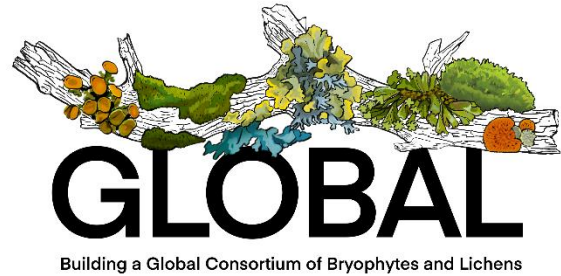




TCN Quarterly Progress Report

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, 2023.

Workflows, Equipment, and Personnel

Most GLOBAL institutions continued steady GLOBAL progress during 2023-Q3.

At ALA, imaging of the remaining lichens and bryophytes continued along with some transcription.

At ASU, specimen digitization continued, focusing on lichen specimens.

BISH joined the TCN as a PEN partner in September. They created their digitizing workflow protocol and trained collections technicians on the new procedures.

The herbarium of non-vascular cryptogams at BRY started a major renovation project in January. Digitization efforts have been halted temporarily in preparation for the major

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



construction that will continue into November 2023. In the interim, BRU team members began discussions with the Portal Manager about transitioning BRY to LIVE status in the Bryophyte Portal.

CINC did not record progress in July and developed a backlog of images and records over the summer months which were processed in September. In addition to specimen records, Margaret Fulford (founder of CINC and liverwort expert) made illustrations of thousands of liverwort specimens. CINC has been scanning these and uploading them to the portal. During Q3, they scanned 2934 of these illustrations. They are not specimens, per se, so were not included in the Digitization Progress numbers, but it is hoped that researchers will find these technical illustrations, made by an expert, to be an invaluable resource.

COLO continued work on imaging and transcribing specimens and uploaded data to the Bryophyte and Lichen Portals. COLO tends to have fewer staff during the summer while school is not in session. They also had two long term digitizers leave for graduate school this quarter and hired several new students in September.

DUKE continued barcoding, imaging, transcribing, and georeferencing activities for their bryophyte collection. They also captured images of lichen type specimens.

At F, imaging and databasing is ongoing for bryophytes and lichens. F has implemented the BCRWatcher and have adjusted their workflow. Preliminary stages indicates this has increased capacity. The BCRWatcher allows the capture of skeletal meta data, which is proving useful if they have batches of specimens from a single country, a taxon or a specific collector.

FLAS has completed barcoding and is continuing the tedious process of staging specimens for imaging, while slowly transcribing records due to unfamiliar international geography and foreign languages.

All ILL & ILLS bryophyte records were uploaded to the Bryophyte Portal. Most (94%) of the ILLS records are georeferenced and 13% of the ILL records are georeferenced. Images will be uploaded and linked to specimen records later this year.

LSU continued digitizing the lichen and bryophyte collection, including imaging, skeletal data, transcription, and some in-house georeferencing.

MICH completed taxonomic curation of the bryophytes and continued barcoding, imaging, transcribing, and georeferencing specimens. Images were uploaded to the U-M digital



collection and linked to records in the portals. This work was primarily completed by a part-time project manager (previously technician) and new technician.

MIN has completed their GLOBAL work, but is gearing up to incorporate existing spreadsheets containing label data to their exsiccate records, which include the images taken during the course of the GLOBAL project.

MO continued digitization work on their bryophyte specimens, including barcoding, imaging, databasing, and georeferencing.

PTBG has finally gotten started as a PEN partner and will begin digitization work in October.

TENN students completed imaging the liverwort collection and bryophyte type cabinet in July, and started and completed imaging of the lichen collection this quarter. They continued transcribing specimens in both the bryophyte and lichen portals, alongside some additional clean-up imaging work. Students also began digitizing a large gift from the Hattori Botanical Laboratory of bryophyte specimens collected in India and the Philippines in the 1960's. Two of the three undergraduate technicians hired in the summer continued GLOBAL work into the Fall semester. Four returning technicians started back in the herbarium in September, and two new interns will help with GLOBAL work among their other herbarium activities.

