

# SYNTHESYS<sup>+</sup>

Synthesis of Systematic Resources

a DiSSCo project

**[Deliverable 7.2: Data pipelines + standard workflows, enabling online access to complex digital content (3D scans)]**

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## Table of content

---

Summary	2
Workflows for online access of micro-CT data - HCMR	3
Workflows for online access of digital content using several imaging techniques - RBINS	7
Workflows for online access of digital content using several imaging techniques - RMCA	13
Workflows for online access of digitised microscope slides - RGBK	16
Workflows for online access of digital specimens - MNCN-CSIC	23
Workflows for online access of digitised content - NHMW	25
Workflows for online access of digital content of MNHN	33
Future developments	41
References	42
List of figures	42

## Summary

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The data pipelines and standard workflows developed by the participating institutes in JRA2 (WP7 – Task 7.2), namely HCMR, RBINS, RMCA, CSIC, RGBK, NHMW and MNHN, are presented in this Deliverable.

These data pipelines and workflows have been developed in order to enable online access to complex digital content.

- HCMR has developed workflows for accessing micro-CT datasets through a web based application.
- RBINS and RMCA have provided workflows for accessing datasets derived by several imaging techniques (micro-CT, surface scanning, photogrammetry, photo-stacking, multispectral imaging).
- CSIC has developed workflows for accessing microscope slides, 2D and 3D images and related data.
- RGBK has developed workflows for accessing microscope slides, 2D and 3D imaging
- NHMW has developed workflows for accessing 2D, 2D+ and 3D objects.
- MNHN has developed workflows for accessing 2D, 2D+ and 3D objects.



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## Workflows for online access of micro-CT data - HCMR

The [Micro-CT vLab](#) is a virtual laboratory which is hosted in the Hellenic Centre for Marine Research (HCMR) and was developed during the ESFRI LifeWatchGreece Research Infrastructure. This tool offers free access for the users to the virtual image galleries of various taxa which can be displayed and downloaded through a web application. With a few clicks, accurate, detailed and three dimensional models of species can be studied and virtually dissected without destroying the actual specimen.

Specifically, by the selection of a micro-CT dataset, the user has the ability to display the dataset details in four tabs, featuring:

- an overview page in which a short description of the micro-CT dataset accompanying by micro-CT images are displayed;
- an interactive tool for manipulating the 3D representation (specimen rotation, change opacity and thresholding parameters, colour the specimen) using the [Slice:Drop](#) software;
- a preview video and
- metadata for the dataset.

All the features available in the micro-CT vLab are presented in Figure 1.

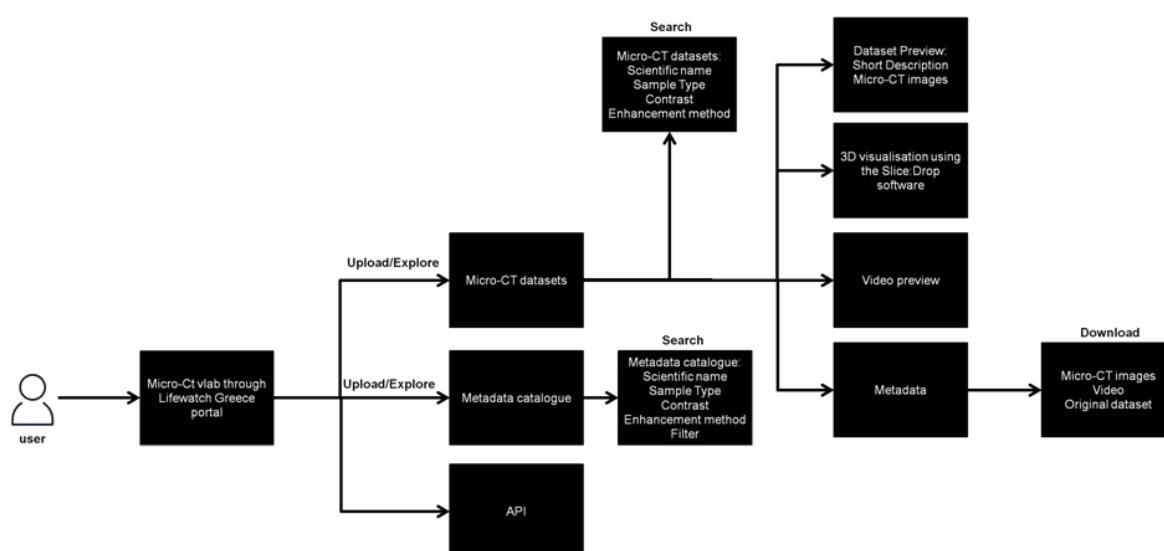
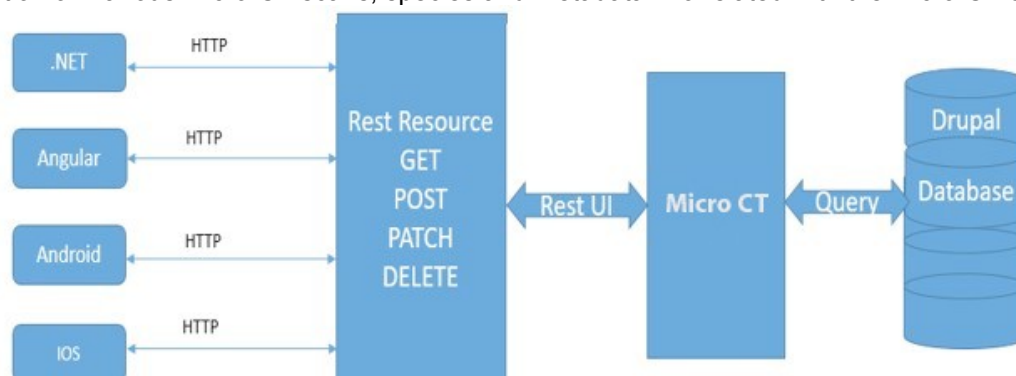


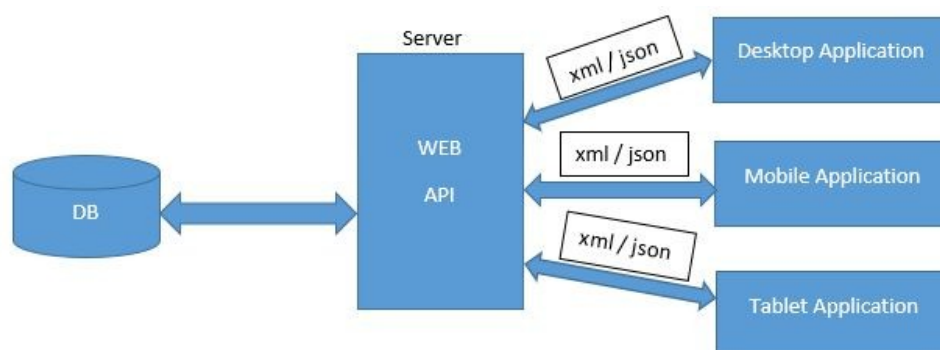
Figure 1. Micro-CT<sub>vlab</sub> workflow

The micro-CT vLab has also a REST API for getting and creating new content. Specifically, through the API, the user has the ability to access micro-CT API endpoints (Figure 2), which can get information on various micro-CT scans, species and metadata info related with the micro-CT datasets.



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**Figure 2.** Micro-CT rest API endpoints

During SYNTHESYS+ project, a metadata catalogue was created in order to dynamically display the complete metadata available for each dataset published in the micro-CT vLab (Figure 3). Each metadata field contains a detailed info point for its description. Furthermore, in the metadata catalogue, the user has the ability to download the related micro-CT images, video and the full dataset. The detailed metadata terms are presented in Table 1.

**Table 1.** The detailed Metadata terms with the info point explanation as they appear in the extended view of the micro-CT vLab

Metadata term	Info point explanation
Specimen ID	A unique identifier for the specimen in the format mCT-xxxxx (where x = incrementing number from 00001 to 99999, with preceding zeros)
Scan ID	A unique code of the format scan-xxxxx (where x = incrementing number from 00001 to 99999, with preceding zeros)
Sample Category	The category to which the specimen belongs to e.g. Zoology, Botany
Scientific name	The lowest taxonomic name to which the specimen has been identified
Taxonomic Group	The general taxonomic group to which the specimen belongs to, e.g. Polychaeta, Insecta etc
Specimen Description	A verbatim description of the specimen, which allows to understand the nature of the specimen at a glance
Provider Institute	Institution which provided the specimen
Specimen Provider	Person who provided the specimen
Material	The material of the scanned sample e.g. soft tissue
Fixation Type	Original fixation type of the specimen e.g. formalin
Preservation Medium	Preservation medium of the specimen e.g. ethanol
Contrast Enhancement Method	Short name of the chemical used e.g. PTA
Scope of Scan	Aim of scan



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Scan date	Start date of the scanning in the format MM/DD/YYYY
Scanned By	The person who performed the scan
Sample Holder	A description of the sample holder e.g. pipette tip
Scanning Medium	The medium that surrounds the sample during scanning e.g. air, ethanol
Scanned Part	Part of the specimen that has been scanned e.g. anterior part, full specimen
Digital Device Type	The brand (manufacturer) of the Digital Device that was used for the scanning
Voltage kV	The voltage in kilovolt (kV)
Current uA	The current in $\mu$ Ampere
Filter	The type of the filter that is used for scanning e.g. Aluminium
Zoom (um)	The resolution of the scan in $\mu$ m (zoom level) e.g. 1.24
Camera Resolution	Camera resolution settings in pixels e.g. 4000
Exposure Time (ms)	The exposure time in milliseconds used for scanning
360°	360° or 180° rotation scan
Random Movement	Random movement value
Averaging	Frame averaging value
Oversize Settings	The number of oversize parts (vertical & horizontal) used for scanning
Dataset	Download the dataset (nifti format)
Micro-CT Images	Download the micro-CT images (jpg format) available for this dataset
Video File	Download the micro-CT video (mp4 format) available for this dataset

A search function is also available which enables the user to search through the micro-CT metadata by e.g. scientific name, contrast enhancement method, sample type and filter used during the scanning acquisition. Furthermore, the user has the ability to upload a micro-CT dataset and the related metadata through a user-friendly form (Figure 4).



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**MICRO-CT vLAB** SAMPLE TYPE API METADATA ABOUT OUR APP SEARCH CONTACT

### Hexaplex trunculus in warm and acidified conditions

View Edit Delete

Sample Category: Zoology / Mollusca / Gastropoda / Neogastropoda

General Info 3D Visualization Video Metadata

Show less metadata

**SpecimenID :** mCT-01133  
**ScanID :** scan-01433  
**Sample Category :** Zoology / Mollusca / Gastropoda / Neogastropoda  
**Scientific Name :** Hexaplex trunculus  
**Taxonomic Group :** GASTEROPODA  
**Specimen Description :** gastropod after 1y in treatment  
**Provider Institute :** HCMR  
**Specimen Provider :** Eva Chatziniolaou  
**Material :** hard tissue  
**Fixation Type :** none  
**Preservation Medium :** Freezer  
**Contrast Enhancement Method :** None  
**Scope of Scan :** acidification in gastropods (ECCO)  
**Scan Date :** 03/04/2021  
**Scanned By :** Eva Chatziniolaou  
**Sample Holder :** styrofoam  
**Scanning Medium :** air wrapped in paper  
**Scanned Part :** whole sample  
**Digital Device Type :** SkyScan 1172  
**Voltage kV :** 100  
**Current uA :** 100  
**Filter :** Aluminium + Copper  
**Zoom um :** 13.79  
**Camera Resolution :** 2000  
**ExposureTime (ms) :** 2480  
**360 :** 180°  
**Random Movement :** 0  
**Averaging :** 1  
**OverSize Settings :** 3 parts  
**Dataset :** scan-01433\_rec-01\_quarter.nii.gz (179.3 MB)  
**Micro-CT Images :** Download scan-01433\_rec\_voi\_vlab.jpg (100.37 KB)  
Download scan-01433\_rec\_voi\_pores.jpg (293.97 KB)  
Download scan-01433\_structurethickness.jpg (163.3 KB)  
**Video File :** scan-01433\_rec\_voi\_mp4 (8.39 MB)

Figure 3. Screenshot of the metadata catalogue of micro-CT vLab

Create Micro-CT Dataset

Provide a title and a short description

**Dataset title \***

**Description (short version) \***

This is the description for the dataset.

**Full description (optional) \***

This is the full description for the dataset. It should be as detailed as possible, including the specimen, the scanning process, and any other relevant information.

**Scientific Name \***

This is the scientific name of the specimen. It should be as detailed as possible, including the genus, species, and any other relevant information.

**Sample ID \***

This is the sample ID of the specimen. It should be as detailed as possible, including the accession number, the specimen number, and any other relevant information.

**Specimen Provider \***

This is the name of the provider of the specimen. It should be as detailed as possible, including the institution, the department, and any other relevant information.

**Material \***

This is the material of the specimen. It should be as detailed as possible, including the type of material, the source, and any other relevant information.

**Preservation Medium \***

This is the medium used to preserve the specimen. It should be as detailed as possible, including the type of medium, the storage conditions, and any other relevant information.

**Fixation Type \***

This is the type of fixation used for the specimen. It should be as detailed as possible, including the method, the duration, and any other relevant information.

**Contrast Enhancement Method \***

This is the method used to enhance the contrast of the specimen. It should be as detailed as possible, including the type of method, the parameters, and any other relevant information.

**Scope of Scan \***

This is the scope of the scan. It should be as detailed as possible, including the area of interest, the resolution, and any other relevant information.

**Scan Date \***

This is the date when the scan was performed. It should be as detailed as possible, including the year, month, and day.

**Scanned By \***

This is the name of the person who performed the scan. It should be as detailed as possible, including the name, the title, and any other relevant information.

**Sample Holder \***

This is the material used to hold the specimen during the scan. It should be as detailed as possible, including the type of material, the shape, and any other relevant information.

**Scanning Medium \***

This is the medium used to scan the specimen. It should be as detailed as possible, including the type of medium, the source, and any other relevant information.

**Scanned Part \***

This is the part of the specimen that was scanned. It should be as detailed as possible, including the location, the size, and any other relevant information.

**Digital Device Type \***

This is the type of digital device used for the scan. It should be as detailed as possible, including the model, the manufacturer, and any other relevant information.

**Voltage kV \***

This is the voltage used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**Current uA \***

This is the current used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**Filter \***

This is the filter used for the scan. It should be as detailed as possible, including the type, the material, and any other relevant information.

**Zoom um \***

This is the zoom factor used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**Camera Resolution \***

This is the resolution of the camera used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**ExposureTime (ms) \***

This is the exposure time used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**360 \***

This is the 360-degree rotation used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**Random Movement \***

This is the random movement used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**Averaging \***

This is the averaging method used for the scan. It should be as detailed as possible, including the type, the parameters, and any other relevant information.

**OverSize Settings \***

This is the over-size settings used for the scan. It should be as detailed as possible, including the value, the unit, and any other relevant information.

