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On Enabling Fast and Secure Access to Herbarium Specimen Images

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Abstract

Access to Natural History Collections helps researchers to better understand the natural world. Millions of digital images of herbarium specimen are openly available via the Internet. However, using these images in a research project can be cumbersome, because they are hard to access, difficult to cite, and complicated to compile into datasets. Here, we use Preston, a biodiversity data tracker, and rsync, a file-copying tool, to enable fast and secure access to hundreds of thousands of digital herbarium images from the Botanical Research Institute of Texas.

Introduction

This experimental data paper describes a method to facilitate fast and secure use of herbarium specimen records and associated images of the Botanical Research Institute Texas.

Tracking Herbarium Images

Preston ([Elliott 2020](#)) ([Elliott 2022](#)) ([Jorrit Poelen 2022](#)) was used to index 825,877 image urls published across three BRIT related to DwC-A records using:

```
# lists image urls after tracking dwca archives
preston track https://sernecportal.org/portal/content/dwca/VDB_DwC-A.zip \
https://sernecportal.org/portal/content/dwca/NLU_DwC-A.zip \
https://portal.torcherbaria.org/portal/content/dwca/BRIT_DwC-A.zip \
| preston dwc-stream \
| grep URI \
| jq --raw-output '."[http://rs.tdwg.org/ac/terms/accessURI" | "http://rs.tdwg.org/ac/terms/thumbna
ilAccessURI" | "http://rs.tdwg.org/ac/terms/goodQualityAccessURI"]' \
| gzip \
> image-urls.tsv.gz
# list image urls and track them
cat image-urls.tsv.gz | gunzip | xargs -L25 preston track
```

The associated digital images were discovered and retrieved using a server in a data center in Germany on a ~ 1Gb connection in period 2022-06-06 to 2022-07-26.

```
# calculate start time
preston history | head -n1 | preston cat | grep -o -P "2022-[0-9]{2}-[0-9]{2}T.*Z" | sort | uniq | head -n1
2022-06-06T17:02:10.924Z
```

```
# calculate end time
$ preston history --data-dir $PWD | tail -n1 | preston cat --data-dir $PWD | grep -o -P "2022-[0-9]{2}-[0-9]{2}T.*Z" | sort | uniq | head -n1
2022-07-26T16:47:05.428Z
```

So, it took about 1 month and 20 days to access and retrieve the BRIT images. This translates to a sustained image transfer rate of about 0.2 images/s or 1 image per 5 seconds.

Example Image

An example of a tracked image shown below was extracted using:

```
# list the first tracked image url
$ preston ls -l tsv\
| grep hasVersion\
| grep -v "well-known"\
| grep -v "zip"\
| head -n1
https://bisque.cyverse.org/image_service/image/00-Bu6svkTKkNx5hdB8niSokV/resize:1250/format:jpeg
http://purl.org/pav/hasVersion hash://sha256/a3e5efcd9905154afea689e7e3c2756521d51265378118a66027c
77eba35e06 urn:uuid:063c8cb0-b0b7-469e-a9b8-65e99803ad54

# and retrieve their associated content via their content id
$ preston cat --remote https://linker.bio hash://sha256/a3e5efcd9905154afea689e7e3c2756521d51265378
118a66027c77eba35e06 > BRIT67501.jpg
```

**Fig. 1**

Specimen BRIT67501 *Dicliptera brachiata* Spreng. Collected on 1967-09-28 by R. Kral, Vanderbilt University Herbarium (VDB) CC BY-NC hash://sha256/a3e5efcd9905154afea689e7e3c2756521d51265378118a66027c77eba35e06