UC's work-study students continue to digitize and image bryophyte specimens. In addition, they hired a museum assistant to help with transcription, so that process has begun for lichens. They are looking into different kinds of paperweights for holding bryophyte packets open, such that they do not interfere with or look bad in the images.

WIS was able to continue imaging and georeferencing without interruption this quarter due to their experienced student workers assisting through the summer break. WIS began imaging labels and specimens from BRU and began a first pass to transcribe label data with those images uploaded to the portal. Collaborative Georeferencing has continued, adding records as they are fully transcribed and made available.

YU undergraduate students continued transcribing bryophyte specimen labels.

Digitization

Seventeen institutions (ALA, ASU, CINC & MU, COLO, DUKE, F, FLAS, ILL & ILLS, LSU, MICH, MO, NY, PH, PTBG, TENN, UC, WIS, and YU) reported progress on digitization deliverables, with a total of 22,688 specimens barcoded (20,239 bryophytes and 2,449 lichens), 41,467 labels



imaged (32,687 bryophytes and 8,780 lichens), 36,027 specimens imaged (25,198 bryophytes and 10,829 lichens), 65,960 specimen records uploaded to the portal (59,250 bryophytes and 6,710 lichens), 24,588 skeletal records created (24,484 bryophytes and 104 lichens), 29,314 labels fully transcribed (17,293 bryophytes and 12,021 lichens), and 29,512 specimens georeferenced (16,071 bryophytes and 13,411 lichens) (See Table 1 & Figure 1).

PEN partner BISH reported their first project activity from September, with a total of 118 specimens barcoded, 118 labels imaged, 118 specimens imaged, 118 skeletal records created, and 118 labels fully transcribed (all bryophytes). PTBG will have their first numbers to report in the next quarter for October 2023.



Table 1: Digitization progress by GLOBAL collaborators in 2023-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						331								2
ASU		1,764		1,764	10	1,653	10	1,653						
BRY														
CINC & MU	4,727	1	2,850		2,850		4,727	1	4,573	1	209	1	758	1
COLO	5,385		5,385				5,385		5,385		62	1,166		
DUKE	1,589		1,843		263		2,898		2,235		35		2	
F	225	471	9,856	264	9,856	264			3,559		3,990	471		471
FLAS	100	100	1,910		1,910		1,910				1,877			
ILL & ILLS							37,889							
LSU	316	96	316	96	213		316	96	316	96	28	51	595	681
MICH	1,663		1,663		185		1,428		1,663		2,553	387	226	31
MIN														
MO	4,462		2,406		2,406				2,406		159		30	
MSC														
NY			20	5,570	20	5,570					2,324	8,940	448	2,863
OSC														
PH											318		126	
TENN	669	17	2,715	1,086	2,715	1,086	3,619	1,005	624	7	4,488	687	2,127	524
UC	150		2,770		2,770				2,770			318		
WIS	953		953		2,000	1,925	1,068	3,955	953				11,757	8,870
YU											1,250			
Totals	20,239	2,449	32,687	8,780	25,198	10,829	59,250	6,710	24,484	104	17,293	12,021	16,071	13,441
B+L Totals	22,688		41,467		36,027		65,960		24,588		29,314		29,512	

