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, 2021.

While many COVID-19 prevention measures remained in place during 2021-Q3, access to collections spaces and student workers improved. All GLOBAL institutions were able to begin GLOBAL work in some capacity during this period, including those collaborators who had been prevented from starting during Year 1.

Imaging Equipment & Workflows

Additional progress was reported in setting up and optimizing imaging equipment and workflows during 2021-Q3. ALA remodeled their imaging station since there were issues with the strobe lights. They are now using a modified imaging station set up with EGO LED lights which is working very nicely and replaced their older strobe light set up. Two BRY undergraduate students organized specimens for digitization and began preliminary light box set up. CINC & MU continued to improve their dedicated bryophyte imaging system, and

[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

recently worked to reposition lighting to minimize reflection from the barcodes. F began developing workflows for imaging whole sheets with the specimen and for packets with the specimen, capturing the label and specimen at the same time. MSC worked on processing data for a complicated lichen accession. WIS made email contact again with their collaborators at NEB to make arrangements for transfer of their collections to WIS for processing. With OH no longer participating they will be working with BRU to digitize their collections.

Personnel

ALA hired a graduate student curatorial assistant and two undergraduate curatorial assistants. DUKE hired and trained five students to assist with label transcription. F gained two dedicated photographers for bryophytes and lichens. FLAS hired two undergraduate students to barcode and card their bryophyte specimens. Alan Franck began work in September as the collection manager upon Kent Perkins' retirement. LSU trained two undergraduate students to digitize bryophytes, including imaging and transcription. One staff member continues to work remotely with limited hours due to the pandemic but has been cleaning records and adding georeferences from matching duplicates in the portals. MIN hired four undergraduate students to start work on the project. A digitization tech started at MO in September and will be working full time on the GLOBAL project. Two students were hired at OSC for the digitization of lichens and bryophytes, respectively. NY hired a new intern who will start work focused on imaging in 2021-Q4. Dr. Tatyana Livshultz joined the GLOBAL project at PH as a co-PI as Dr. Teisher left PH for a new position at MO. Dr. Teisher remains as PI. Five students started working at UC at the end of August, adding barcodes, imaging lichen specimens, and creating skeletal records. WIS interviewed and hired several undergraduate students for hourly vacancies. The students have started imaging lichen specimens and are improving their techniques. They are also being trained in georeferencing with the WIS collection.

Digitization

Nineteen institutions (ALA, ASU, CINC & MU, COLO, DUKE, F, FLAS, ILL & ILLS, LSU, MICH, MIN, MSC, MO, NY, PH, TENN, UC, WIS, and YU) reported progress on digitization deliverables, with a total of 61,925 specimens barcoded (37,449 bryophytes and 24,476 lichens), 50,095 labels imaged (35,376 bryophytes and 14,719 lichens), 45,448 specimens imaged (26,098 bryophytes and 19,350 lichens), 30,073 specimen records uploaded to the portal (25,047 bryophytes and 5,026 lichens), 45,049 skeletal records created (20,542 bryophytes and 24,507 lichens), 27,691 labels fully transcribed (22,945 bryophytes and 4,746 lichens), and 13,278 specimens georeferenced (9,532 bryophytes and 3,746 lichens).

Table 1: Digitization progress by GLOBAL collaborators in 2021-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	55	1,142	55	1,142	55	1,142								
ASU	141	2,633	23	50	23	50		30	141	2,633	141	2,633	19	1,888
BRY														
CINC & MU	351	1	749		749		749	1			5,954	1	2,501	52
COLO		4,994		4,994				4,994		4,994		1,620		
DUKE	2,331		2,815		688	8,953	4,837		3,016		1,238			
F	5,200	625	1,119	625		157			3,450					
FLAS	925		1,030											
ILL & ILLS	10,670		10,670		10,670						3,205			
LSU	438	1	154	10			438	1	364		65	42	32	134
MICH	4,267		5,006		158		1,754		1,596		2,671		97	
MIN	49										49			
MO	1,928		1,210		1,210				341		341		67	
MSC	1,647		1,647		1,647		2,533		1,644					
NY	445	14,880	228	6,083	228	6,083			445	14,880	136		207	304
OSC														
PH	3,262		3,262		3,262		6,797		6,797		5,005		155	
TENN	2,748		4,416		4,416		4,495		2,748		3,760	35	868	78
UC		200		1,815		1,815				2,000				
WIS						1,150						415	5,586	1,290
YU	2,992		2,992		2,992		3,444				380			
Totals	**37,449**	**24,476**	**35,376**	**14,719**	**26,098**	**19,350**	**25,047**	**5,026**	**20,542**	**24,507**	**22,945**	**4,746**	**9,532**	**3,746**
B+L Totals		**61,925**		**50,095**		**45,448**		**30,073**		**45,049**		**27,691**		**13,278**