with the caption text derived from the associated tracked metadata:

```
preston ls\
| grep hasVersion\
| grep zip\
| preston dwc-stream\
```

```
| grep "https://bisque.cyverse.org/image_service/image/00-Bu6svkTKkNx5hdB8niSokV/resize:1250/forma
t.jpeg"\|
| jq .
{
  "http://www.w3.org/ns/prov#wasDerivedFrom": "line:zip:hash://sha256/371984ca4566b7b6bc760d0766873b
469e12af2d87ce9218f1da888a1b4c3948!/multimedia.csv!/L2",
  "http://www.w3.org/1999/02/22-rdf-syntax-ns#type": "http://rs.tdwg.org/ac/terms/Multimedia",
  "http://rs.tdwg.org/dwc/text/coreid": "6816308",
  "http://ns.adobe.com/xap/1.0/rights/Owner": "Vanderbilt University Herbarium (VDB)",
  "http://ns.adobe.com/xap/1.0/MetadataDate": "2018-02-02 11:58:22",
  "http://ns.adobe.com/xap/1.0/rights/WebStatement": "http://creativecommons.org/licenses/by-nc/3.
0/",
  "http://purl.org/dc/terms/type": "StillImage",
  "http://rs.tdwg.org/ac/terms/associatedSpecimenReference": "https://sernecportal.org/portal/collec
tions/individual/index.php?occid=6816308",
  "http://rs.tdwg.org/ac/terms/subtype": "Photograph",
  "http://rs.tdwg.org/ac/terms/caption": null,
  "http://rs.tdwg.org/ac/terms/thumbnaillAccessURI": "https://bisque.cyverse.org/image_service/image/
00-Bu6svkTKkNx5hdB8niSokV/thumbnaill:200,200",
  "http://purl.org/dc/terms/format": "image/jpeg",
  "http://rs.tdwg.org/ac/terms/comments": null,
  "http://rs.tdwg.org/ac/terms/providerManagedID": "urn:uuid:36fd1d6c-3a2b-4cc0-b640-e93c2b400a01",
  "http://rs.tdwg.org/ac/terms/accessURI": "https://bisque.cyverse.org/image_service/image/00-Bu6svk
TKkNx5hdB8niSokV/resize:4000/format:jpeg",
  "http://rs.tdwg.org/ac/terms/goodQualityAccessURI": "https://bisque.cyverse.org/image_service/imag
e/00-Bu6svkTKkNx5hdB8niSokV/resize:1250/format:jpeg",
  "http://purl.org/dc/elements/1.1/creator": null,
  "http://ns.adobe.com/xap/1.0/rights/UsageTerms": "CC BY-NC (Attribution-Non-Commercial)",
  "http://rs.tdwg.org/ac/terms/metadataLanguage": "en",
  "http://purl.org/dc/terms/identifier": "https://bisque.cyverse.org/image_service/image/00-Bu6svkTK
kNx5hdB8niSokV/resize:4000/format:jpeg",
  "http://purl.org/dc/terms/rights": null
}
```

Image Origins

For this corpus, the following servers were queried for reported image urls:

```
$ preston ls --data-dir $PWD -l tsv | grep hasVersion | sed 's+https://++g' | cut -f1 | sed 's+.*
++g' | sort | uniq -c | sort -nr
596759 bisque.cyverse.org
220278 web.corral.tacc.utexas.edu
  7537 api.idigbio.org
   942 portal.torcherbaria.org
   410 storage.idigbio.org
   252 sernecportal.org
    30 static.inaturalist.org
    10 urn:null
     4 inaturalist-open-data.s3.amazonaws.com
```

Images Not Found

Preston reports non-responsive URLs as skolemized blanks ([RDF 1.1 Concepts and ...](#)).

Using this labeling of non-responsible image URLs, the following servers produced non-responsive URLs:

```
$ preston ls -l tsv\
| grep hasVersion\
| grep ".well-known/genid"\
| sed 's+https://++g'\
| cut -f1\
| sed 's+/.*++g'\
| sort\
| uniq -c\
| sort -nr
 98 web.corral.tacc.utexas.edu
 55 bisque.cyverse.org
 10 urn:null
   3 portal.torcherbaria.org
```

156 image locations appeared to yield no content on tracking them a first time [2 \(when indexing all of ...\)](#) hinting at intermittent access issues.