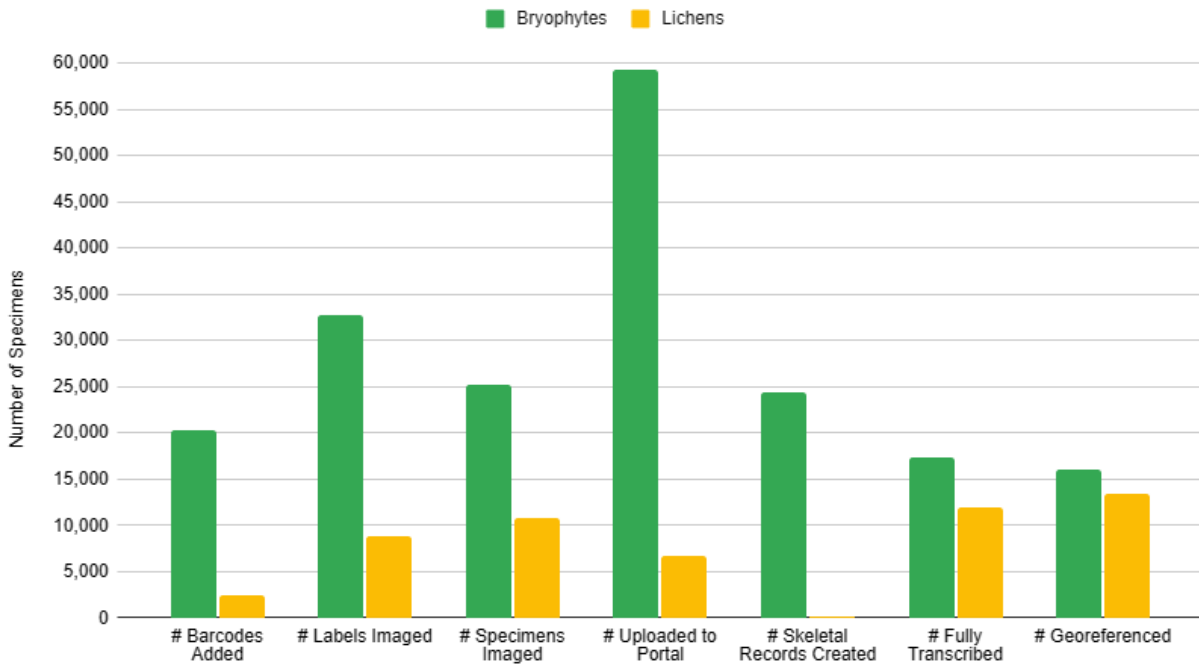


Figure 1: Digitization progress for the GLOBAL collaboration in 2023-Q3, separated by Bryophyte and Lichen specimens.

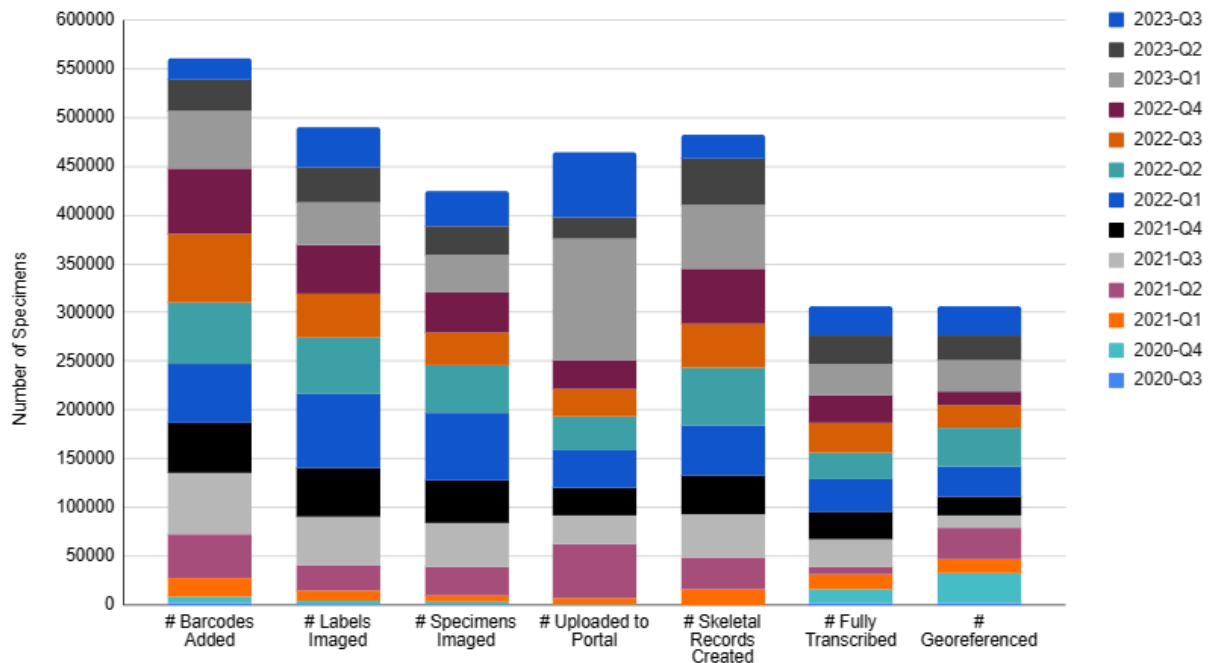


Figure 2: Cumulative digitization progress for the GLOBAL collaboration by quarter.