**Dataset \***

This is the dataset used for the scan. It should be as detailed as possible, including the name, the size, and any other relevant information.

**Micro-CT Images \***

This is the micro-CT images used for the scan. It should be as detailed as possible, including the name, the size, and any other relevant information.

**Video File \***

This is the video file used for the scan. It should be as detailed as possible, including the name, the size, and any other relevant information.

Figure 4. Screenshot of the form for uploading a micro-CT dataset



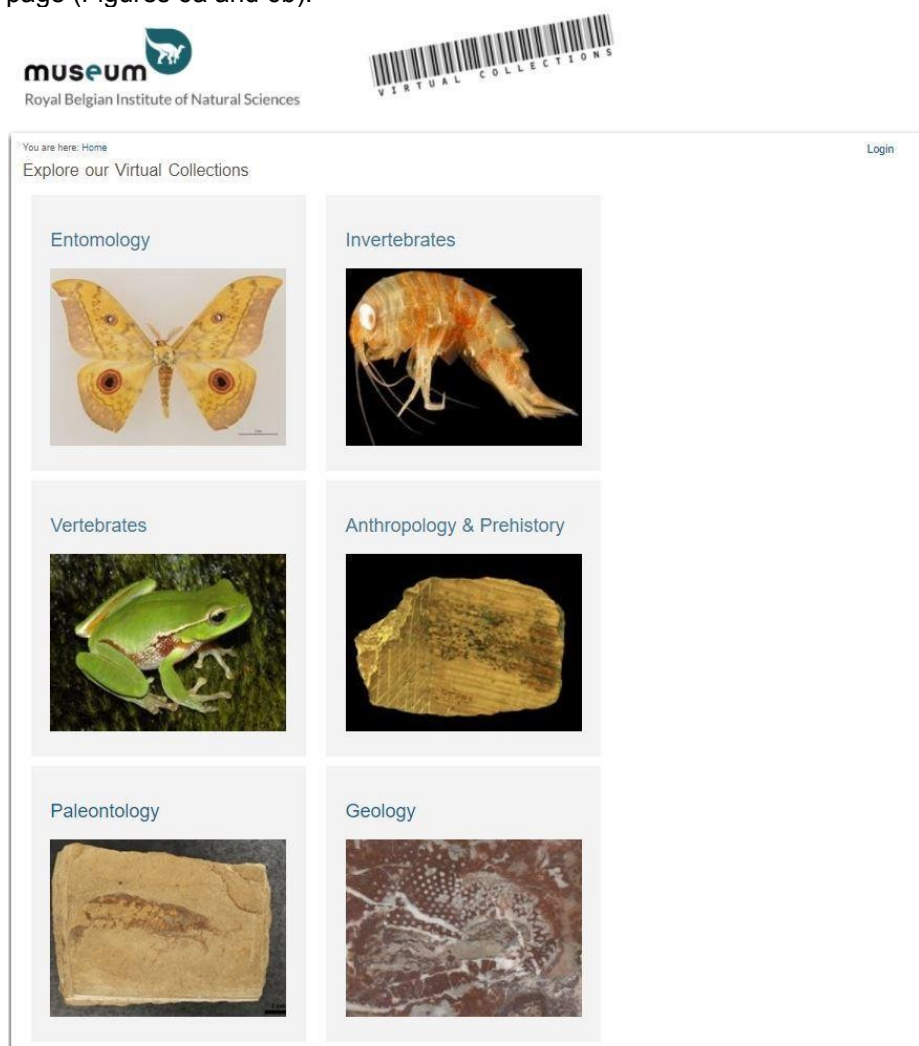
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## Workflows for online access of digital content using several imaging techniques - RBINS

The digitised (type) specimens of the Royal Belgian Institute of Natural Sciences (RBINS) can be accessed through the [Virtualcollections](#) online portal. Through this portal, which was upgraded during SYNTHESYS+, the user can choose the collection of interest to browse through the available images, 3D models, scans, etc. (Figure 5).

For each entered specimen the digitised content is available and includes the information from RBINS [DaRWIN](#) Open Source Content Management System (CMS). In this way, the user can have an overview of detailed high quality digitised data and the available metadata of the specimen (collection number, location, date of collection, etc). The CMS window is an iframe of the specific database page. In case the database content is updated, the new information is automatically visible on the virtual collections page (Figures 6a and 6b).



**Figure 5.** The home page of the RBINS virtual collections



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**Figure 6a.** Example of a specimen page within virtual collections



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Data

Copyright: RBINS / DIGIT-3 Belspo Licence: CC BY-NC-ND

EN | FR | NL | ES

DaRWIN search

### Collection

Name: General Heteroptera Collection ⓘ  
 Institution: Royal Belgian Institute of Natural Sciences (RBINS)

Conservator: Kerkhof Stefan (Dhr.)  
 : Stefan.Kerkhof@natuurwetenschappen.be  
 : 32 2 627 45 03

### Classifications

Taxonomy: Aoba tosta Kiriakoff, 1965 ⓘ

level  
 species

### Specimen Characteristics

Number of items : 1  
 Type : holotype  
 Sex : male  
 Stage : adult  
 Country : Democratic Republic of the Congo  
 Codes : HET GEN  
 RBINS/063673  
 UUID : add4c04b-370f-44fc-b032-56fb063e1a7b

### Associated comment

General : Congo, Kivu, Kabunga, 800/700 m, 27/08/1945, leg. Albéric Dufrane.  
 General : HET GEN: (cf. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, 1965, t. 41(8), p. 15).  
 General : HET GEN: Congo, Kivu, Kabunga, 800/700 m, 27/08/1945, leg. Albéric Dufrane.

### You think there's a mistake ? please suggest us a correction

Your Name :  e-Mail :   
 Comment :  Captcha : ☐ I'm not a robot  
 reCAPTCHA  
 Privacy / Terms

Submit

**Figure 6b.** Iframe of the DaRWIN CMS page in the Virtualcollections portal

The aforementioned pages only show the results of the digitisation process and do not show the metadata of the digitisation techniques. These are hosted in our [collections web portal](#) (Figure 7). All these portals are based on the opensource [Plone CMS](#) and they are easy to adjust and used for entering data. Excel-based batch import and export of data is possible and enables easy uploading and retrieval of content.

An example indicating the metadata of micro-CT scans accompanied by segmented data and 3D models is displayed below (Figures 7, 8 and 9). Within the metadata pages of the collections portal, the technique used and the targeted part are displayed per specimen and sometimes the outcome of the digitisation process is listed (Figure 8). At the moment, most of this information is still private, but a merging of the collections data together with the virtual collections pages is foreseen in the future.



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**museum**  
Royal Belgian Institute of Natural Sciences

You are here: Home / MENU DIGIT / Scans / Hymenochirus boettgeri

**View** Edit Contents Per Type Sharing Actions Display Add new... State: Private

### Hymenochirus boettgeri

by Jonathan Brecko — last modified Sep 30, 2021 01:25 PM — History

**Hymenochirus boettgeri** (Tornier, 1896); Gabon, Ogooué Maritime prov., Ndougou dept Loango Nat Park BE-RBINS-VER-AMP-13332

**Scan ID**  
Unique id of the scan: BE-RBINS or RMCA or Institution acronym+Collection ID+Subcollection ID+ID of the specimen in the (sub)collection (IG number and/or Register number). Example : BE-RBINS-VER-REP-15489  
BE-RBINS-VER-AMP-13332

**Scan date**  
YYYY/MM/DD  
2020/10/29

**Institution**  
Demanding Institution or program  
BE-DIGIT, BE-RBINS

**Collection**  
Vertebrates (VER)

**Type of collection**  
Wet Specimen

**Type specimen**

**Purpose of scan**  
Describe here why this specimen is digitised: eg "Digitisation of type specimen" or "Digitisation on Demand" or "Digitisation to prepare original publication"  
Digitisation to prepare original publication

— Categorization

**Related items**

— Contents

- 1 Scan of the Head — by Jonathan Brecko — last modified Nov 03, 2020 10:40 AM
- 2 Scan of full specimen — by Jonathan Brecko — last modified Nov 18, 2020 08:05 AM
- 3D model of full specimen — by Jonathan Brecko — last modified Sep 30, 2021 01:24 PM
- 3d model of the cranium — by Jonathan Brecko — last modified Sep 30, 2021 01:24 PM
- 3D model of the skin surface — by Jonathan Brecko — last modified Sep 30, 2021 01:25 PM

Filed under: Recent vertebrates

**Figure 7.** Overview page of micro-CT scan metadata for a single specimen

You are here: Home / MENU DIGIT / Scans / Hymenochirus boettgeri / Scan of the Head

**View** Edit Contents Per Type Sharing Actions Display Add new... State: Private

### Scan of the Head

by Jonathan Brecko — last modified Nov 03, 2020 10:40 AM — History

**Date of scan**  
Format: YYYY/MM/DD, example: 2019-01-09  
2020/10/29

**Scan ID**  
Unique id of the scan: BE-RBINS or RMCA or Institution acronym+Collection ID+Subcollection ID+ID of the specimen in the collection (IG number and/or Register number)  
BE-RBINS-VER-AMP-13332

**Remarks**

**Screen capture of scanning parameters**  
No image

— Scan

**W**  
10

**Kv**  
110

**µA**  
90

**Focal spot**  
From small to large  
small

**Filter(s)**

**Scan mode**  
1x1 0.5 pF VG 1 (high resolution)

**Frame rate**  
5.5

**Number of average frames**  
5

**Shift**  
No

**Shift if custom**

**Figure 8.** Detailed information (metadata) of the used settings for the micro-CT scan (cont. next page)



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Data
Project dir :BE-RBINS-VER-AMP-17296 Hymenochirus sp Head
Type Tomography
Type option(s) Continuous, Ref img
Anti ring Shift no
Number of images 1440
Turns 1
Zoom (X) 11.34
Voxel Size (µm) 11.2
Volume Height (mm) 14.5
Volume Diameter (mm) 20.1
Number of slices 1290
Estimated time (minutes) 21
Categorization
Related items
Contents
There are currently no items in this folder.
<a href="#">Site Map</a> <a href="#">Accessibility</a> <a href="#">Contact</a> <a href="#">Phone</a>

**Figure 9.** Detailed information (metadata) of the used settings for the micro-CT scan (cont. prev. page)

You are here: [Home](#) / [MENU DIGIT](#) / [Scans](#) / [Hymenochirus boettgeri](#) / [3d model of the cranium](#)


**View** [Edit](#) [Contents](#) [Per Type](#) [Sharing](#) [Actions](#) [Display](#) [Add new](#) [State](#) [Private](#)

### 3d model of the cranium

by Jonathan Brecko — last modified Sep 30, 2021 01:24 PM — [History](#)  
There are currently no items in this folder.

status  
Open

View



13332 Hymenochirus boettgeri Crâne Gabon Ndougou by Royal Belgian Institute of Natural Sciences on Sketchfab

- [Hymenochirus boettgeri BE-RBINS-VER-AMP-13332](#)
- [Gabon, Ogooué Maritime prov., Ndougou dept Loango Nat Park](#)
- [µCT Scan](#)
- [10.50 µm voxel size](#)
- [RX EasyTom](#)
- [Cranium only \(no jaws, hyoid, vertebrae\)](#)
- [Segmentation in DragonFly](#)
- [Cleaning of the Model in GOM Inspect](#)

Contributors  
µCT, segmentation & 3D: Jonathan Brecko

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**Figure 10.** 3D model extracted from the digitisation data with brief metadata on scanning and post-processing parameters



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The digitisation pathway at RBINS, which is the same as for the RMCA, is documented in Figure 11. Once a digitisation request is made, the pathway remains the same regardless of whether this is part of the routine digitisation strategy or a Virtual Access (VA) request from an external user or it is on the specimen or collection drawer level.

Part of the digitisation protocol is to determine which digitisation technique is the best suited for a specific specimen(s). This procedure is always done through close contact between the digitisation specialists, the requester and the curator. An easy-to-use tool [DIGIT-KEY](#) was developed within Task 7.2 of the SYNTHESYS+ project which aims to help the user to identify which strategy is the best to use. Important questions for VA demands are: What is the final purpose of the digitisation? What needs to be visualised? How detailed does the digital twin need to be? Does it fit within the institute's digitisation priorities (i.e. types, figured specimens or highly valuable collection items)?

Each digitisation setup is defined by information about the technique, examples and by the associated costs (human, computing, equipment).

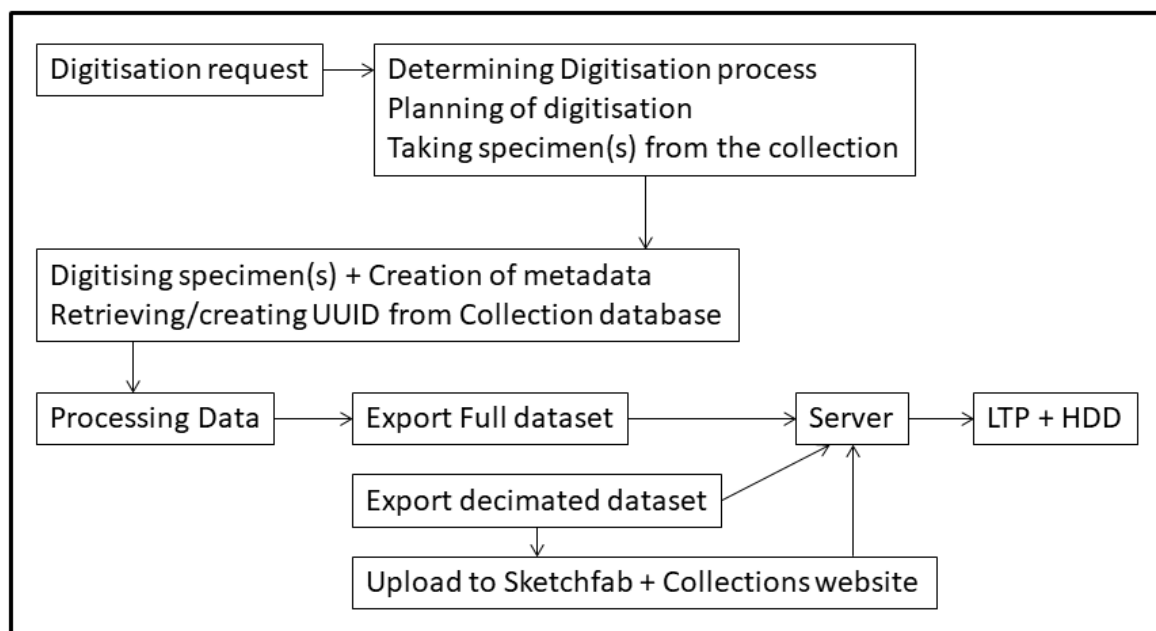
Once the digitisation technique is selected and the specimen is retrieved within the collection, the next step is to check whether a similar scan is already entered in the CMS and if all data are correct and up to date.