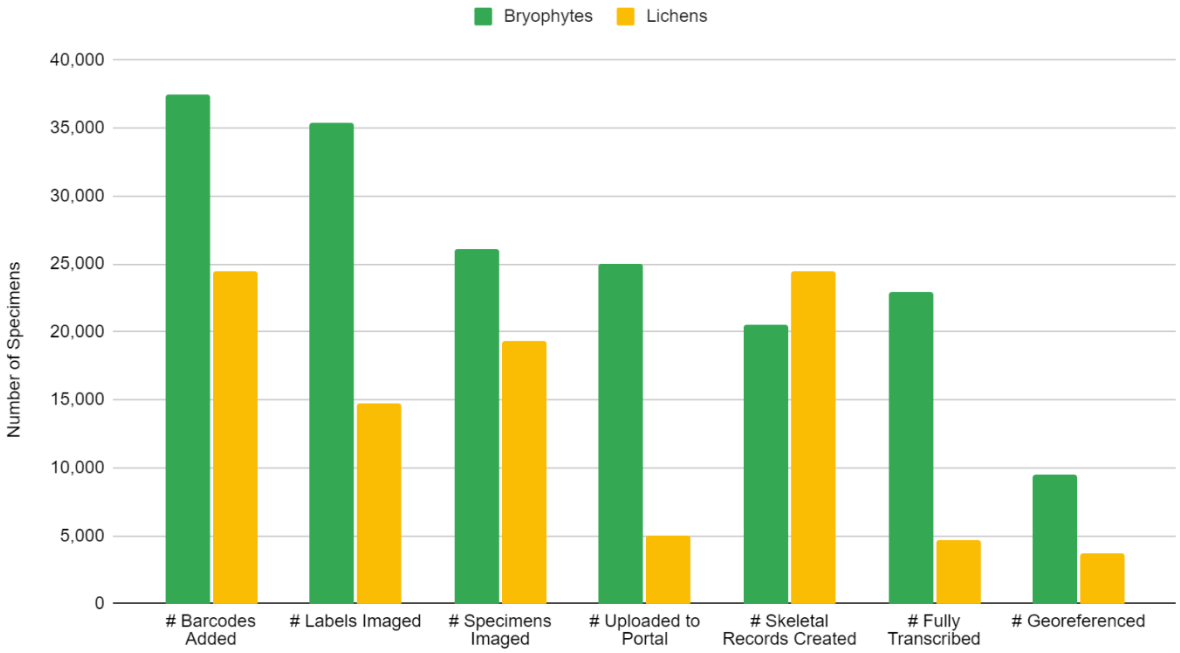

Figure 1: Digitization progress for the GLOBAL collaboration in 2021-Q3, separated by Bryophyte and Lichen specimens.

Share Best Practices, Standards, and Lessons Learned

Flexible Workflows

The GLOBAL teams continued to make use of flexible digitization workflows in 2021-Q3, including some use of remote imaging stations, virtual transcription work, and prioritizing label imaging. However, COVID-19 restrictions continued to ease for most participants, allowing all collaborators to begin some digitization activities and more to transition to on-site work.

COLO is exploring options to start capturing images of specimens and hopes to have a workflow in place soon. Their primary focus has been to capture label data to facilitate transcription and get their specimens ready for centralized georeferencing. Access to the collection improved, but they do not have as many digitizers as they have had in the past. As a collection they were not happy with the image quality of specimens when trying to capture labels and specimens in the same frame. They hope this will be a turning point for the project and they can speed up the process of getting packets imaged to help drive the transcription process. They will most

likely retake the specimen images later in the project when we have a system in place for capturing better specimen images.