On retrying the inaccessible content locations, only 33 remained inaccessible [3](#), hinting at possible permanent access issues.

Data Transfer from Germany to US

The BRIT images were originally tracked from Germany on a commercial "off-the-shelf" server.

After receiving blank storage hardware [\(3\)](#), the BRIT image corpus

hash://sha256/76d40abccfc71bc2cdaf4ea4a6003b9ac49123b27abe9f0d81e233299baf5e94 ([Botanical Research In...](#))

was transferred from Germany to Minnesota, US on 5 Sept 2022 onto a USB 3.0 Seagate Expansion HDD 18TB

STKP180000402 PN 3EGAPR-570 connected using a Lenovo T430 running Ubuntu Ubuntu 20.04.5 LTS using Intel® Core™ i5-3320M CPU @ 2.60GHz × 4 and 8GB of memory. The corpus spanned over 900k files / 309GB and was transferred in about 21h (see below for details) via a consumer grade fiber internet connection.

A total of 902626 files were received.

```
# count number of files in data folder
$ find data/ -type f | wc -l
902626
```

Also, the *rsync* logs below captured the transfer statistics, indicating the transfer rate and total volume.

```
[...]
data/ff/ff/ffffe29becf0e65f3c32f9bb53f18f418fc0e6ff432ab1b2176bad560930be99
      358,999 100%    2.18MB/s    0:00:00 (xfr#902621, to-chk=2/968416)
data/ff/ff/ffffe5eedcebb869f14ecf6cce5b5fceae629ae363ce833431bba46a19f8eb6c8
      78 100%    0.49kB/s    0:00:00 (xfr#902622, to-chk=1/968416)
data/ff/ff/fffff8aa693c59e91b94e4de61d7ce035c69c94077ccf158e3d23a0a039216f
      383,141 100%    2.12MB/s    0:00:00 (xfr#902623, to-chk=0/968416)

sent 17,752,067 bytes  received 329,479,912,584 bytes  4,412,629.51 bytes/sec
total size is 329,293,755,413  speedup is 1.00
```

Finally, the *time* program recorded and logged the duration of the transfer.

```
real   1244m30.854s
user   98m36.885s
sys    55m19.359s
```

Local Verification and Duplication

After receiving the corpus in Minnesota, the content was duplicated locally to a WD Elements 5TB PN WDBU6Y0050BBK-XD. The *rsync* local replication took a little over an hour (~81 minutes), and the Preston-based verification took under 7 hours (322 minutes). The verification checks the local copy and verifies whether the reference content is actually present and has the expected content. Content verification is a computationally heavy operation because hundreds of thousands of files are processed and their cryptographic hashes are re-computed. The verification reported no missing or altered content.

Transfer by USPS

To demonstrate that the image corpus can be transferred without using the internet, the Seagate Expansion HDD 18TB containing the BRIT image corpus copy was labeled and shipped by US Postal Service on Friday, 16 Sept 2022 at 13:05 local time in Minneapolis, Minnesota, and received in Fort Worth, Texas on Monday, 19 Sept 2022 at 12:50 local time. Note that the three day transfer time included a weekend.

Data

method	duration	rate (image/s)
HTTP/GET	two months	<1
rsync via internet	about a day	10
rsync via USB 3.0	about an hour	250
US Postal Service	three days	3

Table 1

Image transfer rates for (a) HTTP/GET using image record URLs, (b) rsync via internet from Germany to Minnesota, USA, (c) local rsync via USB 3.0 using a Lenovo T430 Laptop, and (d) shipping digital content on an external hard disk using US Postal Service. (a)-(d) applied to the same image corpus ([\[Origins of BRIT coll...\]](#)).