The specimen(s) will be transported to the digitisation facility and handed to the digitisation specialists well before the scheduled time for digitisation. During the digitisation process, the specialist will:

- create a file with all the necessary digitisation metadata.
- link this new information to the specimen data in the CMS and later on to the digitised data through the UUID (Universally Unique Identifier) created in the CMS.

Once the digitisation dataset is created (3D scan, imaging, or other), specific post processing steps need to be followed to ensure that the 3D data can be shared and published:

- A decimated meta-dataset is created before data releasing, which includes selected basic data in order to enable access even under low speed internet connection or through a smartphone.
- The full and decimated datasets are stored on the server and are automatically sent to the Long Term Preservation platform (LTP) and stored on a local Hard Disk (HDD).



**Figure 11.** Digitisation pathway at RBINS



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# Workflows for online access of digital content using several imaging techniques - RMCA

The digitised (type) specimens of the Royal Museum for Central Africa (RMCA) can be found at the [virtual collections portal](#) based on the Open Source [Collective Access](#) platform (Figure 12).

This portal, created during SYNTHESYS+ project, shows all digitisation results derived from different techniques for a single specimen. Through the upload process of the digitisation results, the collection and specimen data can be retrieved from RMCA [DaRWIN](#) Open Source Content Management System (CMS). The portal can be used in several different ways. More specifically, it is possible to make a thorough search (Figure 13) or to browse the collections (Figure 14), to eventually reach the specimen level pages (Figure 15).

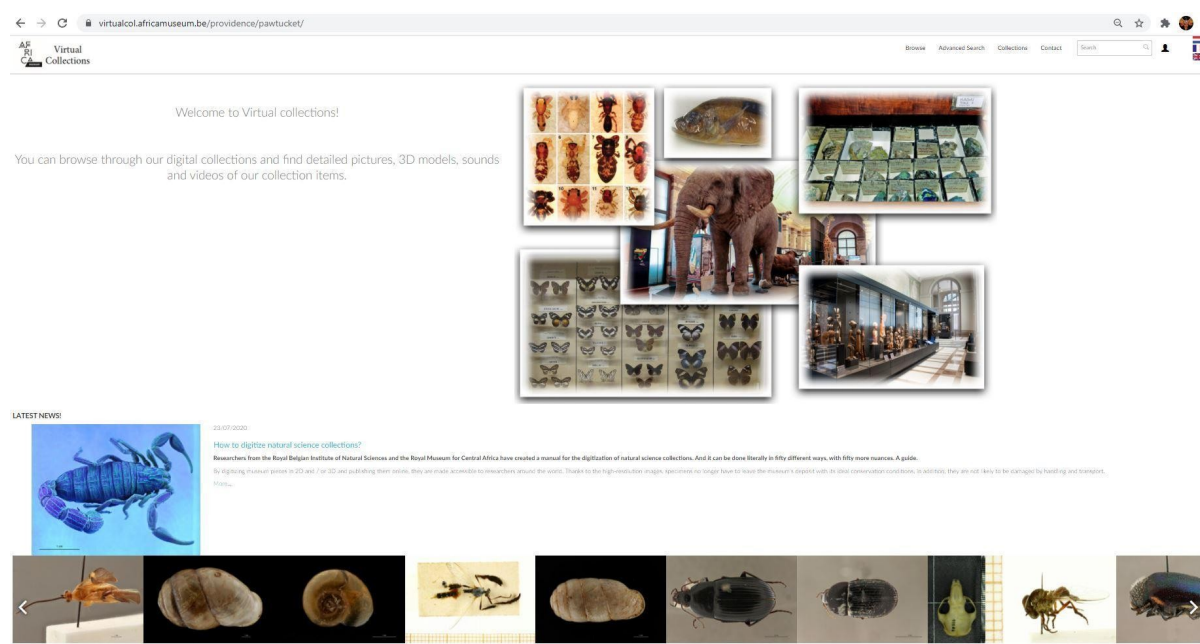


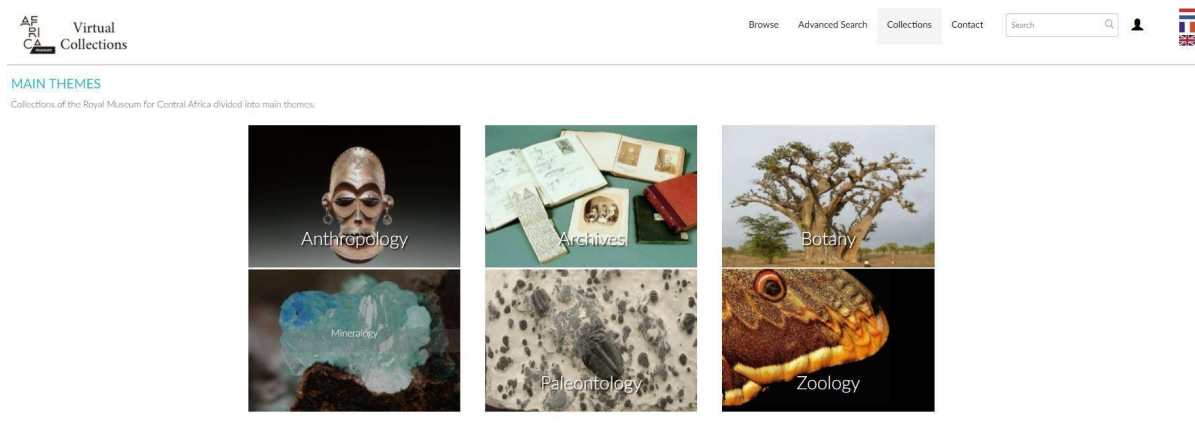
Figure 12. Home page of the virtual collections portal of RMCA

Figure 13. The advanced “search” function of the virtual collections portal.

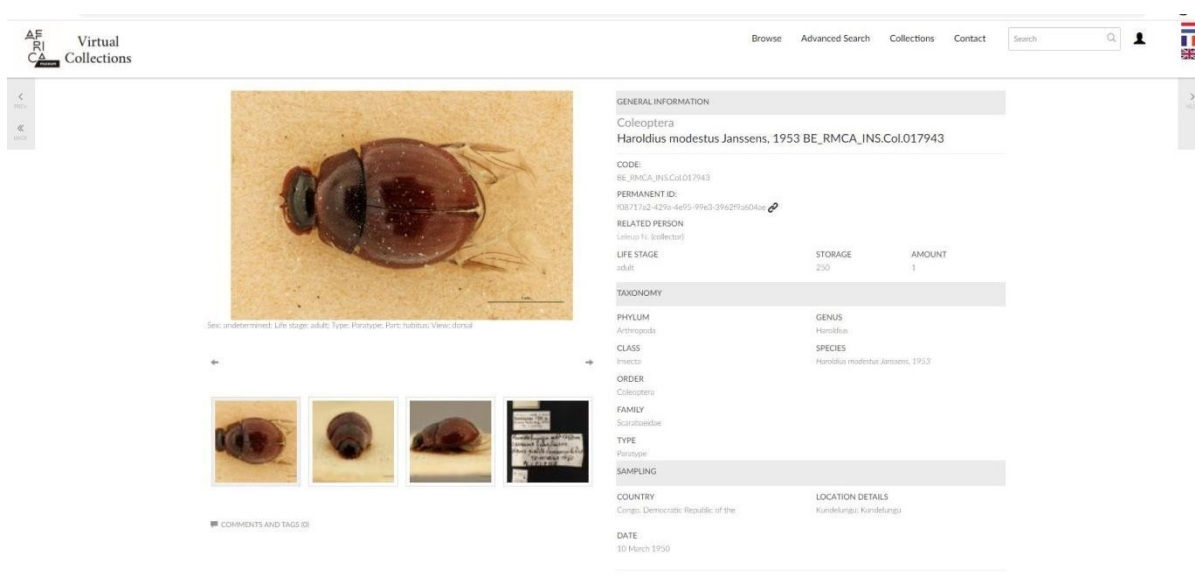


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**Figure 14.** The main themes page of the virtual collections portal



**Figure 15.** The page of a digitised specimen with added CMS information

In the future a landing page will be developed which will combine the information of the CMS and the digitisation results visible at the virtual collections page similarly to the RBINS virtual collections page.

The digitisation pathway at RMCA, which is the same as the one described for RBINS, is documented in Figure 16. Once a digitisation request is made, the pathway remains the same regardless of whether this is part of the routine digitisation strategy or a virtual access (VA) request from an external user, or it is on the specimen or collection drawer level.

Part of the digitisation protocol is to determine which digitisation technique is the best suited for the specific specimen(s). This procedure is always performed through close contact between the digitisation specialists, requester and curator. An easy-to-use tool was developed during Task 7.2 of the SYNTHESYS+ project to facilitate deciding upon which strategy will be the best to use of the [DIGIT-KEY](#) tool. Important questions for VA demands are: What is the final purpose of the digitisation? What needs to be visualised? How detailed does the digital twin need to be? Does it fit within the institute's digitisation priorities (i.e. types, figured specimens or highly valuable collection items)?

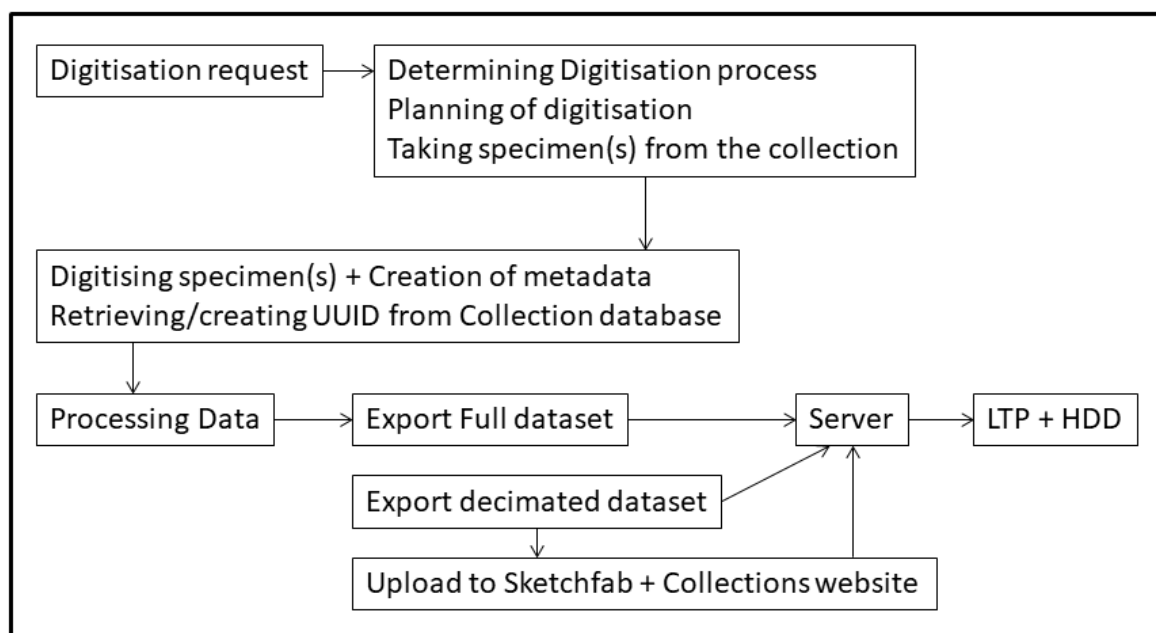
Once the digitisation technique is decided and the collection specimen is retrieved from the collection, it is important to check whether it is already entered in the CMS, and if all data is correct and up to date. The specimen(s) will be transported to the digitisation facility and handed to the digitisation specialists well before the planned time of digitisation. During the digitisation process, the digitisation specialist will create a file with all necessary digitisation metadata. This new information is linked to



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the specimen data in the CMS and later on the digitised data through the UUID (Universally Unique Identifier) created in the CMS. Once the digitisation dataset is created (3D scan, imaging, or other) it needs to follow some post processing steps to ensure that the 3D data can be shared and published. For data releasing, a small dataset is created with some basic data to enable access to the data even with a low speed internet connection or a simple smartphone. The full and decimated datasets are stored on the server and automatically sent to the Long Term Preservation platform (LTP) and stored on a local Hard Disk (HDD).



**Figure 16.** Digitisation pathway at RMCA

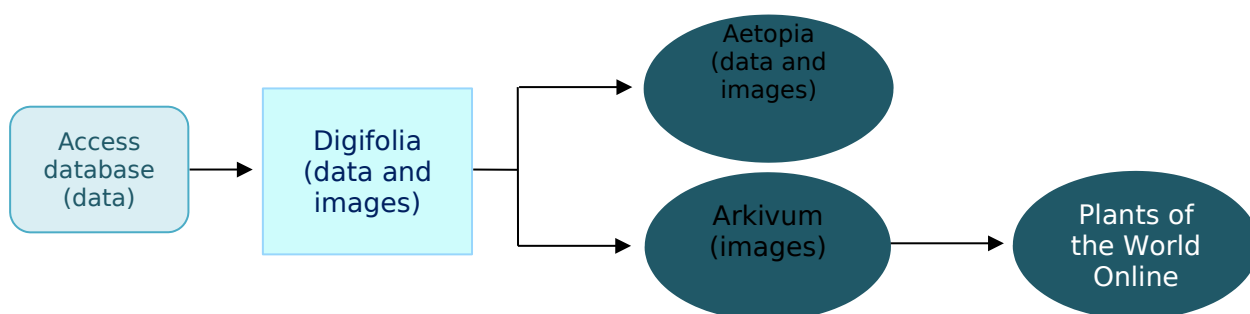


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## Workflows for online access of digitised microscope slides - RBGK

The standard workflow for enabling online access to microscope slides specimens in RBGK is presented in Figure 17. For the SYNTHESYS+ project, new and previous work was documented and conclusions were drawn for the report.



**Figure 17.** RBGK workflow describing how data and images for microscope slides are currently stored and linked

Derivatives of images are produced from the images stored in Arkivum in an automated workflow and displayed in the corresponding pages of the Plants of the World Online website (<http://www.plantsoftheworldonline.org/>), see Figures 18 and 19.

Specifically, when the microscope slides are accessioned, the data are entered into an Access database. Subsequently, when the slides are imaged, the data for these slides are exported from the Access database, rearranged, and imported into RBGK Digital Asset Management system (Digifolia) along with the corresponding images. The filenames of the images, which contain barcode numbers, are used to link the data from the Access database to the correct image record in Digifolia. The relevant information is combined in an Excel spreadsheet before being imported into Digifolia.

The Digifolia system is comprised of two components:

- 1) Aetopia – where data and derivatives of images are held. The data that were exported from the Access database become the metadata for the images in this system (<https://www.aetopia.com/>).
- 2) Arkivum – off-site tape storage for original, full-sized images. These images can be accessed and downloaded by the user (<https://arkivum.com>).



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Royal Botanic Gardens **Kew** | Plants of the World Online

HOME ABOUT HELP Search by keyword

Family: *Fabaceae* Lindl.  
Genus: *Dalbergia* L.f.