DUKE's current imaging system is optimized for specimen images, and single label images. It proved to be more time consuming to capture labels one by one. They will benefit from purchasing a second lens, specialized on capturing whole sheets of labels.

F's collection access opened up during 2021-Q3 so they transitioned back to on-site imaging in place of remote stations. They are correspondingly developing workflows for imaging whole sheets with the specimen and packets with the specimen, capturing the labels and specimens in one image.

NY decided to lower the camera on their light box station to take photos with a slightly smaller footprint but higher definition of the image. This workflow is working well for their specimens in loose packets.

UC has established that for their collection, it is best to take two separate images: one of the packet and one of the specimen. This helps to prevent specimen loss or damage if students were to attempt to remove specimens from their packets for imaging.

Collaboration

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2021-Q3. A Management Committee Meeting was held in August open to all GLOBAL team members to review quarterly and Year 1 grant progress. The GLOBAL Project Manager (TENN) completed check-in meetings with most collaborators in September (ASU, BRY, CINC & MU, COLO, DUKE, F, LSU, MICH, MIN, MO, MSC, PH, UC, WIS, and YU) to discuss progress, concerns, and plans for the fall. The GLOBAL IT Team met in September to update progress and priorities.

The Georeferencing Manager (WIS) is continuing to create communities and georeference in the Collaborative Georeferencing Client (CoGe) for those institutions who have opted into centralized georeferencing and have transcribed records available. She is finding nuances to the Collaborative Georeferencing Web Client. For example, utilizing the History function is time-saving when finding similar or exact localities (with slightly different transcription or spelling).

Share Identified Gaps in Digitization Areas and Technology

Image Uploading

While image uploading for collaborators hosting images through ASU has been established, those institutions with alternate hosting may have separate challenges. ALA had a delay in uploading images as there have been changes to the protocol with their partner at TACC (Texas Advanced Computing Center) and they needed to get through a lengthy process of administrative agreements and adjusting the protocols. This has recently been resolved and they have uploaded 68 GB of images to TACC now. The digitization of additional specimens and uploading will now progress nicely with an expected 14GB of image data per month.

ASU continued to provide support with image acquisition and skeletal metadata upload, soon to be streamlined with the new software PhotoWatcher.

Barcode Renaming

ASU's prototype version of PhotoWatcher, a small program to facilitate image acquisition tested at TENN, COLO, F, and OSC is now in the final test stages to be more broadly released to the community of participating institutions. The program will replace previous versions of the BarcodeRenamer. It automatically renames image files by detecting barcodes in the picture during image capture and provides the user with an option to enter skeletal image metadata that are written into the XMP header of the JPGs, as a sidecar for the raw files and a CSV that can be uploaded alongside the images directly to the portal. The PhotoWatcher also now automatically adds the unique exsiccatae identifier (ometid) to the skeletal metadata upload file. Whenever the user captures an image of an exisccata specimen the ometid is added automatically to the XMP metadata and the XMP skeletal metadata CSV upload file.

Share Opportunities to Enhance Training Efforts

Digitization

The GLOBAL TCN website (https://globaltcn.utk.edu) continued to be updated with additional links and resources during 2021-Q3.

Transcription

The GLOBAL Project Manager (TENN) continued compiling transcription resources during 2021-Q3 to share on Basecamp and all resources were posted to the project website.

Georeferencing

WIS began to train recent student hires and found the Georeferencing Resources section of Cal. Phenology Network developed by Katie Pearson to be extremely valuable.

Symbiota

The GLOBAL Portal Manager (ASU) led a webinar for interested GLOBAL collaborators demonstrating the Symbiota Crowdsourcing Module as well as an overview of Notes From Nature in preparation for the October WeDigBio Event. A video introduction can be found here: https://youtu.be/cKHnaYzvI8E and a written protocol here: https://tinyurl.com/9t6wrvcj.

As part of our outreach to lichenologists from Latin America, ASU PI Bungartz held a Symbiota workshop (in Spanish) for the Consorcio de Herbarios de Líquenes en América Latina during the 9th Symposium of the International Association for Lichenology, in Brazil August 1-6.

Citizen Science

The GLOBAL Project Manager (TENN) attended four of iDigBio's Citizen Science webinars to gain more understanding of resources including BioSpex, iNaturalist, DigiVol, and CitSci.org.