Conclusion

In period 2022-06/2022-07, images related to three herbarium collections managed by Botanical Research Institute of Texas spanned across primarily two resource locations: (1) bisque.cyverse.org and (2) web.corral.tacc.utexas.edu . The results show that the referenced specimen images were (mostly) successfully transferred (transfer A) in about 2 months at a sustained rate of about 1 image per 5 seconds. A similar transatlantic transfer (transfer B) of this image collection was

performed using rsync in 21 hours, showing that transfer B was about 60x more efficient in transferring >800k images than transfer A. Repeating a similar transfer (transfer C) locally took a little over an hour, yielded another order of magnitude in transfer speed improvement, suggesting that the network, not local I/O nor computation, in transfer B was the primary bottleneck compared to transfer C.

Finally, the data was transferred on an external harddisk using the US Postal Service from Minnesota to Texas using Priority Mail (transfer D). Given that this transfer takes less than two months, this transfer will be faster than transfer A.

Discussion

The results suggest that (a) keeping local copy of an image corpus are expected to increase image access speeds by orders of magnitude, (b) BRIT current image access services are optimized for viewing individual images manually, (c) Preston can be used to make identical copies of image corpora of known provenance (or origin) while allowing for verification of the authenticity of the referenced image corpus, and (d) Preston can be used to securely cite a corpus of hundreds of thousands of images in a single line ([Elliott 2022](#)), and, in addition, a QR code can be generated from the citation to further facilitate the access to the image corpus [2](#).



Fig. 2

Label with QR Code that uniquely identifies the Botanical Research Institute of Texas image corpus as tracked in period 2022-06/2022-07 ([Botanical Research In...](#))

Optimizing Image Access

Choosing the image retrieval methods depends on how the images are used. Our results suggest that using the existing method (i.e., http/get) may be suitable for manual view of individual images in web pages.

However, for cases that require long term archives, or repeatable processing of hundreds of thousands of images, other methods may be more suited.

For instance, in cases where internet access is limited, using conventional mail (aka snailmail) to send physical storage media (e.g., hard disk) with a cloned, and clearly labeled, image corpus may provide fast offline, access. However, currently, more skills (e.g., computer programming, familiarity with linux command-line tools) may be needed to access and process the images. And, additional education and tool development may further facilitate (image) access.

Alternatively, in cases when fast internet access and storage capacity is available, packaging the image corpus using content-based identifiers (e.g., sha256 hash) instead of location-based identifiers (e.g., URLs) may help to dramatically speed up the image access speeds through parallel process, and opening up the ability to keep (local) redundant copies.

Finally, reproducible scientific research workflows need to allow for independent archiving, citing, and authentication, of an image corpus. Rather than requiring providing institutions to keep their image URLs responsive and stable, our content-based tracking method allows for image corpora to be cited, found, and retrieved from current and future digital archives.

Over the last decades, millions of dollars have been invested in digitizing existing collections. We showed that these access to these digital collections can be improved by re-using readily available tools like rsync and Preston. By combining existing infrastructures with these tools, we expect to significantly increase processing speeds of image corpora to help facilitate re-use of these valuable images at scale.