Share Best Practices, Standards, and Lessons Learned

Flexible Workflows

The GLOBAL teams continued to make use of flexible digitization workflows in 2023-Q3, including some use of virtual transcription work, while most collaborators were able to continue on-site work.

New PEN collaborator BISH ran through several scenarios in developing their protocol including how to deal with mixed collections collected in bulk and unsorted, bulk collections that have been sorted into several packets and collections where the material is so small that opening the packet could result in loss of the specimen. In the first two cases they will image the plant material removed from any packets and with all accompanying information clearly referencing the material contained within. In the third case they will not image the specimen, only the outside of the specimen packet.

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 will most likely retake the specimen images later in the project when we have a system in place for capturing better specimen images. They are planning to capture both packets and specimens for the bryophyte collection in the same pass using two separate cameras and will circle back for lichen specimen images. They are getting a start with the bryophyte collection using the same workflow as the lichens to maximize the number of labels in the system. They want to get as many transcribed records into the system as possible to give WIS specimens to georeferenced, and are targeting later this fall to make the switch. They have also been splitting digitization time between this project, the Southern Rocky Mountain and the All-Asia projects. They finished the Southern Rocky Mountain project in August and expect a return to better numbers once we have their new digitizers trained.

Indet Specimens

At LSU, they are now including bryophyte records that are species indets (only a genus is determined for the species). With these collections imaged, researchers will be able to locate the material, and receive dups for gift as determination if interested.



Georeferencing / Duplicate Matching

Georeferencing in CoGe continued across collections as records are transcribed. WIS has been able to use the History function in CoGe to easily and quickly capture duplicate localities for similar records. This was especially true for Japanese exsiccata. Because they do not have collection numbers, they cannot be linked in duplicate matching. They were able to use previously georeferenced records to quickly populate the coordinates in duplicate exsiccata across multiple collections.

Collaboration

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2023-Q3. New collaborators and students were given access to Basecamp group resources. The GLOBAL IT Team met in July to review the status of grant deliverables and discuss plans and priorities. The Outreach & Education Group met in September to be planning for the October WeDigBio event. A Management Committee Meeting was held in August open to all GLOBAL members to review progress from 2023-Q2 and Year 3, and to provide an open forum to the GLOBAL team.

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.

Share Identified Gaps in Digitization Areas and Technology

ILL's Philip Anders has been working to improve the initial features of the Symbtk: Symbiota toolkit. The current features of the toolkit provide specimen metadata exports for GenBank submissions, occurrence record, per collection, taxa coverage reporting, a web-based utility for large file uploads, and backup scheduling. A new Symbtk feature to provide a simple interface to manage both system, and user defined, image meta-data and tags, as well as reporting any orphaned media associations, is currently in development.



Share Opportunities to Enhance Training Efforts

The GLOBAL Project Manager (TENN) and Georeferencing Manager (WIS) continued compiling resources during 2023-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. More tutorials have been added to the Symbiota Documentation by the Symbiota Support Hub at <https://biokic.github.io/symbiota-docs/>.

In September, ASU's paper on how to manage large biodiversity inventories in a megadiverse country like Ecuador was published in [The Lichenologists](#). The publication discusses how Symbiota provides sophisticated tools to manage biodiversity data, such as occurrence records, a taxonomic thesaurus, and checklists. They use the [Checklist of Lichen-forming, Lichenicolous and Allied Fungi of Ecuador](#) as an example to discuss advantages and limitations of creating Symbiota Checklists versus traditional ways of compiling these lists. With this publication, we hope that tools available in Symbiota will be more widely adopted

At DUKE, three graduate students were trained in basic lichen herbarium curation, and one undergraduate student was trained in lichen collection and identification over Summer 2023. In addition, one undergraduate student received training in bryophyte herbarium curation, and two work-study students returned in the Fall semester to work on the project.