ADBC Summit 2021

Many GLOBAL collaborators joined the 2021 ADBC Summit to hear about progress from our and other TCNs, including a few developing unique functions. These and similar workshops are always valuable for training.

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

A meeting with the TCN's External Advisory Committee (EAC) was held in July. Representatives from the GLOBAL Executive Committee (F, NY, TENN, and UC) and EAC members Deborah Paul (University of Illinois Urbana-Champaign; TDWG), Joe Miller (GBIF), Rosa Scherson (University of Chile), Shelley James (Western Australian Herbarium; Australasian Herbarium Collections;

SPNHC; TDWG), and Shuo Shi (Hebei Normal University) reviewed the GLOBAL TCN project's goals, progress, and challenges. The External Advisory Committee members offered advice on possible tools and connections that could be explored by the GLOBAL team.

The GLOBAL team was contacted by a representative from the Canadian Museum of Nature after the BL2021 event and shared resources and information about bryophyte and lichen digitization resources posted on our project website.

Lead PI Budke (TENN) was contacted in 2021-Q3 by the Harvard University Herbarium (FH), the Brown University Herbarium (BRU), and University of California, Davis (DAV) about the possibility of joining the GLOBAL collaboration as PEN's. Initial discussions were conducted via email and resources about the PEN process, as well as current GLOBAL digitization resources, were shared with all institutions. It was decided that BRU's collection was small enough in size to be digitized by WIS in place of the original collection from OS, who has decided not to participate. Their specimens will be loaned to WIS for digitization and preparation is in process. FH and DAV, along with CAS, may pursue the PEN process in 2022.

The GLOBAL TCN agreed to share their Data Management Plan with a researcher at the University of Texas at Austin as part of a project funded by an NSF award seeking to study DMPs and science data practices.

CINC is a member of the newly funded All-Asia TCN. They expect to apply upgrades and updates between projects. Workers on both projects will be sharing the same space (but separate imaging systems), and will benefit from learning from each other. COLO is also a member of the SoRo TCN and the All-Asia TCN and will continue to share info and technology between projects to help optimize workflows.

MICH has ongoing collaborations 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.

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

The GLOBAL Project Manager (TENN) attended an Armchair Botanist Event sponsored by the Botanical Research Institute of Texas (BRIT).

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.

During 2021-Q3, ASU added 4 new bryophyte collection profiles and 15 new lichen collection profiles. They provided regular assistance with custom data management and synchronization tasks and user management help desk requests. They have acquired 10 TB additional storage at ASU in preparation for migrating images from iDigBio servers to ASU servers.

ASU submitted hundreds of code developments and bug fixes to the Symbiota GitHub code repository (https://github.com/BioKIC/Symbiota-light/commits/master). For the GLOBAL project, they have, for example, added exsiccatae to Skeletal Data Entry tool and made adjustments to the crowdsourcing tools in preparation for the WeDigBio event. The PhotoWatcher tool now natively supports generating skeletal metadata als for Exsiccatae specimens. They have also established a framework and started development of a GLOBAL joint control panel that will be used to partially integrate the Lichen and Bryophyte portals.

ASU's revision of the character matrix in the lichen consortium continues. A new glossary with definitions and illustrations is being developed that helps to explain the revised terminology.

NY has been cleaning their internal database records for exsiccatae collections to be able to link these data to the portals more effectively.

Back Ups

ALA continued their collaboration with TACC for the uploading of raw images (DNGs) and JPGs. TACC provides both cloud storage as well as tape back-up of our data.

COLO's 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 our data.

Taxonomy

ASU's data maintenance of the taxonomic thesaurus in the lichen consortium continues as part of regular database maintenance and updating. Most recent updates: revision of higher level taxonomy to match the current Outline of Fungi; updating the taxonomy of Teloschistaceae.

The taxonomic dropdown for the ImagingWorkflow application used by COLO and UC was missing many of the scientific names they use in their collections. They worked with ASU's Frank Bungartz and Katie Pearson to get an export of the lichen taxonomic thesaurus. COLO's Ryan Allen reformatted this list so it could be added to the application. Klara, UC's Lichen Curator, has also been manually adding missing species names to CSpace.