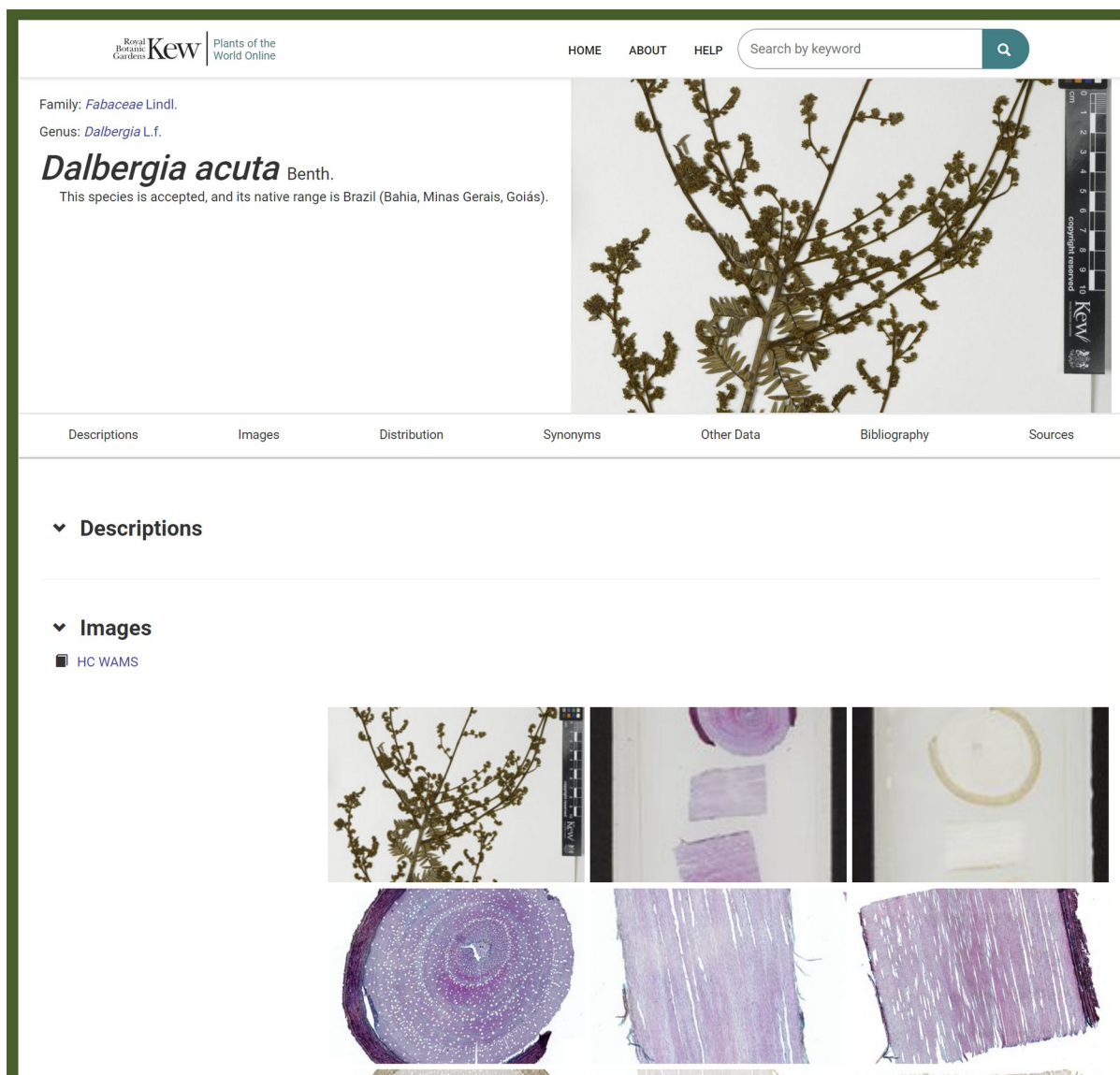
***Dalbergia acuta*** Benth.  
This species is accepted, and its native range is Brazil (Bahia, Minas Gerais, Goiás).

Descriptions Images Distribution Synonyms Other Data Bibliography Sources

▼ Descriptions

▼ Images

HC WAMS

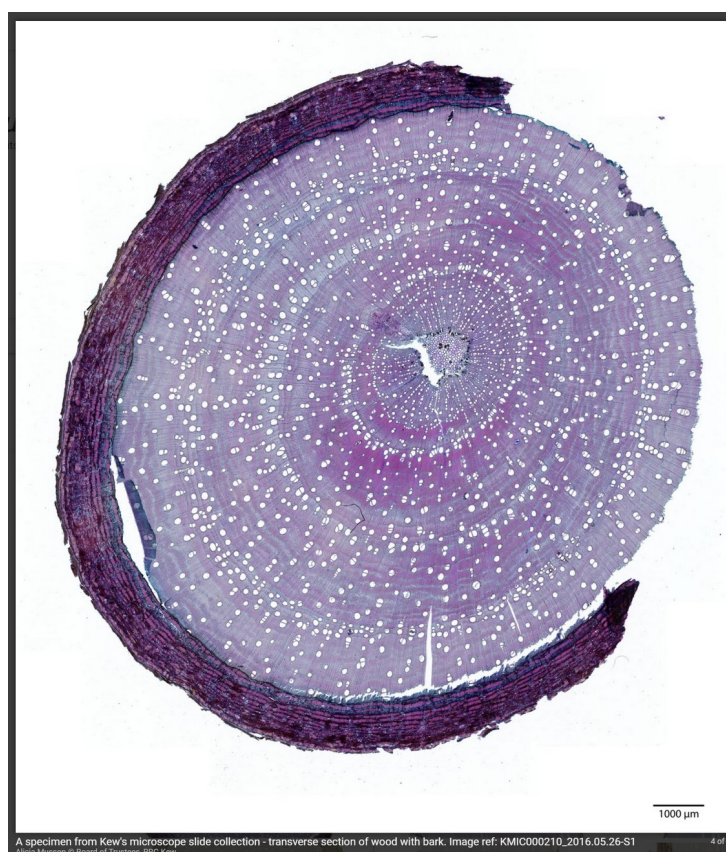


**Figure 18.** Plants of the World Online page displaying [images](#) for the species *Dalbergia acuta* Benth



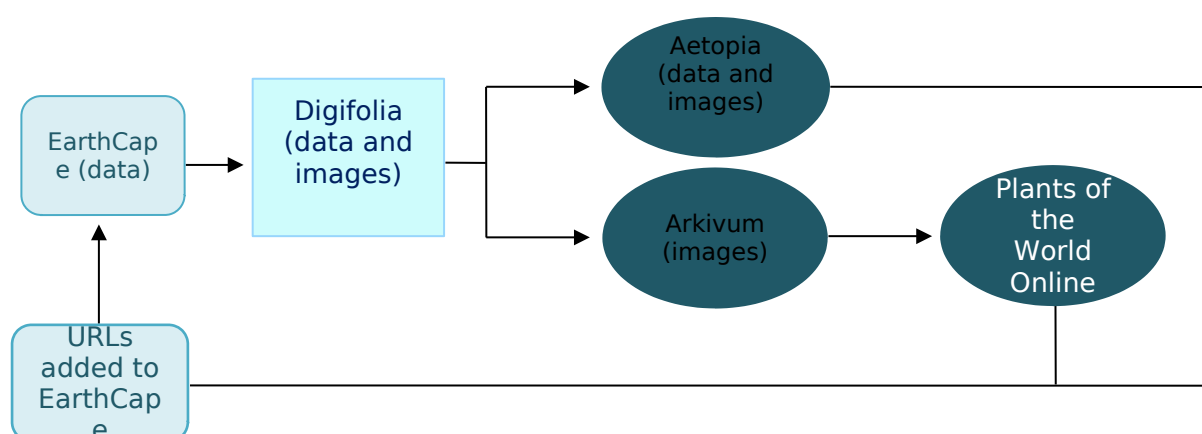
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**Figure 19.** Large image with caption displayed when clicking on thumbnail of image in the Plants of the World Online page for the species *Dalbergia acuta* Benth

A new database, EarthCape (<https://earthcape.com/>), is currently being configured and adopted. All data in the Access database will eventually be moved to EarthCape and will be exposed to the public in a new data portal. Images will still be uploaded to Digifolia and Plants of the World Online, but data will be held in EarthCape with URLs linking to the images. In the future, it is envisaged that data from EarthCape will be automatically imported into Digifolia (Figure 20).



**Figure 20.** The workflow indicating how data and images for microscope slides will be stored and linked in the future

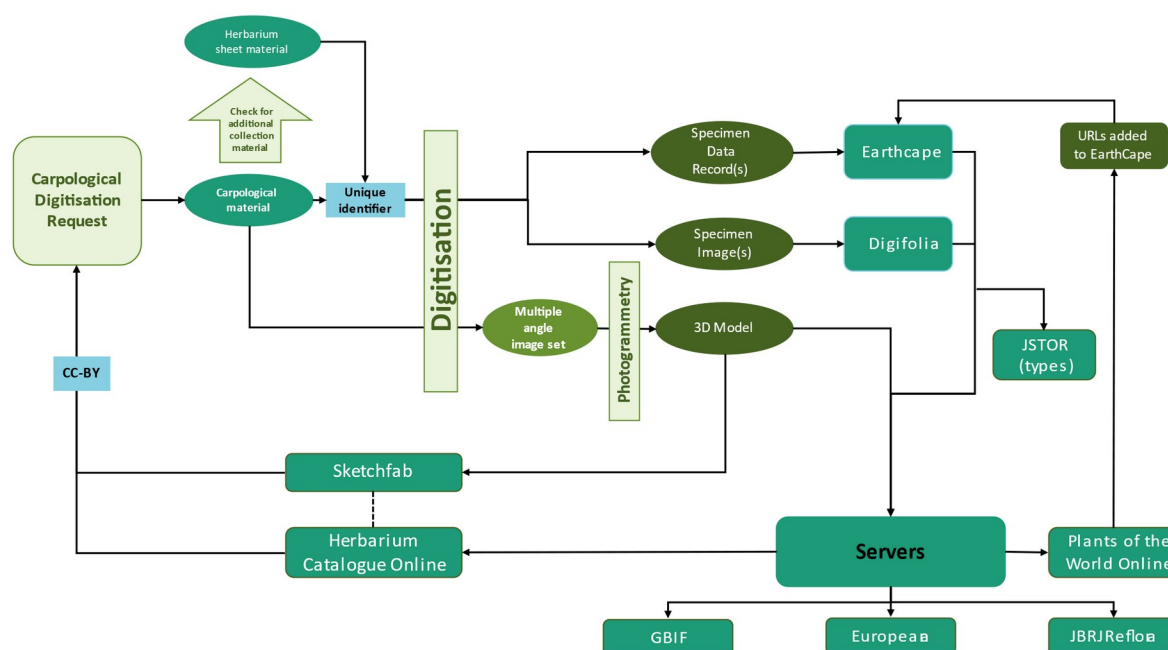


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## Workflows for online access of 2D and 3D images and data - RBGK

The standard workflow for enabling online access to 2D and 3D images and data in RBGK is presented in Figure 21. During SYNTHESYS+ project different 3D imaging workflows and software were investigated in order to incorporate 3D imaging requests into RBGK's already established 2D digitisation workflow.



**Figure 21.** RBGK workflow describing how data and images for carpal specimens are currently stored and linked

Following a digitisation request, the specimen is pulled from the collection and any other herbarium material corresponding to this collection. A unique identifier is given to the specimen in the form of a barcode, which is used to link the specimen with its digital data record. Any images and models that will be created will include this barcode within the filename. Subsequently, specimen collection and taxonomic data are entered into the commercial data management system [Earthcape](#). Different specimens with unique identifiers can be linked via another identifier to the same collection event or occurrence. However, this is a newly adopted system at RBGK and is currently being updated and configured for improvised use.

Images are uploaded to Digifolia and image metadata are created (creation date, digitiser, collection type). Digifolia is comprised of two components:

- Aetopia – where data and derivatives of images are held and
- Arkivum – off-site tape storage for original, full-sized images.

These images can be accessed and downloaded by the user. The 3D models can also be uploaded and saved to the Digifolia server. However, further investigation into the preferable long term solution for storing large model files and multiple angle image sets is required.

Derivatives of images are produced from the images stored in Arkivum in an automated workflow and



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displayed in the corresponding pages of the [Plants of the World Online website](#), along with some of the specimen data taken from Earthcape (Collector, Collector number, collection date, locality) (Figures 22 and 23).

Family: *Aristolochiaceae* Juss.  
Genus: *Hydnora* Thunb.

***Hydnora abyssinica* A.Br.**  
This species is accepted, and its native range is Eritrea to S. Africa, Arabian Peninsula.

Descriptions Uses Images Distribution Synonyms Common Names Other Data Bibliography Sources

▼ **Descriptions**  
Includes data from the synonyms:  
*Hydnora johannis* Becc.

▼ **According to Flora of Tropical East Africa**  
[FTEA]  
Hydnoraceae, Henk Beentje & Quentin Luke. Flora of Tropical East Africa. 2002

**Morphology > General > Habit**  
Subterranean root parasite. Plant body ("branch") rhizome-like, simple or with widely spreading horizontal branches, fleshy, irregularly shaped, to 1 m long, to 10 cm wide, somewhat flattened, brown outside, brick-red or reddish pink to white inside, with sticky, astringent exudate when fresh, side branches cylindrical or nearly so, 1.7–4 cm in diameter, densely covered with small warts and with flower buds on the upper surface.

**Morphology > Reproductive morphology > Flowers**  
Flowers emerging directly from the main and side branches, remaining partially below ground and partially emerging, solitary or in groups, but only one per branch emergence point (?), with very foetid smell; pedicel absent or up to 2.5 cm long.

**Morphology > Reproductive morphology > Flowers > Perianth**  
Perianth fleshy-coriaceous, (8?–)11–25(–33) cm long; tube 4-sided to terete, reddish brown and smooth outside, pinkish to ivory white inside, 4.8–14(–19) cm long (depending on depth of rhizome), 3–5.5 cm in diameter; lobes (2?–3)4(–6), emergent from ground, either (?in dry weather or in early stage) erect and connivent by the thickened tips with only side vents open, or (?in moist weather or at a later stage) spread and flat on ground, lanceolate to spatulate, thickly fleshy, 4–9(–14) cm long, 1.7–3.8 cm wide, broadly channelled on the inside, lower 1/3 to 2/3 of margins bright red, turning pink or cream/yellow, to 10–13 mm wide, densely setose with broad-based tapering white

**Figure 22.** Plants of the World Online page displaying [information and images](#) for the species *Hydnora abyssinica*.