Appendix A

Data

https://bisque.cyverse.org/image_service/image/00-fXkw8KPeArtBjNrpPHtvTU/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-cXkjNdUW9rKCE8etGzpHtg/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-intt3JyJUMbaF3FBJZtKhc/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-d3bwMyyiXEQHApGbt6LxF/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-a6d7xZ2uPa9Kbsfr8cEpBm/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-RjMY6zZ1s3JdapmTuuf6L/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-C4CNLCZD46aJZmcxx4rm2i/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-3TJvfeyG9D8wtKSTkZa8AG/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-F7jtcCZ9oBA3j2YnwbmKrH/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-g96HN5fQsJnEoBLbhwg8Le/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-iyKdXjKoQTgXy9iZxeEQDM/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-6GjTcou77eDxdcixkGt9c/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-tX6XLpXivgF6t9jkesZ38F/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-CzChz3A6abzTwB9zCeRZCi/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-QoCbePYv8BYX3JbYDWavdR/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-9otLzbWx7KMyeCGqJu9Fg8/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-ie3faMpL5fmZZGmW6dfyyf?resize=1250&format=jpeg
https://bisque.cyverse.org/image_service/image/00-PSmXxi7JywUxnFbmfcAF2e?resize=1250&format=jpeg
https://bisque.cyverse.org/image_service/image/00-GYe8bJ3z7KozDsJqbzfVVZ?resize=1250&format=jpeg
https://bisque.cyverse.org/image_service/image/00-T88aXALn5zsWPhaP6DvEKd/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-gdGPD7Xmo9NoqSDKXszgN/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-N4VHTti4mToXwCcJXHHQnB/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-iX4e3Cck6qDU4npjabyE39/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-MAGixLashpnatT3B9DDlb/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-jt29JHUMYHVZBdMwX8YEjf/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-cGNuk7rjCFQJwRwkEre4zg/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-2wXBZEQdEsFwamBV2SLfPZ/resize:1250/format:jpeg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0509000/BRIT509186_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0557000/BRIT557009_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0502000/BRIT502367_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0502000/BRIT502116_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0502000/BRIT502415_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0502000/BRIT502258_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0502000/BRIT502460_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0502000/BRIT502086_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT545461_med.jpg

https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0547000/BRIT547289_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0536000/BRIT536480_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0537000/BRIT537103_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0240000/BRIT240966_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0537000/BRIT537135_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0537000/BRIT537131_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0539000/BRIT539156_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0539000/BRIT539158_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0539000/BRIT539144_med.jpg
https://web.corral.tacc.utexas.edu/torch/BRIT/BRIT0539000/BRIT539136_med.ina

Table 2

156 image URLs failing to produce content on first attempt

Appendix B

Data

https://bisque.cyverse.org/image_service/image/00-7J9FqXFGUzAyrVZbgJJoGG/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-anTuWfwkPTuFCGbS4QVpgT/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-bd6zjsQ5MUErQZS9M5r8M/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-bedLvssypaWBZSXxH7xkkc/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-bP7yMwFuoJqkHLXgVxpmb8/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-dfdfCUqfDWiKywrvcXaEkWY/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-dguyqrpa3MhC4mFQAvffiE/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-drdu6yfv2iMHEScNCnauC/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-fzaczeURipNgfB5ATsN9jX/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-gdGPD7Xmo9NoqSDKXszgN/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-iX4e3CcK6qDU4npjabyE39/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-jt29JHUMYHVZBdMwX8YEjf/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-JTMsT2xqjGtEkRJ2XTUnf8/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-K6MzoZ5CzDCjkYNrToQVCT/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-KFQVR865F2tCnmFuFE2Sfc/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-Kknpm4havinGzqosXCiy84/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-kTVY9mVbNbMmJ9m6sEa6ei/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-MAGixLashpnatT3B9DDLb/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-mDazNumFjZw6UcTadscLnF/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-N4VHTti4mToXwCcJXHHQnB/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-NNbUnwSApdKpwV88jya73Q/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-NseahVLc4aigczTwhpx38/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-Q8wQTFuJfBGKFXHQRjfSca/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-rB3x6s6GiQDf3zM39XWbte/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-Va4gmxfFrMyhNGahaDBrZe/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-Vg77D6CrcTp2M3bM5q2WbP/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-wmVFuTzpyNtMqiGZrbp2GZ/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-wQhG7Kwjx7bfici3xgnDxG/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-Y4gyWqVBAWTjQxvijXmXxC/resize:1250/format:jpeg
https://bisque.cyverse.org/image_service/image/00-zEx63i64ZvuGotD3whiFFT/resize:1250/format:jpeg
https://portal.torcherbaria.org/imglib/seinet/torch/BRIT/202006/field_madder-6270273_1593287703.jpg
https://portal.torcherbaria.org/imglib/seinet/torch/BRIT/202007/scf_35-2_1595371669.jpg
https://portal.torcherbaria.org/imglib/seinet/torch/BRIT/202010/IMG_0846_1601579155.jpg

Table 3

33 image URLs failing to reproduce content after second attempt.