Share Education, Outreach, Diversity, & Inclusion (EODI) Activities

PI von Konrat (F) presented the GLOBAL project to conference attendees at Bryophytes, lichens, and northern ecosystems in a changing world (BL2021; July 6-9, 2021), reaching participants from the four major bryological, lichenological and botanical societies: the International Association of Bryologists (IAB), the American Bryological and Lichenological Society (ABLS), the Canadian Botanical Association (CBA-ABC) and the Société québécoise de bryologie (SQB).

Lead PI Budke (TENN) and PI von Konrat (F) presented an update on the GLOBAL TCN during the virtual ADBC Summit in September and many GLOBAL participants attended the Biodiversity Digitization Conference that followed the summit.

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 GLOBAL Project Manager (TENN) also updated information on the GLOBAL TCN iDigBio wiki page (https://www.idigbio.org/wiki/index.php/Building_a_global_consortium_of_bryophytes_and_lichens:_keystones_of_cryptobiotic_communities).

The GLOBAL Outreach & Education group held an initial meeting in August and began discussions about WeDigBio. Six GLOBAL collaborators (DUKE, COLO, CINC & MU, F, MSC, TENN) agreed to participate and began planning for the October event. They held three additional WeDigBio Planning Meetings in September. The team from F shared their extensive experience and resources with the GLOBAL team. It was decided to focus on GLOBAL records during the Friday-Saturday of WeDigBio. The GLOBAL Portal Manager (ASU) also helped with preparation for the WeDigBio event.

ASU PI Bungartz held a two day Symbiota workshop (in Spanish) for the Consorcio de Herbarios de Líquenes en América Latina after the 9th Symposium of the International Association for Lichenology, in Brazil August 1-6. He also met online with Latin American collaborators facilitating data management practices in the Lichen Portal.

The Lichen Consortium recently added a new category of GLOBAL checklists, i.e., checklists with global reach, the Global Checklists of Lichens & Lichenicolous Fungi (https://lichenportal.org/cnalh/projects/index.php?pid=558) and, in collaboration with the IUCN, the Global IUCN Red-Lists (https://lichenportal.org/cnalh/projects/index.php?pid=556).

The team at F started working with six student interns from Roosevelt University in Chicago for their biodiversity class. The students are photographing labels and specimens and physically processing specimens that are part of the GLOBAL project on Thursdays until December. July also included working with two high school students (not paid by Museum) from Chicago Public Schools developing a community science project using the Zooniverse platform: https://www.zooniverse.org/projects/nvuitton/unfolding-of-microplant-mysteries.

NY started developing outreach content, publishing two public interest articles on The Hand Lens and working with the Children's Education Department at NYBG to talk about lichen and bryophyte collaborations.

TENN Collections Manager Oliver and the GLOBAL Project Manager participated in a Career and Jobs Mixer associated with the Botany 2021 conference in July. They answered questions from current graduate students about their paths to herbarium and collections careers.

Share Information About Your Website and/or Portal Usage

The GLOBAL project website, https://globaltcn.utk.edu, was utilized by 220 users during 2021-Q3, including 22 from Asia, 16 from Europe, 4 from Oceania, and 2 from Africa (see Figure 2).