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## Other Data

*Hydnora abyssinica* A.Br. appears in other Kew resources:

[IPNI - The International Plant Names Index](#)

Herbarium Catalogue (10 records)



Date	Reference	Identified As	Barcode	Type Status
	Jameson, J.D. [134], Uganda		18760.000	
	Welwitsch [s.n.], Angola		<a href="#">K000435229</a>	
	Wissel, B. von [s.n.], Swaziland		K000354833	
	Guy, J. [159891], Zimbabwe		K000354835	
	Welwitsch [s.n.], South Africa		K000354834	
	Biegel, H. [1929], Zimbabwe		K000354836	
	Bayer, W.F. [s.n.], South Africa		K000354832	
	Burger, W. [2695], Ethiopia	<i>Hydnora johannis</i>	29047.108	
	Ebba, T. [734], Ethiopia	<i>Hydnora johannis</i>	32148.000	

**Figure 23.** Plants of the World Online page displaying [resources and links](#) to specimens of *Hydnora abyssinica*.

Data are sent to different data aggregators such as [GBIF](#), [Europeana](#), [JSTOR](#) and [JBRJ Reflora virtual herbarium](#), either through xml and file transfer (JSTOR) or through DwCA or ABCD packaged data and derivative images from the Digifolia server.

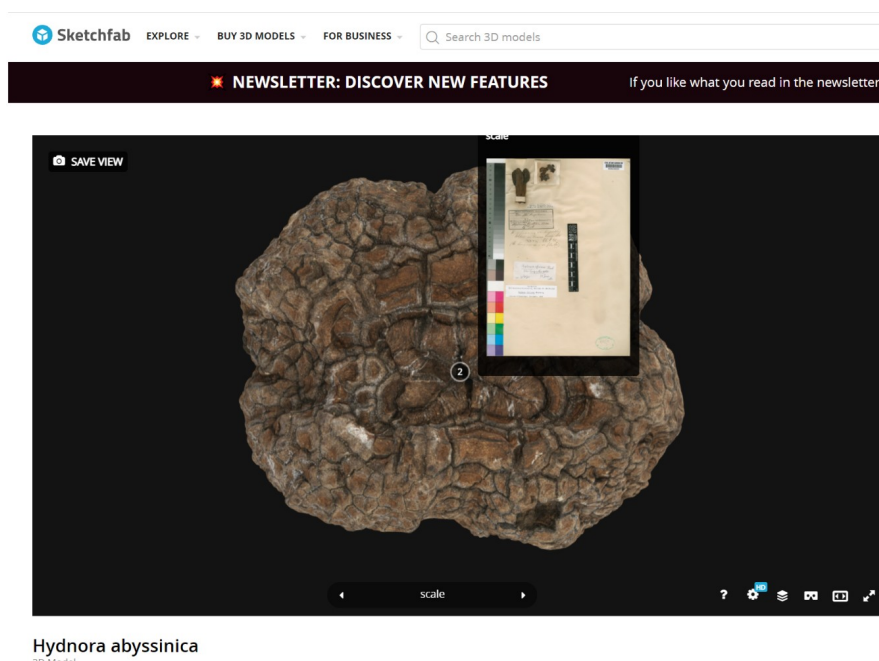
In addition to storing the model data on the server, the model is also uploaded to the [Sketchfab](#) site where it is made available to view (Figure 24a and 24b). The 2D images of the specimen and the corresponding record data are made accessible through the [online herbarium catalogue](#). There are plans for a new data portal that will host all RBGK collections in 2022.

Users requiring to use images, models or data for research purposes are granted access through a [CC-BY licence](#).



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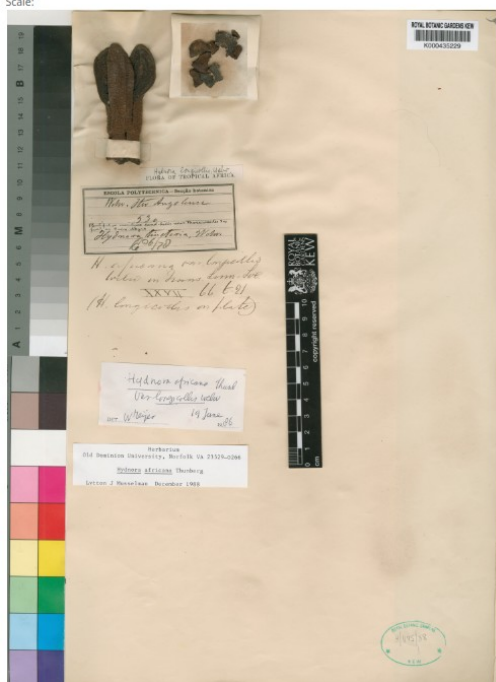


Hydnora abyssinica  
3D Model

**Figure 24a.** Sketchfab: [model of \*Hydnora abyssinica\*](#) with the scale information.

Subterranean root parasite occurring in dry woodland, wooded grassland or bushland, on roots of Acacia (various species), Albizia, Adansonia, Delonix, Kigelia, Piliostigma

Scale:



More information via Plants of the World Online:  
<http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:316038-1>

3D Model created using Nikon D800E and Meshroom by Laura Green

#### Model Information

INSPECT THE 3D MODEL  
MATERIALS AND MORE

Image formats	png (2)
Download size	84MB <a href="#">See all files</a>
Geometry	Triangles 1M
Vertices	576.8k
PBR	No
Textures	2
Materials	2
UV Layers	Yes
Vertex colors	Yes
Animations	0
Rigged geometries	No
Morph geometries	0
Scale transformations	No



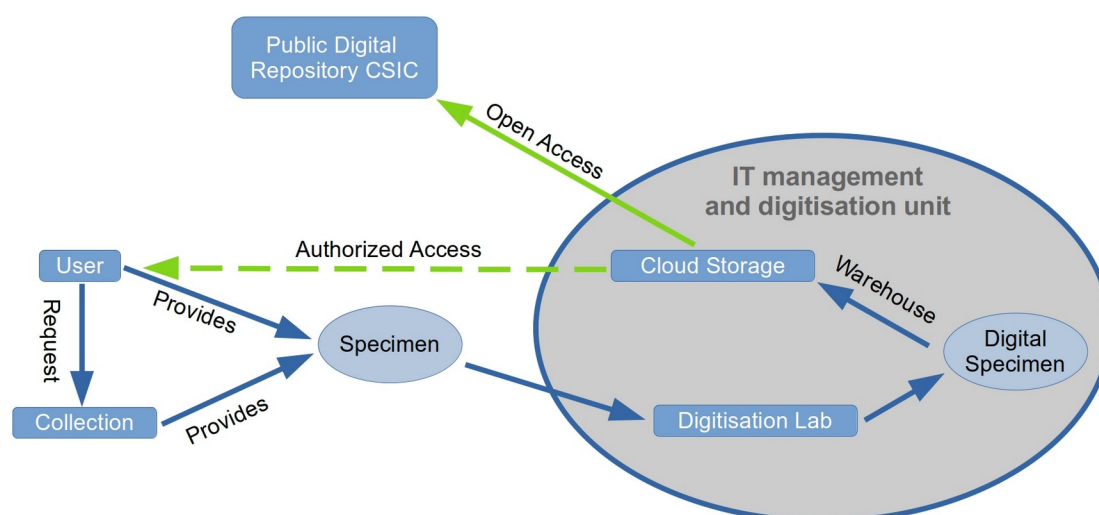
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**Figure 24b.** Sketchfab: additional information, link and 3D model metadata of [Hydnora abyssinica](#).

## Workflows for online access of digital specimens - MNCN-CSIC

The UGID-MNCN (Spanish abbreviation for “Unit for Digitization and Digital Collection Management of the Museo Nacional de Ciencias Naturales MNCN”) has developed the toolkits and workflows for the digitisation on demand (DoD) and management of digital collection specimens in the MNCN-CSIC data base ([Bastir et al., 2019](#)). Here are preliminary screenshots showing some of the steps in the workflows for digital collection processing (Figure 25) and of the internal web-based semi-automatic tool for digital database management (Figure 26). Figure 25 shows an example of a user request for high resolution imaging services (digitisation). The user either provides a specific specimen or requests a given specimen of the MNCN-CSIC collections. By using the various techniques of the MNCN-CSIC digitisation labs the virtual specimen is produced and then stored in the cloud. After quality control and completion of metadata (Fig. 26) the UGID-MNCN provides either open or authorized access to the digital specimen.

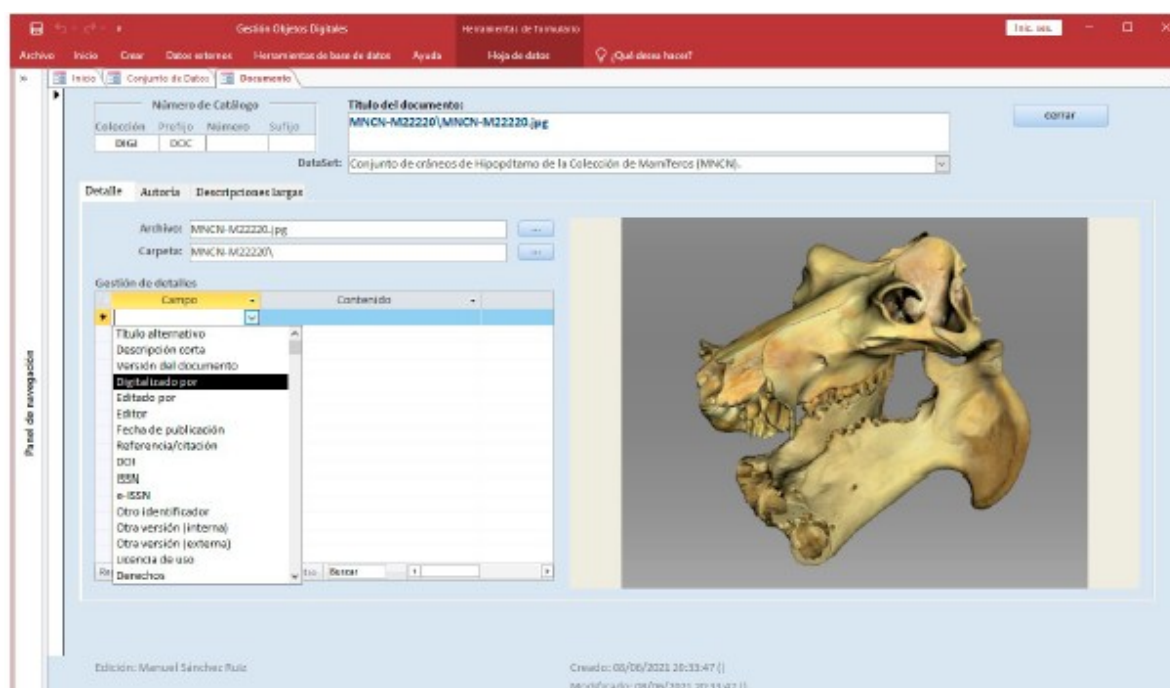


**Figure 25.** Diagram of the digitisation workflow of MNCN-CSIC



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**Figure 26.** Internal web-based semi-automatic tool for digital database management

As an example, the [Virtual Morphology Lab of the MNCN-CSIC](#) has carried out the pilot workflows to centralize the digital collection items:

In the pilot test the lab technicians scanned and reconstructed in 3D the surface geometry and texture of a *Hippopotamus amphibius* skull of the Mammals Collection (Catalogue number MNCN-M22220) using our Artec MHT (EVA) surface scanning equipment, and uploaded the digital 3D data to the cloud connected web tool (Fig. 26), which is able to automatically extract the digital content and provide the necessary fields for metadata requests. Following that, the MNCN researchers are able to search, access and download these digitized objects from the MNCN-UGID database toolkit (internal access).

### Future development

All laboratories of the CSIC, capable of producing digital collection items, are currently collaborating to centralize their digitization work and to contribute to the digitisation of the objects and metadata base. In the future, these laboratories will provide digital information to this web-tool following major guidelines of the [DIGITAL.CSIC](#) database repository. Future development will also include the international (English) version of the web tool to provide controlled and Open Access to external researchers.



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# Workflows for online access of digitised content - NHMW

The NHMW hosts 2 different portals for digitised collection specimens for the general public:

a) The [online collection](#) (currently only in German, Figure 27). This portal is enriched with metadata like stable identifiers, description, and additional information, geographic data, time scale, etc.

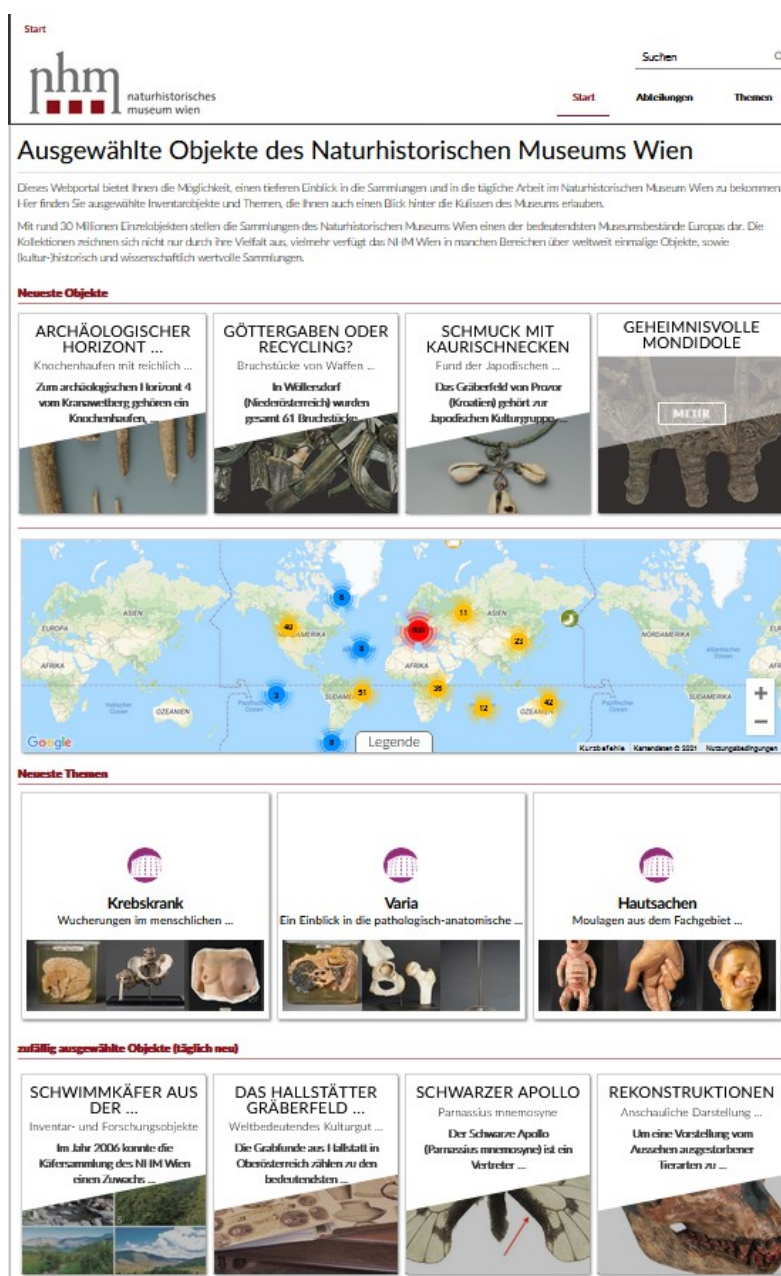


Figure 27. The home page of the ["The online collection"](#) of the Natural History Museum of Wien (NHMW)



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b) **The 3D Museum** ([https://www.nhm-wien.ac.at/en/museum\\_online/3d](https://www.nhm-wien.ac.at/en/museum_online/3d))

<https://sketchfab.com/NHMWien> The 3D Museum includes metadata for the object and its historical information, as well as links to available scientific databases.

