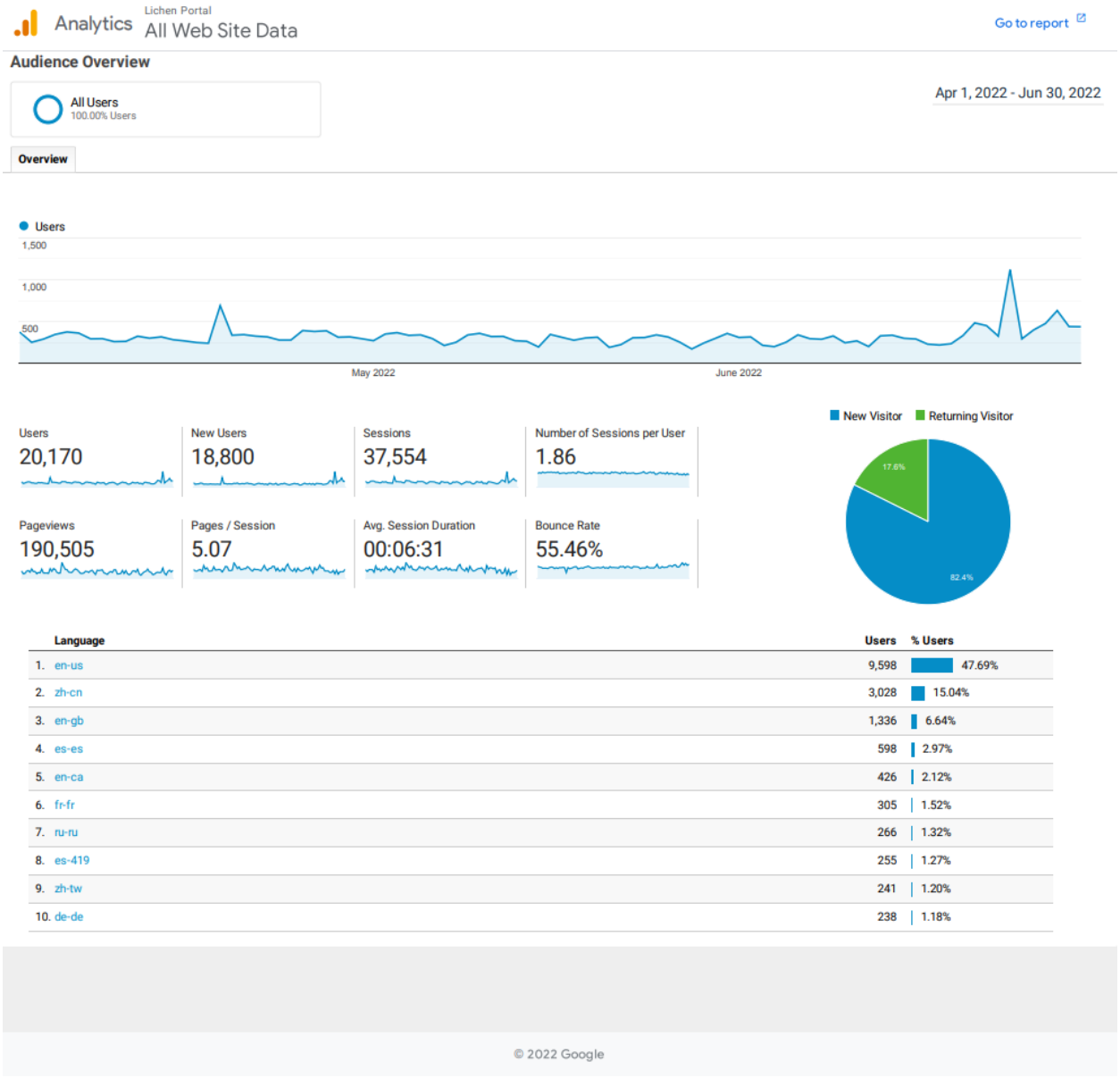

Figure 5: Use metrics for the Lichen Portal (https://lichenportal.org/cnalh/) from April 1 – June 30, 2022.

Share Other Activities and/or Progress

Annual Reporting

TENN Project Manager updated reporting sheets for the Year 2 NSF Annual Reporting that will be completed in July.