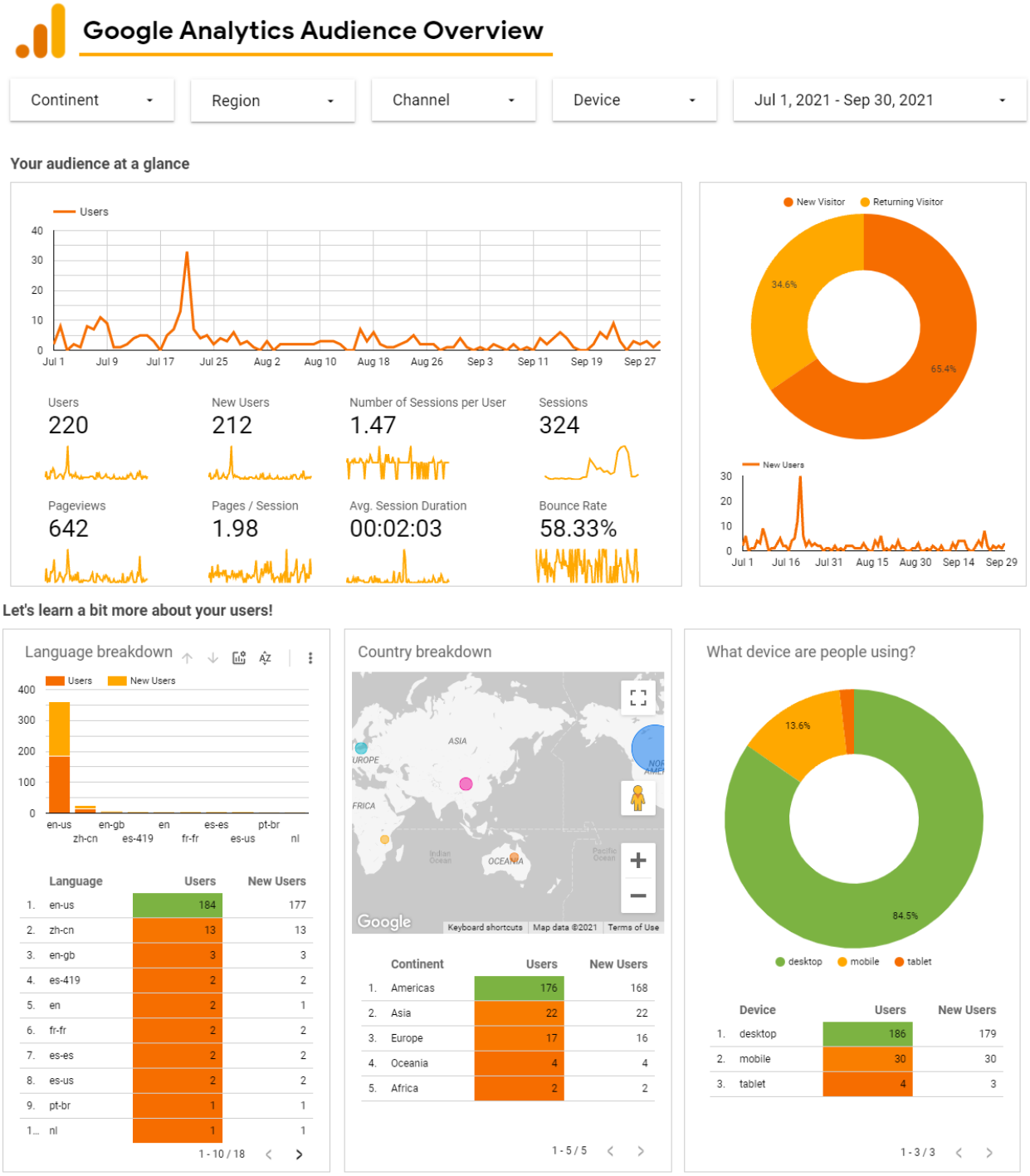

Figure 2: Use metrics for the GLOBAL project website (https://globaltcn.utk.edu) from July 1 – September 30, 2021.

The Bryophyte and Lichen Portals, created as part of the original LBCC grant, host new images and data produced by the GLOBAL collaborators. Over 2,800 users visited the Bryophyte Portal and over 11,500 users visited the Lichen Portal during 2021-Q3 (see Figures 3 & 4).