The NHMW 3D-Museum is based on the Sketchfab platform, which is identified as one of the most suitable 3D repositories for 3D digital heritage data for the [GLAM sector](#) in a study by [Champion & Rahaman \(2020\)](#). Sketchfab enables interactive annotations, variable licensing options, data sharing for downloads, user comments and much more. In addition, Sketchfab provided a straightforward code snippet generator for embedding 3D models hosted on Sketchfab in other websites.

**Workflow:** Specimen selection largely follows the NHMW Top100 ([Ott et al. 2011](#)) list of culturally and historically most significant specimens displayed in the galleries of the NHMW. Due to technical limitations of the 3D scanning process only a subset (ca. 2/3) of the specimens are suitable for the structured light 3D scanners employed for 3D digitization at the NHMW (Artec Leo and Artec Space Spider). Transparent or glossy objects, as well as very small objects can, currently, not be digitized with the available infrastructures. The NHMW Top 100 specimens 3D scans are supplemented with scans of additional specimens related to current research activities or exhibitions at the NHMW.

Scanning is carried out by the team of the NHMW 3D Lab (part of the [NHMW Central Research Laboratories](#) and financed by an infrastructure programme by the Austrian Research Promotion Agency FFG via the MicroMus Project, PI: Andreas Kroh) in collaboration with the responsible curators after assessment of the suitability of the specimens and the best scanning strategy (instrument, location of scan, conservatory precautions etc.). Multiple partial scans are generated to capture all sides of the specimen. Raw scans are processed using the software Artec Studio and Blender. Descriptions and annotations for each specimen are written by the team of the NHMW 3D Lab in collaboration with the responsible curator. Key data included in the descriptions are:

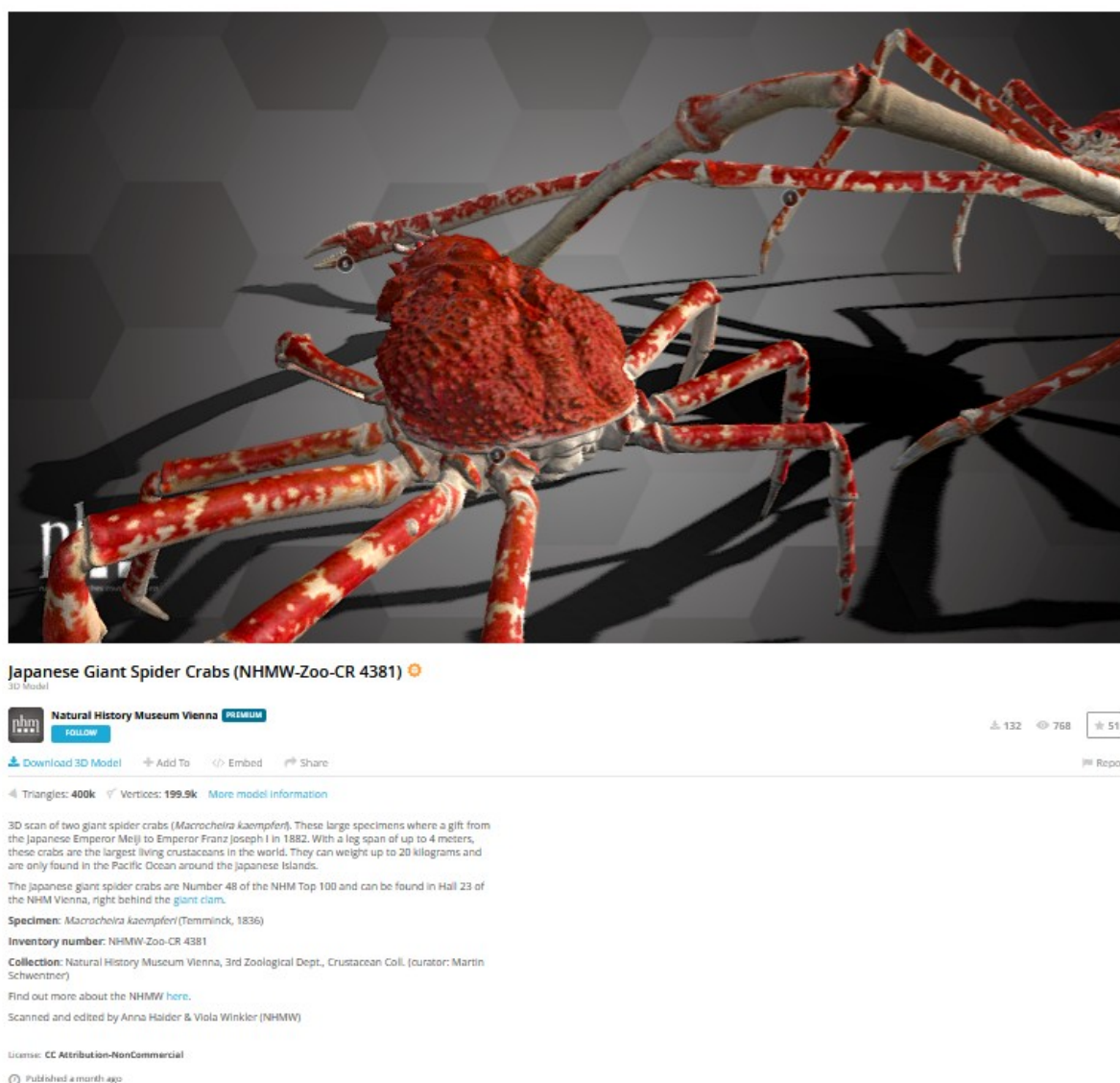
- Object title
- Significance
- Location in the galleries (if applicable)
- Scientific name
- Collection name
- Repository number
- Responsible curator
- Creators of the Scan
- Instrument details
- License (for scans where data are provided as downloads)

Reduced versions of the 3D models (typically aiming for 200K triangles, in order to allow displaying of the models on mobile devices) are uploaded to Sketchfab. In the Sketchfab backend, annotations are added and scene details (light etc.) are configured.



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**Figure 28.** 3D model of a [Japanese giant spider crab](#) in Sketchfab

An **Institution database for digitised specimens** from the different Departments for scientific investigations does not exist so far. But portals like

- [GBIF](#)
- [JACQ](#)
- [GeoCASE](#)
- [THANADOS](#)
- [Meteoritical Bulletin Database](#)

are used for international visibility of the museum's specimens and their metadata.

The decision regarding what is digitised and put in a platform is in the charge of the single curator and the head of the department. The new director of the museum made a strong commitment on the digitisation process and open data – a lot of new pipelines will be set up in the near future.

### Digitisation for SYNTHESYS+ Virtual Access

The NHMW is part of the development of the virtual access program within SYNTHESYS+ project.



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Title	Institutions involved	NHMW department
Digitisation of <b>Dianthus</b> collections	HNHM, <u>NHMW</u> , NMP, RBGE, HUJI, RGBK, BGM	Botany
COVID-19 <b>Chiropteran</b> knowledge base	HMNH, RMCA, MfN, MNHN, NMP, NHM, <u>NHMW</u> , SMNS, Senckenberg	Zoology
Digitisation of <b>Greenlandic peat moss</b> (Sphagnum) collections	SNM, <u>NHMW</u> , BGM	Botany
<b>Bryozoa</b> Identification Tool (BIT) For Quaternary and Recent Mediterranean And North Atlantic Bryozoans	NHM, MNHN, CSIC(MNCN), <u>NHMW</u> , MfN, HUJI	Geology & Paläontology
Harmonizing verbatim names in digitized collections – the <b>Krantz</b> material as a model	LUOMUS, NMP, <u>NHMW</u> , CSIC(MNCN), NHM, SMNS, HUJI, MNHN, NRM, MfN	Geology & Paläontology
Accelerating taxonomic progress on the large rainforest genus <b>Cyrtandra</b>	RBGK, RBGE, <u>NHMW</u> , UCPH	Botany



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## Digitization on demand at the department of Botany

At the botany department, requests for 2D digitisation of selected specimens have been in place since the early 2000s. A request from external researchers is initially processed by checking the availability of a specimen usually based on its scientific name (including nomenclatural and taxonomic synonyms). The curators decide if the request is valid and the effort is feasible and in case of a positive evaluation they can check the physical collections for the requested material. In case the material is available it is inserted in the production line.

As a first step the metadata for the specimens are entered into the JACQ System. Details include curatorial metadata such as unique:

- herbarium catalogue number
- scientific name
- identification history
- type status (in case applicable)
- collector(s)
- collection number
- collection date(s)
- country / province (Admin1 unit)
- geographical coordinates (if available)
- elevation (min-max)
- location
- habitat
- habitus
- remarks – any specific additional information

The data are then immediately available online in the JACQ platform based on the CETAF stable identifiers to be cited in scientific publications.

In a second step, the specimen is digitized using the in-house Mamiya Leaf 80 Camera with an 80 Megapixel Digital Back. The resulting TIF file is transformed by the Open source [Djatoka image server](#) into a JPG2000 file format that is used for visualisation via the public [JACQ Platform](#). For the above mentioned specimen the image can also be accessed directly at

[http://jacq.nhm-wien.ac.at/djatoka/jacq-viewer/viewer.html?rft\\_id=w\\_0102955&identifiers=w\\_0102955](http://jacq.nhm-wien.ac.at/djatoka/jacq-viewer/viewer.html?rft_id=w_0102955&identifiers=w_0102955)



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Synthesis of Systematic Resources  
a DiSSCo project



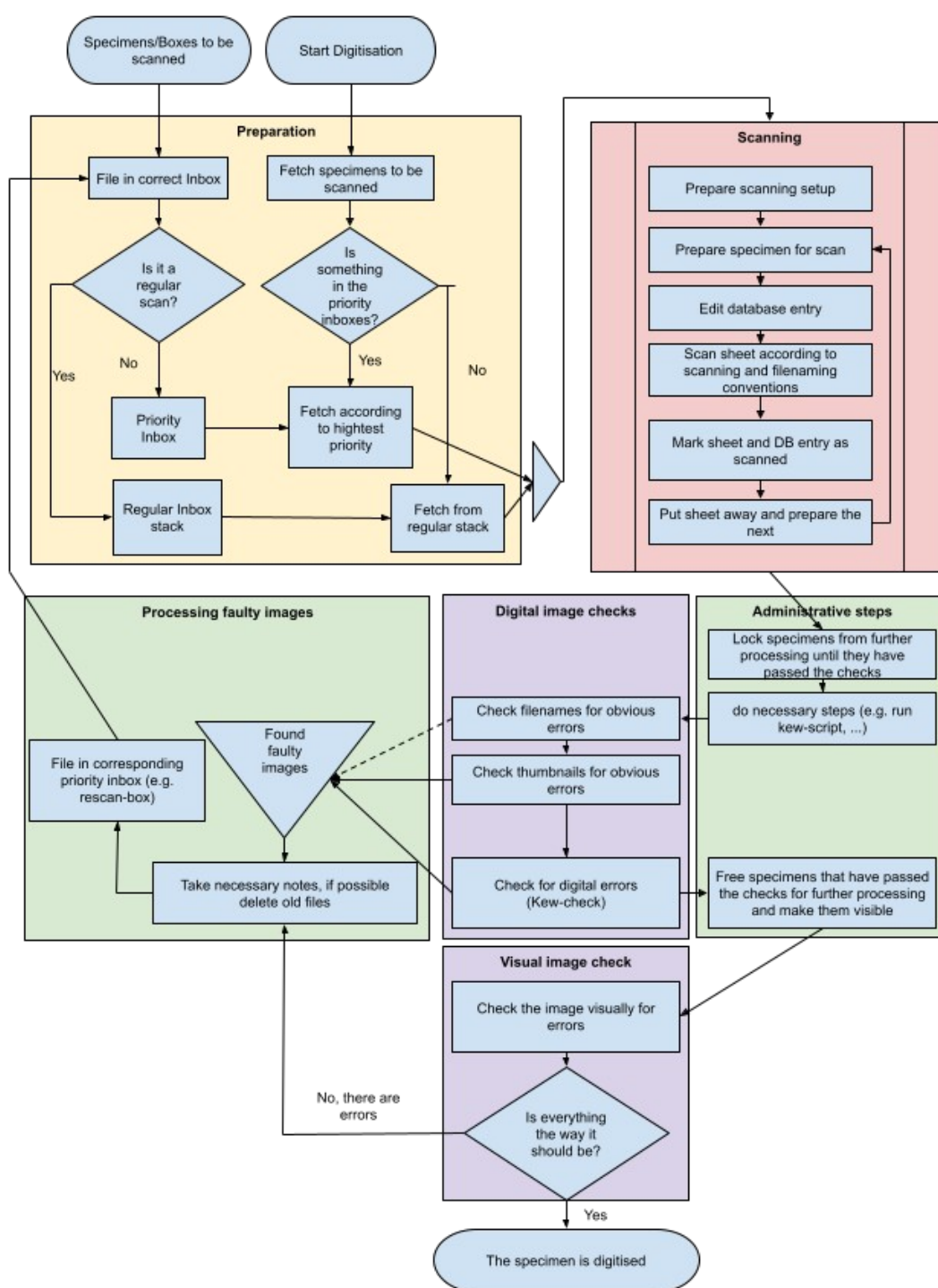
Figure 29. View of an [herbarium sheet](#) digitized following the NHMW workflow on the JACQ platform



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The digitisation process is illustrated in detail in Figure 30.



**Figure 30.** [Digitization workflow at the NHMW department of botany.](#)



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Once the digitisation process is finished and the quality and consistency checks are successfully completed, the physical specimens are stamped with the acquired image ("photo") and re-loaded in the collections.

Subsequently, an additional automated procedure prepares the metadata in ABCD 2.06 format for publication on the GBIF platform as a daily routine. The above-mentioned specimen can be found in the GBIF portal under <https://www.gbif.org/occurrence/3071002301>.

This procedure is applied to requests for individual specimens, as well as in bulk requests performed for projects, such as the Virtual Access projects for Dianthus and Greenland Sphagnum Mosses.

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## Workflows for online access of digital content of MNHN

The MNHN's central tool for all requests for access to specimens is centralised through the [Colhelper access interface](#) (figure 31). Colhelper is an application developed by the Muséum national d'Histoire naturelle (MNHN) in 2006 that allows any registered user to make requests for visits, loans, DoD, etc. It is a single entry point for scientists from all over the world.



**Figure 31.** [Colhelper Access interface](#).

The majority of digitised specimens at MNHN are (pending embargo) listed and searchable on the portal according to the type of digitisation.

- The 2D and 2D+ photos are directly accessible via the ["Science" portal](#).
- 3D digitisations (surface scan and tomography) reported on the "Science" portal are reported on the ["3dteque" website](#).