The team at F continues to train new volunteers, and four new interns from Roosevelt University that are working on aspects of the project half a day a week as part of their course requirements and curriculum.

UC trained three new undergraduate students in bryophyte digitization and imaging.

YU undergraduate students were trained in transcription of bryophyte and lichen specimens.

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

The team at ASU helped international institutions and collaborators continue to join the Consortium of Lichen Herbaria.



Collaboration between GLOBAL teams and other TCN projects occurring concurrently at their sites continued. CINC is also a member of the All-Asia TCN. The students work in the same space and regularly exchange tips and work together to improve workflows. COLO is also a member of the SoRo TCN and the All-Asia TCN and continued to share info and technology between projects to help optimize workflows. At MICH, ongoing collaboration continued between the All-Asia and GLOBAL TCNs, which share many resources 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.

TENN Project Manager participated in the quarterly iDigBio Stakeholder Engagement Meeting (Formerly Internal Advisory Committee Meeting) in August with other TCN participants.

The Hawaii PEN was officially approved by the NSF with a start date of September 1. New collaborators BISH and PTBG participated in a joint orientation meeting with the leadership of the TCN and separately met with their local partners to discuss the coordination of the outreach workshops that they will do as part of the grant deliverables.

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.

The Symbiota Support Hub team continues to work on strategies to use the new API to facilitate data queries across different Symbiota platforms. ASU student worker Ramisa Zaman (undergraduate student, computer science major) has expressed an interest in starting an internship in Java and C++ programming to develop a prototype for a cross platform search for ecological data analysis.

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.

All ILLS and ILL data are archived on mirrored servers at the University of Illinois.

Images are backed up on the LSU herbarium's local RAID drive and pushed to a herbarium server managed at the Frey Computing center on the LSU campus. A copy is archived in the cloud using LSU supported Box software. This process is semi-manual using a custom script to file images, create image derivatives, and produce portal mappings.

MICH's images are archived at the U-M Digital Library.

All MIN data is archived on servers at the Minnesota Supercomputing Institute.

TENN continues to back-up project images on external hard drives.

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.

Editing progressed for the GLOBAL educational videos that were filmed in May in conjunction with the team at ALA and F.

In November a virtual workshop on specimen management and the creation of checklists using the tools available in the Consortium of Lichen Herbaria will be held for the [International Association for Lichenology](#). For spring 2024, ASU is planning a virtual workshop at the Middle East Lichen Symposium, February 5-7, organized by Mohammad Sohrabi in Oman. With these initiatives they are hoping to extend international participation from regions that are currently underrepresented (e.g., Asia, Africa, the Middle East).

CINC gave tours of the herbarium to two classes with a total of 26 participants.



Lesson plans are being finalized by Field Museum educators. F has continued to do a number of tours, particularly to volunteers and interns from other areas throughout July and August.

At LSU, four herbarium tours were given, with 45 participants total. One herbarium outreach talk was given for the Discover Nature series at LSU's Hilltop Arboretum.

TENN continued hosting the GLOBAL weekly transcription event on Fridays during 2023-Q3. Five community science volunteers from two countries participated (US, Canada) and transcribed skeletal data for over 300 specimens. Volunteers were also able to see a number of "Specimen Spotlight" presentations on specimens and collectors compiled by the TENN GLOBAL Project Manager.

The TENN Herbarium hosted a "Specimens and Scones" open house in September for students, staff, and faculty on campus including tours of the herbarium.

UC led multiple Herbarium tours for members of the public as well as different classes on campus, including over 100 participants total.