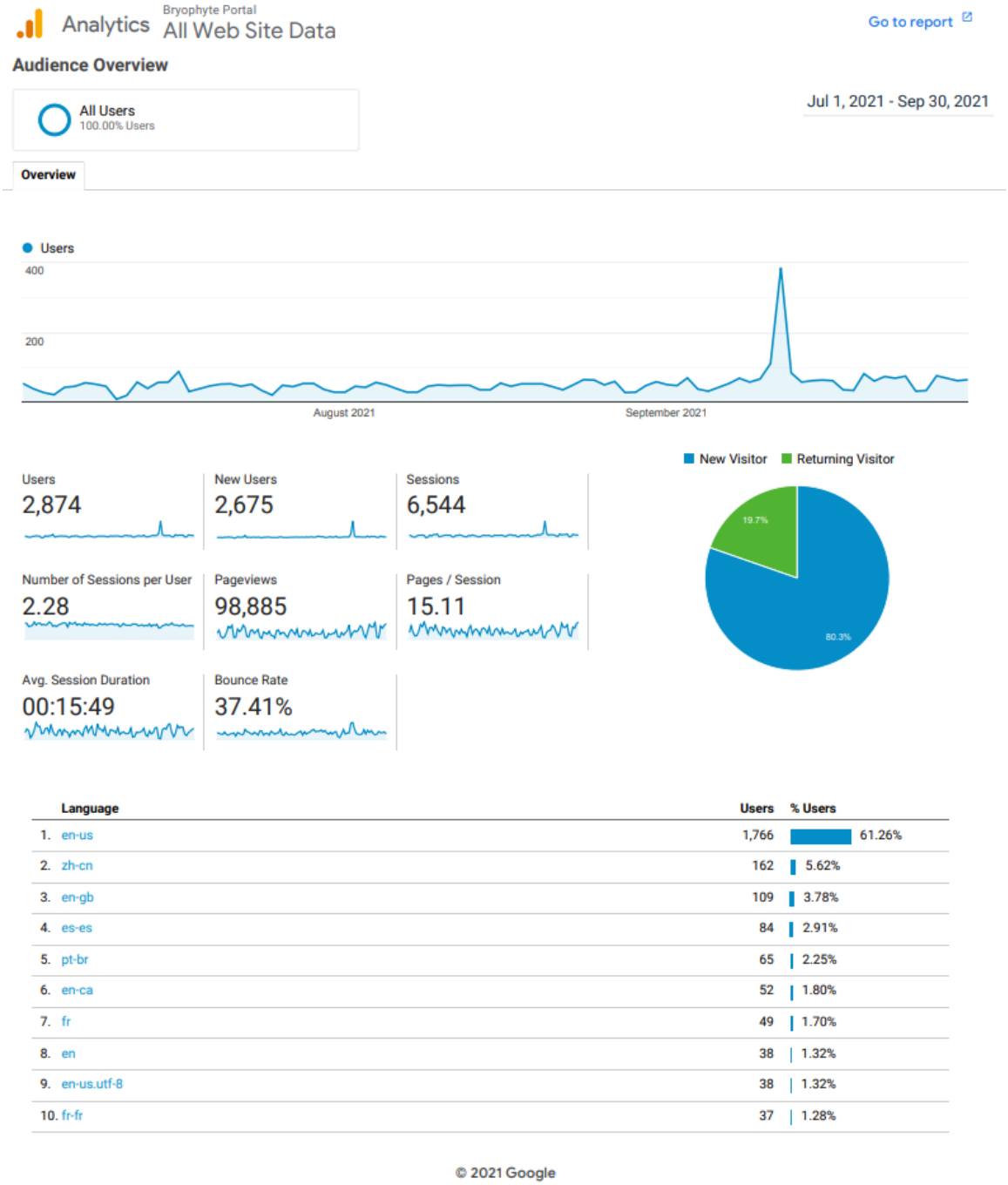

Figure 3: Use metrics for the Bryophyte Portal (https://bryophyteportal.org/portal/) from July 1 – September 30, 2021.