When a user wishes to obtain 2D/2D+/3D images of MNHN specimens, the process involves first making an image request on Colhelper. The user is then referred to the two sites mentioned above to find out whether or not the scan has already been performed. Depending on this, the user is led by the MNHN teams through the Colhelper site to follow different processes detailed below.

### Access to 2D/2D+ digitised specimens

In the case of 2D/2D+ specimens, users are invited to consult the "Science" site. This access portal is of wider interest as it provides a view of the catalogue of all MNHN computerised specimens.

In particular, this tool makes it possible to know what is present in the collection and to download lists of targeted specimens with all the associated data. A search field allows us to select only the specimens that have been photographed. In figure 32 below, the user has selected "Photographed only" as well as the field "Family: Brentidae" in order to have access to the photographs of the specimens of Brentidae (Coleoptera) (cf. figure 33).



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**MUSÉUM**  
NATIONAL D'HISTOIRE NATURELLE

FRANÇAIS

Partner collections Simple search

General search

**SPECIMEN / SET - ITEM**

Catalog number  
Type status  
Collection  
Item name  
Meteorite classification  
Meteorite name  
Photographed only

**TAXONOMY**

Scientific name  
Family  
Specific epithet  
Intraspecific epithet  
Author  
Vernacular name

**ORIGIN**

Country label  
Locality  
Site  
Collector's name  
Expedition  
Spot number  
Collector's number  
Geographic coordinates

**STRATIGRAPHY**

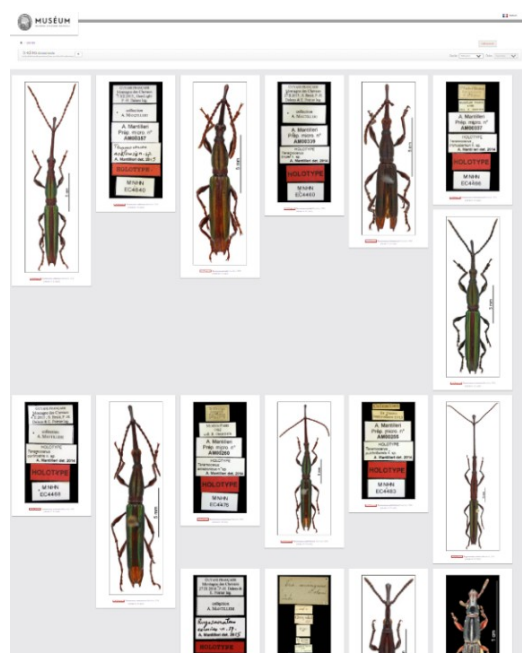
System  
Series  
Stage

OK

**Figure 32.** Search fields for collection specimens on the [MNHN "Science" website](#).

This allows the user to access all photographs according to the search fields entered.

At this stage, although the tool does not provide a download functionality, the user is able to download (right click / save as) each photograph individually. However, the system does not allow for the download of photographs in batches and photographs are not populated with associated metadata such as catalogue number. The link between the specimen lists and the photographs must be made manually. However, each uploaded photo is named after its unique identifier (digital object identifier) and cannot be mistaken for another.



**Figure 33.** Page of photographs of the types of Brentidae (Coleoptera).

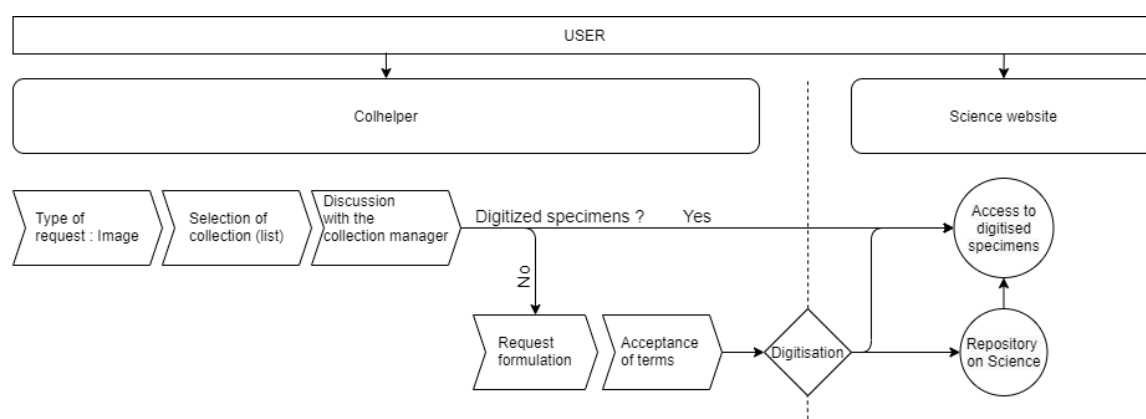


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## 2D digitisation on demand

Via Colhelper, users can also make requests for digitisation of collections. If the specimens of interest do not appear on Science, the user will formulate the request via Colhelper by filling in the list of specimens for which they would like photographs. Once the terms and conditions have been accepted, the request is processed by the collections teams who provide the images directly to the requester. Each new image is integrated into the MNHN databases which are linked to the Science website and thus made accessible, subject to possible embargoes on digital data.



**Figure 34.** Process for requesting access to digitised specimens and for digitisation on demand 2D/2D+.

## Access to 3D digitised specimens

When a request for access to 3D images is made via Colhelper, users are in most cases referred first to the Science website in order to locate and collect the inventory numbers of the targeted specimens, and then to the "3dtheque" interface in which information on the 3D digitised specimens is recorded (cf. Figure 35). The tool allows users to access lists of specimens by type of technical platform involved.

3 technical platforms are associated with it:


- (1) [Surfacus](#) has several surface scanners and photogrammetry setups, accessible to all natural history collections.
- (2) [AST-RX](#) for tomography with macro and nano focus equipment, accessible to all natural history collections.
- (3) [MH2D/3D](#) has several surface scanners, photogrammetric equipment, a 3D microscope, and high-performance graphics workstations. This platform prioritises acquisitions for the Anthropology collections.



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# 3Dthèque



Muséum  
national  
d'Histoire  
naturelle

[français](#) | [english](#)

## MNHN Digitization Work Portal

### The 3Dthèque

All works

### Platforms

AST-RX

MH-2D/3D

Surfaçus

**Objectives**

The Museum has several digitization facilities and services. The objective of the 3Dthèque is to centralize requests for 3D imaging achievements in order to provide simplified and uniform access to specimen resources related to the scientific databases of the Museum's collections.

The purpose of this service is to promote the conservation of specimens from collections and to make 3D imaging files available to the community for new research programs or for any other use related to the Museum's missions.

**Provision of digital data**

The available digitalization works carried out by the different platforms can be consulted on this page. Any request for access to the digitalization already performed is done via the Colhelper interface <http://colhelper.mnhn.fr> (section « Choice of types of request », « Images »). The MNHN collection specimens images are property of the Museum. The right to use these images is given for a single use only, and for purpose defined in the initial request for authorization to use them.

**Today, the program is being implemented with the services of:**

**AST-RX**

The « Scientific Access to X-Ray Tomography » (AST-RX in French) of the UMS 2700 2AD « Acquisition and Analyses of Data in natural history » <http://www.ums2700.mnhn.fr>

**Figure 35.** Home page of the "3dteque" website.

A query field allows searches by key words such as inventory number, project name, etc. The user, using the list of inventory numbers, can search by type of scan.

In the case of Figure 36, the user has performed a search with the inventory number and has access to the information relating to the surface scan operation of a *Steneosaurus* skull.

Once the digitised specimen has been identified, the user will formulate the access request on the Colhelper site and accept the terms and conditions.

## Works done on all platforms

Show  entries
Search:

Project	Title	Description	Collection	Inventory number	Platform	Thumbnail
2009 régularisation	Musée Villers-sur-mer, régularisation	Crâne et mandibule de <i>Steneosaurus heberti</i> , Galerie de Paléontologie, sur socle	F	1890.13	Surfaçus	

Showing 1 to 1 of 1 entries (filtered from 6,719 total entries)
Previous 1 Next

**Figure 36.** 3dtheque Search page for a specimen by inventory number.

In the event that the data is temporarily blocked by an embargo, the request is returned to the owner and the transfer of the data can be made directly from the owner to the requester. In case the data is



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free to share, it is transferred directly to the requester by the collections team. It is also possible to locate digitised specimens directly on the Science site. On the page of a targeted specimen, the 3D digitisation operation is displayed by a box with the operation number (cf. figure 37). This box gives direct access to the page of the 3dtheque presenting the information on the digitization operation (cf. figure 38).

However, improvements to the system are planned for better referencing of scans on the Science website.

The screenshot shows the 'Science' website interface. At the top is the 'MUSÉUM NATIONAL D'HISTOIRE NATURELLE' logo and a language selector set to 'FRANÇAIS'. The breadcrumb trail is 'MNHN / Mammals (ZM) / AC.1864-103'. The specimen name is 'Boselaphus tragocamelus Pallas, 1766'. Below this, there are two main sections: 'SPECIMEN' and 'TAXONOMY'. The 'SPECIMEN' section lists details: 'Crâne Et Squelette Complet', 'MNHN-ZM-AC-1864-103', 'Sex F', and 'Age Ad'. The 'TAXONOMY' section lists: 'Class Mammalia', 'Order Artiodactyla', 'Family Bovidae', 'Genus Boselaphus', 'Species Boselaphus tragocamelus', and 'Name Boselaphus tragocamelus Pallas, 1766'. A blue arrow points from the 'Operation 7571' box in the 'TAXONOMY' section to the '3Dthèque / AST-RX' page shown in Figure 38.

**Figure 37.** Information page on Science about a specimen that is being digitised

The screenshot shows the '3Dthèque / AST-RX' website. At the top is the 'Muséum national d'Histoire naturelle' logo and a language selector set to 'français|english'. The breadcrumb trail is 'Home / AST-RX / Works / Project'. The project title is 'ASTRX-2021-024-HOUSSAYE'. The description is 'Spécialisations microanatomiques dans les os longs de bovidés'. Below this, there is a section 'Works done by the platform AST-RX' with a search bar and a table of results. The table has columns: 'Collection', 'Inventory number', 'Description', 'Thumbnail', and 'Equipment'. The first entry is for 'ZM' collection, 'AC-1864-103' inventory number, 'os longs Boselaphus : fémur, humérus, radio-ulna, tibia' description, and 'v|tome|x L 240-180' equipment. The page shows 'Showing 1 to 1 of 1 entries'.

**Figure 38.** Information page on the 3dtheque website on the digitisation operation (7571) mentioned in figure 37.



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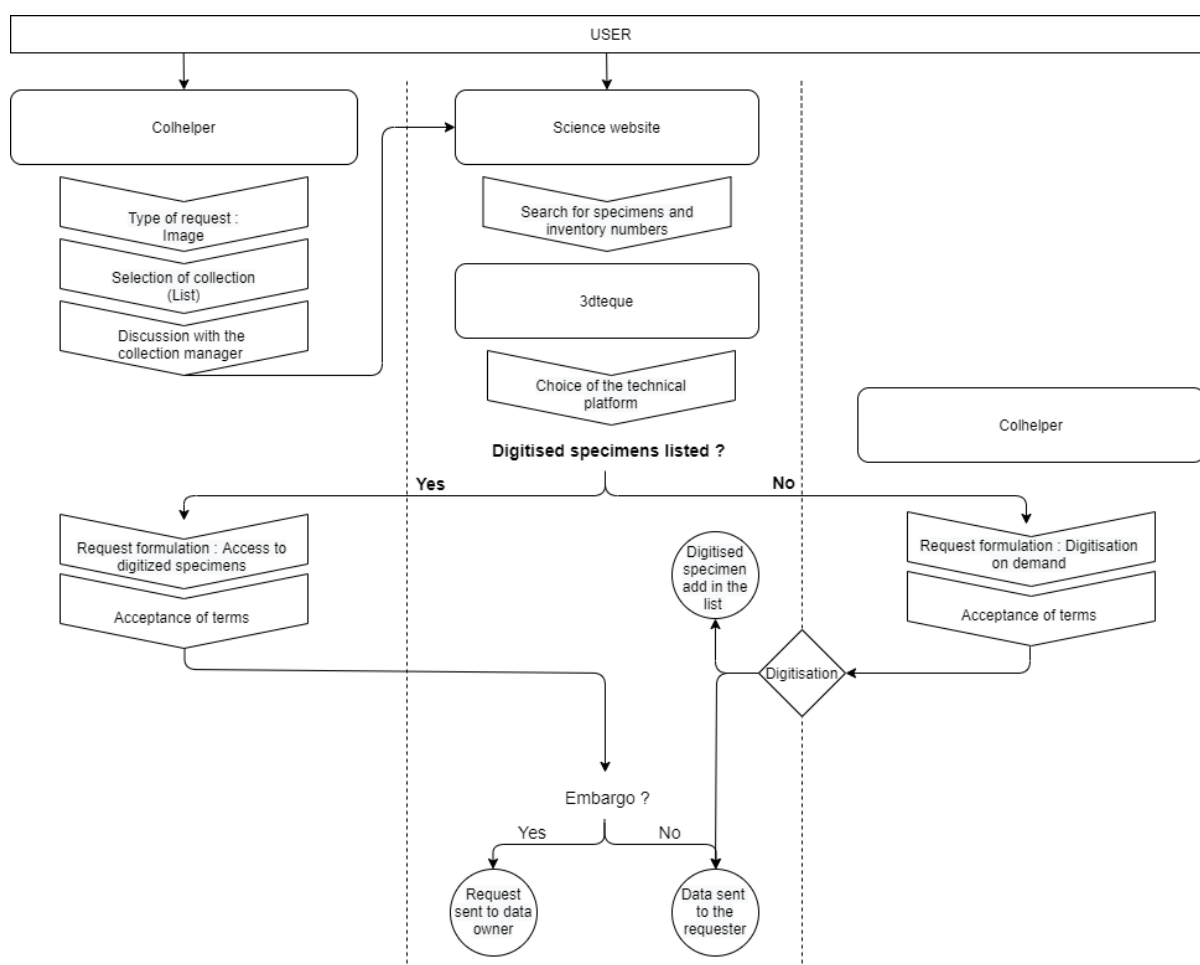
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### 3D digitisation on demand

If the targeted specimens are not yet digitised, the user, after having listed the specimens of interest on the "Science" site, can make an on-demand digitisation request via Colhelper. In the case of acceptance of the digitisation operations validated by the persons in charge of the targeted collections and the managers of the technical platforms, the user is again sent back to the "3dtheque" to fill in and submit a digitisation request form to the technical platforms. In this process, the user must take note of the conditions of use and characteristics of each technical platform and fill in the details of their project for submission to the technical platform teams.

Once the request has been validated by the technical platform, the request made on Colhelper can also be validated with the planning of the digitisation between the requester, the collection managers and the technical platform staff.

Once the digitisation has been completed, the data can be edited (on request) and then sent directly to the applicants. At the same time, the digitisation operation is registered in the MNHN databases and is therefore recorded on Science and the 3dtheque.