WeDigBio

Six GLOBAL collaborators (COLO, DUKE, F, FLAS, LSU, and TENN) agreed to participate in the October 2023 WeDigBio. They held one WeDigBio Planning Meeting in September to discuss initial logistics. The dates and times were chosen and they began creating print, virtual, and social media advertising for the event. The GLOBAL project website was also updated for the event.

Share Information About Your Website and/or Portal Usage

The GLOBAL project website, <https://globaltcn.utk.edu>, was utilized by 185 users during 2023-Q3, including 22 from Europe, 19 from Asia, 5 from Oceania, 5 from South America, 3 from Central America, 2 from the Middle East, and 1 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. 64,613 users visited the Bryophyte Portal and 54,799 users visited the Lichen Portal during 2023-Q3 (see Figures 4 & 5).

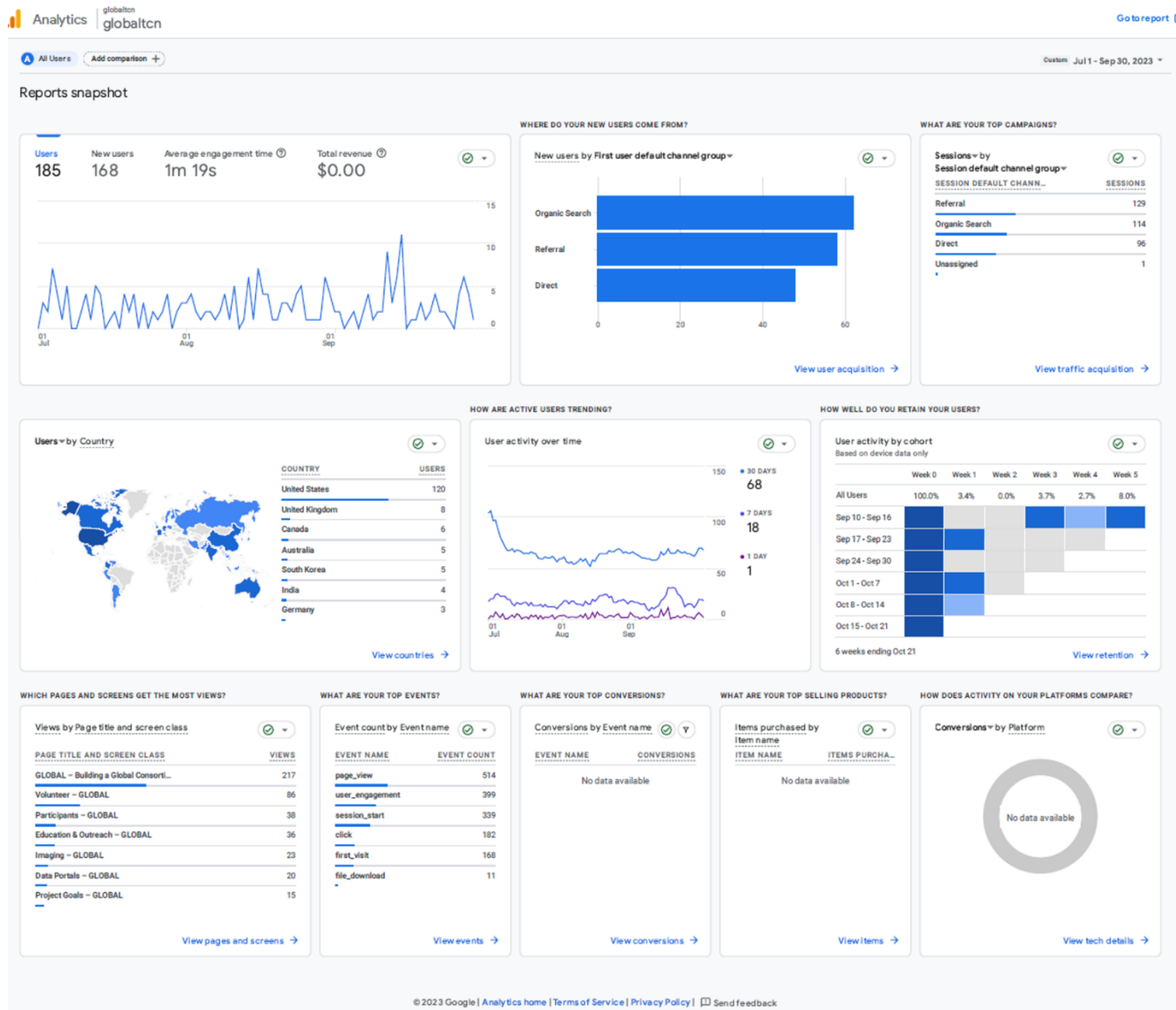


Figure 3: Use metrics for the GLOBAL project website (<https://globaltcn.utk.edu>) from July 1 – September 30, 2023.



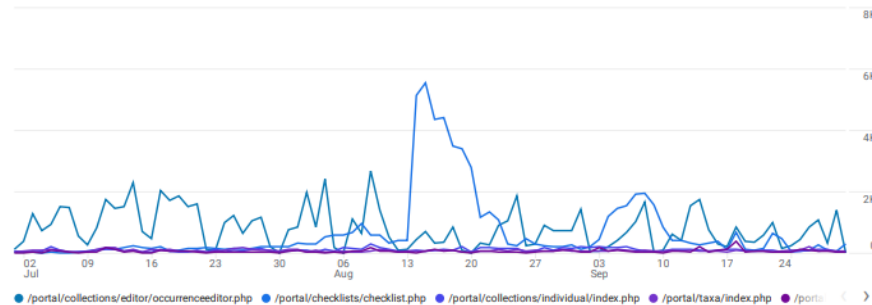
All Users | Add comparison

Custom Jul 1 - Sep 30, 2023

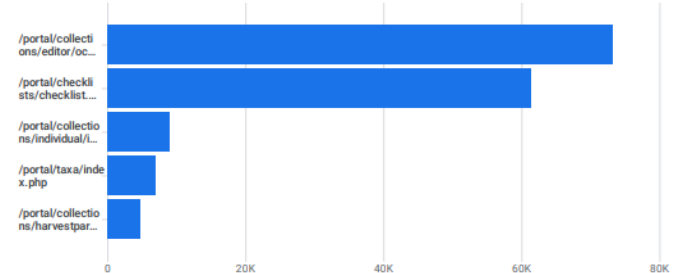
Pages and screens: Page path and screen class

Add filter