Appendix C

Photos of the various transfer methods as they happened.



Fig. 3

Storage media received by mail on 2022-09-04

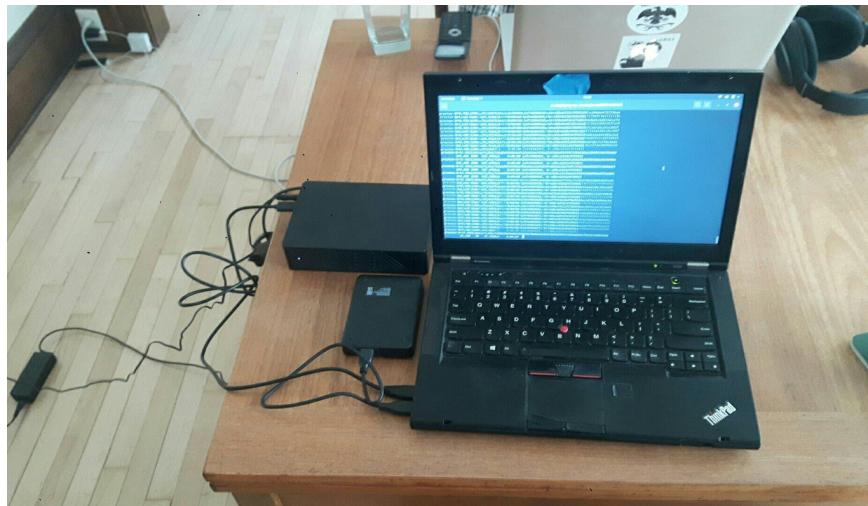


Fig. 4

Local rsync transfer between external hard disks via a Lenovo T430 laptop.



Fig. 5

Hard disk labeled with QR Code of corpus content id and other metadata.

**Fig. 6**

USPS Drop-off Receipt Friday, 16 Sept 2022.

Fwd: USPS® Item Delivered, Front Desk/Reception/Mail Room 9405803699300813415091

Subject: Fwd: USPS® Item Delivered, Front Desk/Reception/Mail Room
9405803699300813415091
From: Jason Best <jbest@brit.org>
Date: 9/19/22, 16:20
To: Jorrit Poelen <jhpoelen@jhpoelen.nl>

Jorrit,
I have the drive and data now! Below is the delivery notice so we can use that to stop
the timer on the delivery speed of a physical drive vs. download of image data. I'll take
a look at the data more over the next few days and will also look at the article draft
you shared with me.

Thanks!

Jason Best
Director of Biodiversity Informatics
Fort Worth Botanic Garden | Botanical Research Institute of Texas
1700 University Drive
Fort Worth, Texas 76107

817-332-4441 ext. 230
<http://www.fwbg.org>

Begin forwarded message:

From: auto-reply@usps.com
Subject: USPS® Item Delivered, Front Desk/Reception/Mail Room
9405803699300813415091
Date: September 19, 2022 at 12:54:53 PM CDT
To: jbest@brit.org

[USPS Logo](#)

Hello **JORRIT POELEN**,

Your item was delivered to the front desk,
reception area, or mail room at 12:50 pm on
September 19, 2022 in FORT WORTH, TX
76107.

Tracking
Number: **[9405803699300813415091](#)**

1 of 2

9/19/22, 16:24

Fig. 7

Receipt confirmation on Monday, 19 Sept 2022 by USPS and co-author Jason Best.

**Fig. 8**

Transfer of corpus from external hard disk to network storage on 19 Sept 2022.

References

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