**Figure 39.** Process for requesting access to digitised specimens and for digitisation on demand 3D.

### Various

Other types of digitisation requests are also possible on a case by case basis. At MNHN, many technical platforms allow for 2D, 2D+ and 3D imaging (other than by the three technical platforms mentioned above), such as optical microscopy, SEM, fluorescence imaging, etc. Here again, requests are most often made via the Colhelper site and each technical platform has its own specifications and its own protocols.



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## Access to 2D digitised specimens via RECOLNAT: National Collection Research Infrastructure

[RECOLNAT](#), led by the MNHN, is a distributed infrastructure, which produces, gathers and makes accessible data from all natural history collections held in metropolitan France and the French overseas territories. [RECOLNAT](#) is organised to be the French node of the European mirror infrastructure DiSSCo.

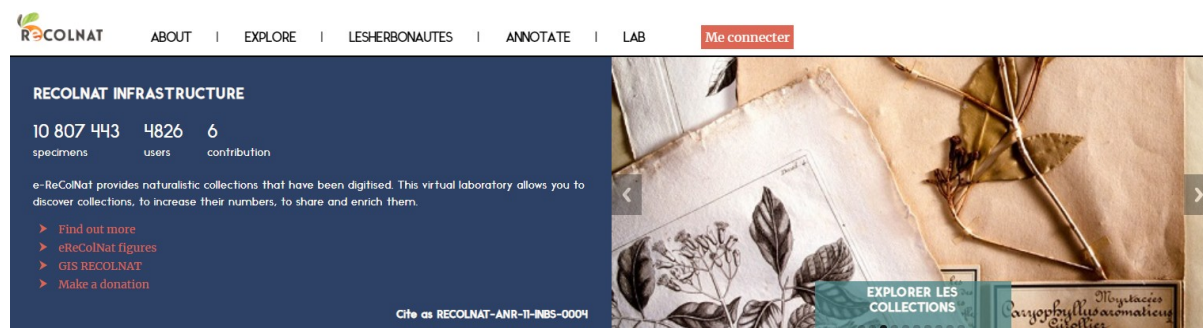


Figure 40. Front page of the RECOLNAT website.

Among these services, [RECOLNAT](#) has developed an interface allowing access to computerised and digitised specimens. The user can carry out simple and advanced searches according to the type of collection, digitised or not digitised specimens, localities, institutions, date of collection, etc.

Depending on the search criteria, the user is led to a result page where it is possible to reapply different filters such as geographical locality, status of the specimens, taxonomic rank lower than the one first entered, type of collection (see figure 41).

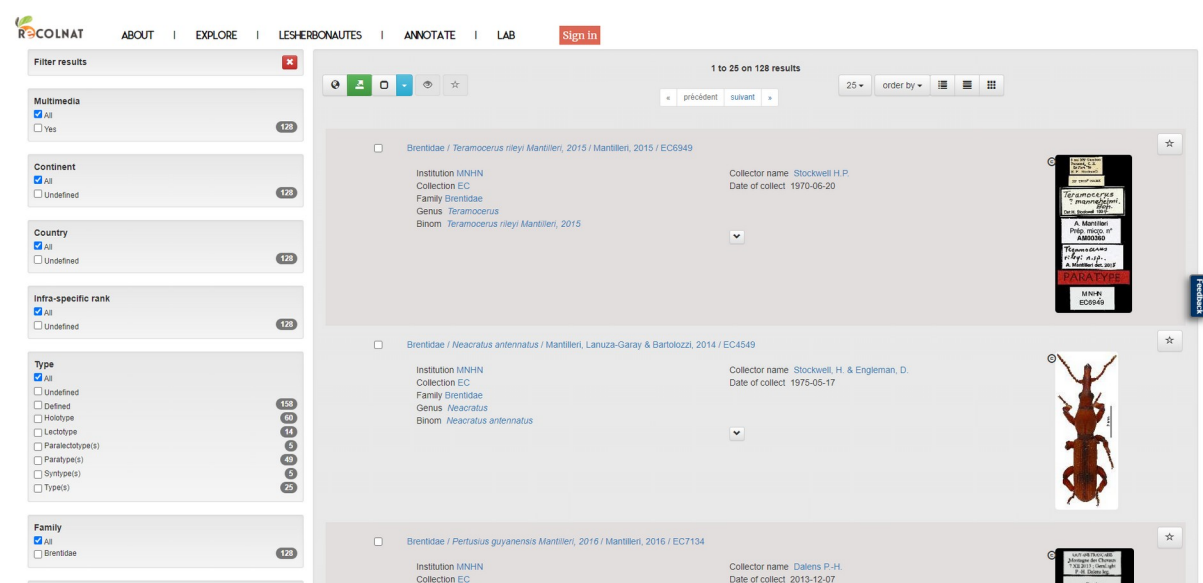


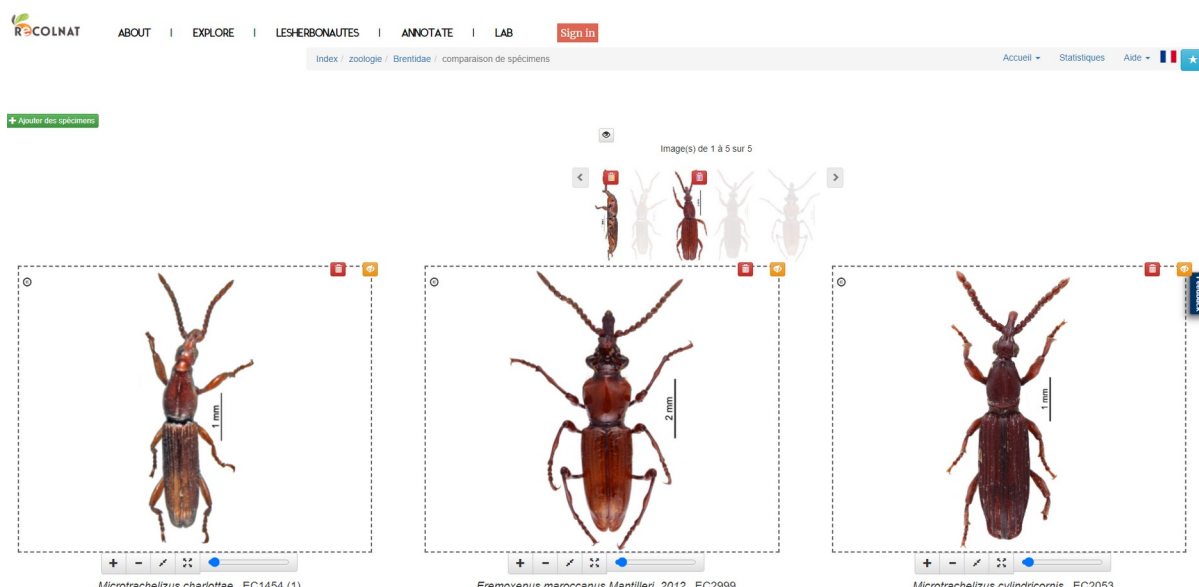
Figure 41. RECOLNAT website specimen search results page.

Thus, through this portal, the user can download the data files of the targeted specimens as well as the image(s) that are associated with the specimens. The search system also offers an online comparison tool of the digitized specimens. In this way, the user can select from the list of photographed specimens and compare them online (see Figure 42).



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**Figure 42.** Image comparison tool on the RECOLNAT website.

Here, the site does not offer a process for making on-demand digitisation requests. However, the site references the collections of several institutions whose contacts are listed in a dedicated tab, which allows the user to contact an institution directly in order to make their requests.

### **Development and revision of information systems and accessibility to digital data**

Over the past 20 years, MNHN has developed a number of tools to manage and access data on its collections. Today, the MNHN is engaged in a vast overhaul of its information system, the objective of which will be to centralise all of the MNHN's databases and to optimise access and archiving of digitised specimens. This work also involves the services and databases of the RECOLNAT infrastructure and will be built in coherence with the construction of DiSSCo.



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## Future developments

**HCMR** is planning to upload more micro-CT datasets from several biological samples in the future. Furthermore, dissemination activities will be performed in order to attract potential users of the micro-CTvlab.

**RBINS** is planning to merge the existing data collections together with the virtual collection pages in order to be accessible by all interested users. The [DaRWIn CMS](#) will provide all data and metadata related to the specimen(s) and link to the image stored in the new Virtualcollections system based on [Collective Access](#) (as Africa Museum) with the use of a IIIF compatible viewer ([Mirador](#)). RBINS will also extend the [DIGIT-KEY](#) to all digitization devices used by the Task 7.2 partners. The user will be able to navigate in the selection key and see the available setups on the basis of the digitization requirements.

You are here: [Home](#) / [DIGIT-KEY](#)

### Key to identify the appropriate digitization technique and the accompanying workflow and data pipeline (D7.2.)

This form will guide you through the process of deciding which digitisation technique is the best suited to meet the request of the Digitisation on Demand (DoD). It can also be used to browse through the options of currently used digitisation techniques for Natural History Collections. At the moment two handbooks have been published regarding these digitisation techniques which provide more basic information.

Keklikoglou, K., Faulwetter, S., Chatzinikolaou, E., Wills, P., Brecko, J., Kvaček, J., Metscher, B., & Arvanitidis, C. (2019). Micro-computed tomography for natural history specimens: a handbook of best practice protocols. *European Journal of Taxonomy*, (522).  
<https://doi.org/10.5852/ejt.2019.522>

Brecko, J., & Mathys, A. (2020). Handbook of best practice and standards for 2D+ and 3D imaging of natural history collections. *European Journal of Taxonomy*, (623).  
<https://doi.org/10.5852/ejt.2020.623>

The collection or specimen has to be digitised in:



**Figure 43.** Home page of the [DIGIT-KEY](#) website.

**RMCA** is envisaging to develop a landing page in order to combine the information of the DaRWIn CMS and the digitisation results from the virtual collections, which will be similar to the RBINS virtual collections page.

**RBGK** will eventually move all the microscope slides data from the Access database to the EarthCape and these will be available for the public in a new data portal. RBGK images will still be uploaded to Digifolia and Plants of the World Online, but data will be held in EarthCape with URLs linking to the images. Even further planning includes the automatic import of data from EarthCape into Digifolia. Furthermore, RBGK is planning to develop a new data portal for all collections in 2022.

The **CSIC** laboratories will provide digital information to their web-tool following major guide-lines of the DIGITAL.CSIC database repository. Future development will also include the international (English) version of the web tool to provide controlled and open access to external researchers.

**NHMW** supports a strong commitment for further digitisation of collection specimens for the future. An institution-wide collections database is under construction which will be the base for feeding a future portal of a digitised collection in NHMW. So far, digitised objects of the NHMW are implemented in internationally available scientific collection portals like GBIF, GeoCAsE, Jacq, Thanados and others. Likewise, an institutional repository for digital research data is currently being set up.

It will primarily house data generated by the NHMW 3D Lab and micro-CT facility and will be financed through the MicroMus Project supported by the Austrian Research Promotion Agency FFG. Its



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structure, however, will be designed in such a way that other digital content (e.g. datasets from data loggers, photogrammetry datasets, sequencing data, audio-visual data, and other generic datasets) will be made available through this repository in the future.

**MNHM** will centralise all of the MNHN's databases and to optimise access and archiving of digitised specimens.

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Champion, E., & Rahaman, H. (2020). Survey of 3D digital heritage repositories and platforms. *Virtual Archaeology Review*, 11(23), 1-15. doi: 10.4995/var.2020.13226

## List of figures

Figure 1. Micro-CTvlab workflow	3
Figure 2. Micro-CT rest API endpoints	4
Figure 3. Screenshot of the metadata catalogue of micro-CT vLab	6
Figure 4. Screenshot of the form for uploading a micro-CT dataset	7
Figure 5. The home page of the RBINS virtual collections	8
Figure 6a. Example of a specimen page within virtual collections	9
Figure 6b. Iframe of the DaRWIN CMS page in the Virtualcollections portal	10
Figure 7. Overview page of micro-CT scan metadata for a single specimen	11
Figure 8. Detailed information (metadata) of the used settings for the micro-CT scan	11
Figure 9. Detailed information (metadata) of the used settings for the micro-CT scan	12
Figure 10. 3D model extracted from the digitisation data with brief metadata on scanning and post-processing parameters	12
Figure 11. Digitisation pathway at RBINS	13
Figure 12. Home page of the virtual collections portal of RMCA	14
Figure 13. The advanced “search” function of the virtual collections portal	14
Figure 14. The main themes page of the virtual collections portal	15
Figure 15. The page of a digitised specimen with added CMS information	15
Figure 16. Digitisation pathway at RMCA	16
Figure 17. RBGK workflow describing how data and images for microscope slides are currently stored and linked	17
Figure 18. The “Images” section of the <i>Dalbergia acuta</i> Benth from the Plants of the World Online	18
Figure 19. Image with caption displayed in the <i>Dalbergia acuta</i> Benth from the Plants of the World Online	18
Figure 20. The workflow indicating how data and images for microscope slides will be	19



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**SYNTHESYS+**  
Synthesis of Systematic Resources  
a DiSSCo project

stored and linked in the future	
Figure 21. RBGK workflow describing how data and images for carpological specimens are currently stored and linked	21
Figure 22. Plants of the World Online page displaying information and images for the species <i>Hydnora abyssinica</i>	21
Figure 23. Plants of the World Online page displaying resources and links to specimens of <i>Hydnora abyssinica</i>	22
Figure 24a. Sketchfab: model of <i>Hydnora abyssinica</i> with the scale information	23
Figure 24b. Sketchfab: additional information, link and 3D model metadata of <i>Hydnora abyssinica</i>	23
Figure 25. Diagram of the digitisation workflow of MNCN-CSIC	24
Figure 26. Internal web-based semi-automatic tool for digital database management	24
Figure 27. The home page of the The online collection of the Natural History Museum of Wien (NHMW)	26
Figure 28. 3D model of a Japanese giant spider crab in Sketchfab	28
Figure 29. View of an herbarium sheet digitized following the NHMW workflow on the JACQ platform	29
Figure 30. Digitization workflow at the NHMW department of botany	31
Figure 31. Cohelper Access interface	33
Figure 32. Search fields for collection specimens on the MNHN "Science" website	34
Figure 33. Page of photographs of the types of Brentidae (Coleoptera)	34
Figure 34. Process for requesting access to digitised specimens and for digitisation on demand 2D/2D+	35
Figure 35. Home page of the "3dteque" website	36
Figure 37. Information page on Science about a specimen that is being digitised	37
Figure 38. Information page on the 3dtheque website on the digitisation operation (7571) mentioned in figure 37	37
Figure 39. Process for requesting access to digitised specimens and for digitisation on demand 3D	38
Figure 40. Front page of the RECOLNAT website	39
Figure 41. RECOLNAT website specimen search results page	39
Figure 42. Image comparison tool on the RECOLNAT website	40
Figure 43. Home page of the DIGIT-KEY website	41