Views by Page path and screen class over time



Views by Page path and screen class



Search

Rows per page: 10 | Go to: 1 | 1-10 of 31

Page path and screen class	Views	Users	Views per user	Average engagement time	Event count	Conversions	Total revenue
	175,771 100% of total	64,613 100% of total	2.72 Avg 0%	1m 02s Avg 0%	426,238 100% of total	0.00	\$0.00
1 /portal/collections/editor/occurrenceeditor.php	73,115	267	273.84	3h 14m	145,233	0.00	\$0.00
2 /portal/checklists/checklist.php	61,262	59,987	1.02	0m 02s	189,894	0.00	\$0.00
3 /portal/collections/individual/index.php	8,889	1,293	6.87	1m 30s	18,260	0.00	\$0.00
4 /portal/taxa/index.php	6,850	2,004	3.42	1m 00s	16,518	0.00	\$0.00
5 /portal/collections/harvestparams.php	4,791	439	10.91	2m 45s	9,752	0.00	\$0.00
6 /portal/collections/list.php	4,550	445	10.22	6m 12s	9,219	0.00	\$0.00
7 /portal/	4,188	1,282	3.27	0m 35s	11,530	0.00	\$0.00
8 /portal/collections/map/index.php	2,474	209	11.84	7m 42s	5,134	0.00	\$0.00
9 /portal/collections/index.php	2,404	547	4.39	0m 41s	4,967	0.00	\$0.00
10 /portal/index.php	2,064	480	4.30	0m 43s	4,495	0.00	\$0.00

Figure 4: Use metrics for the Bryophyte Portal (<https://bryophyteportal.org/portal/>) from July 1 – September 30, 2023.