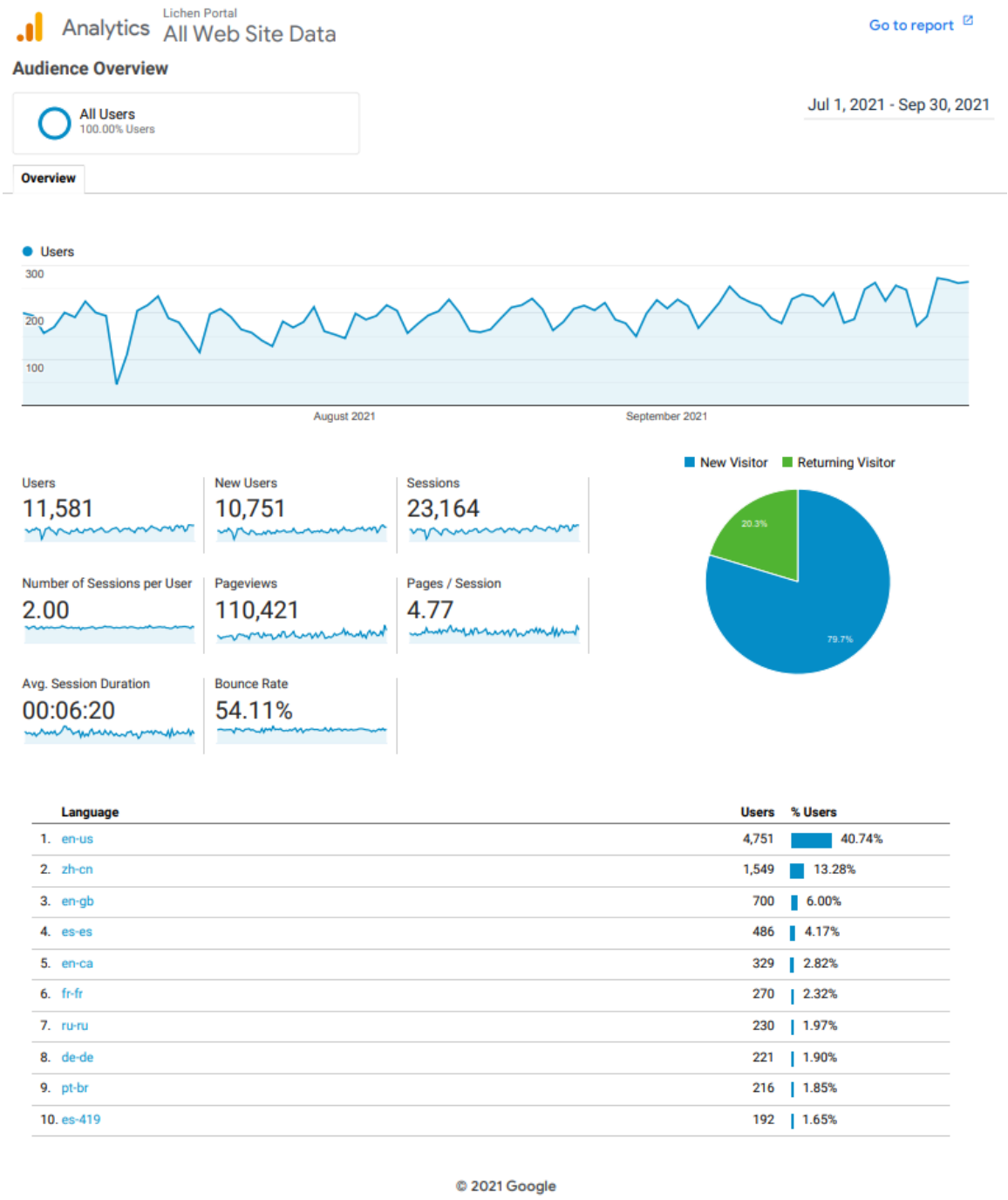

Figure 4: Use metrics for the Lichen Portal (https://lichenportal.org/cnalh/) from July 1 – September 30, 2021.

Share Other Activities and/or Progress

Bryophyte Packet Labels

A new label format has been integrated into the Lichen and Bryophyte portals by the team at ASU, where labels can be directly printed onto full paper sheets that can then be folded into lichen/bryophyte packets. Instructional videos will be shared in 2021-Q4.

Lichen Publication

Dr. Nash published a paper documenting WIS's unique collection of lichenicolous fungi which was only possible thanks to our digitization efforts (Evansia, 38(3):90-99 (2021).

ABSTRACT: The WIS herbarium has ca. 1000 specimens of lichenicolous fungi distributed across 406 species. Fifty-nine of the specimens are types, of which fourteen are isotypes and seven holotypes.

https://bioone.org/journals/evansia/volume-38/issue-3/0747-9859-38.3.90/Lichenicolous-Fungi-in-WIS/10.1639/0747-9859-38.3.90.full

NSF Annual Reporting

All GLOBAL institutions completed their Year 1 NSF Annual Reporting during 2021-Q3. The GLOBAL Project Manager (TENN) compiled the Integrated Report for the TCN which was attached to each main award report.

GLOBAL Logo

The team at TENN worked with scientific illustrator Andi Kur during 2021-Q3 to develop an official logo for the GLOBAL TCN to use on the project website, resources, and outreach activities.

GLOBAL
Building a Global Consortium of Bryophytes and Lichens