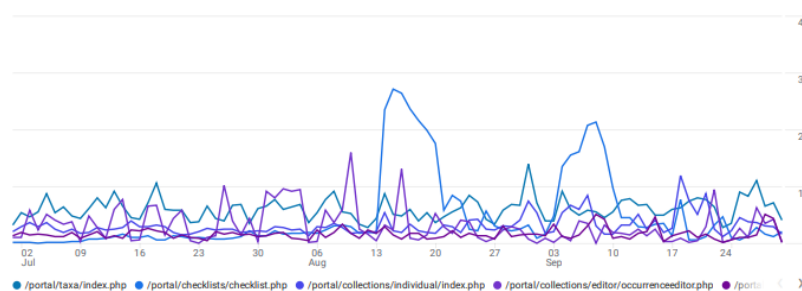
All Users Add comparison

Custom Jul 1 - Sep 30, 2023

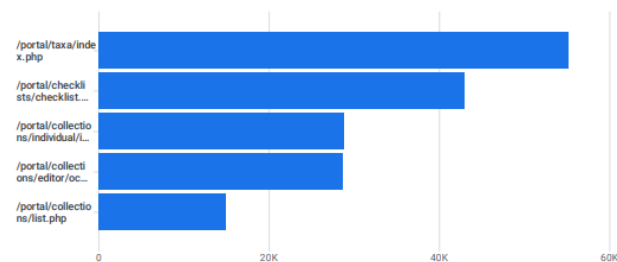
Pages and screens: Page path and screen class

Add filter

Views by Page path and screen class over time



Views by Page path and screen class



Q Search...

Rows per page: 10 Go to: 1 < 1-10 of 38 >

Page path and screen class	Views	Users	Views per user	Average engagement time	Event count	Conversions	Total revenue
	221,128 100% of total	54,799 100% of total	4.04 Avg 0%	1m 20s Avg 0%	507,103 100% of total	0.00	\$0.00
1 /portal/taxa/index.php	55,210	10,700	5.16	2m 40s	130,007	0.00	\$0.00
2 /portal/checklists/checklist.php	42,911	41,513	1.03	0m 02s	127,505	0.00	\$0.00
3 /portal/collections/individual/index.php	28,754	3,116	9.23	1m 24s	56,858	0.00	\$0.00
4 /portal/collections/editor/occurrenceeditor.php	28,640	106	270.19	2h 45m	55,910	0.00	\$0.00
5 /portal/collections/list.php	14,930	770	19.39	9m 10s	29,108	0.00	\$0.00
6 /portal/collections/harvestparams.php	13,174	650	20.27	5m 20s	26,489	0.00	\$0.00
7 /portal/collections/index.php	8,191	958	8.55	0m 53s	16,595	0.00	\$0.00
8 /portal/index.php	6,823	903	7.56	1m 40s	14,310	0.00	\$0.00
9 /portal/	6,133	1,838	3.34	0m 37s	16,162	0.00	\$0.00
10 /portal/imagelib/imgdetails.php	3,054	1,136	2.69	0m 20s	5,906	0.00	\$0.00

Figure 5: Use metrics for the Lichen Portal (<https://lichenportal.org/cnalh/>) from July 1- September 30, 2023.



Share Other Activities and/or Progress

Image Tagging

Progress continued at ASU on character revision for tagging and identification keys and the [glossary](#).

Increased Specimen Deposits at BISH

Word has gotten out that BISH has an interest in Bryophytes and Lichens. Partially as a result of workshops they held earlier this year and in 2021 and partially due to the announcement of this PEN grant, the number of lichen and bryophyte specimens coming in to the herbarium from collectors has increased by a large magnitude.

Annual Reporting

GLOBAL Project Manager helped all teams with Annual NSF Reporting and completed the Integrated Annual Report for Year 3.

No-Cost Extensions

All Main-Award GLOBAL Collaborators requested No Cost Extensions to continue GLOBAL work that was delayed by COVID into Year 4. The GLOBAL Project Manager updated the reporting sheets to include the additional time period. She also transitioned to a part-time work schedule starting in September. This will allow her to stay on the project and support coordination and reporting activities longer throughout the extension period.