Digitisation of Microscopic slides in the Myriapod Collection of the Natural History Museum Vienna

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Introduction

The microscopic slides of the Myriapoda collection of the Natural History Museum Vienna (NHMW) comprise 5063 units (slides), organized taxonomically and containing parts of dissected specimens representing 2054 nominal taxa (including valid species, names that have fallen into synonymy in the course of time, manuscript names, etc.). The slides are stored separately in 48 drawers of a wooden cabinet (Fig. 1), bearing small etiquettes on the front to display the name of the taxonomic orders. Each drawer contains several flat carton microscope slides holders, placed without any particular order, showing on the cover the names of the taxa, with the names of types underlined in red.

Fig. 1. Wooden cabinet with 48 drawers containing the microslides of the Myriapod collection of NHMW. Photo credit N. Akkari

The microscopic slides contain parts of dissected specimens of millipedes (Myriapoda, Diplopoda), centipedes (Myriapoda, Chilopoda) and a few slides of the smaller Myriapoda group Symphyla and Pauropoda, in vast majority mounted in Canada balsam between a slide (of generally a size of 7.7cm x 2.5cm) and a coverslip, and are intended to be permanently conserved in the collections of the NHMW. Several of the structures mounted in these preparations are of taxonomic importance,

for example gonopods (copulatory organs of millipedes), mouthparts, legs, body-parts and are in most cases used to help the identification of the corresponding species and subspecies. Their importance becomes paramount in the case of type specimens, as these structures usually correspond to what has initially been studied and illustrated by the authors in the original description of the species and are solicited by experts for current research on these taxa. The vast majority of the microscopic preparations in the collections of the NHMW correspond to those prepared by Carl Attems (1868-1952) either for the species he described or those he himself collected and/or studied and illustrated (or not) in his publications, thus also historically important. In most cases, the microscopic slides contents could be linked to the corresponding specimens preserved in 70-80% ethanol and from where they were dissected, but in many other instances, specimens are missing, lost or simply not kept in NHMW.

While a large number of the microslides has survived the course of time, offering a good material for examination and research, the mounting medium in several others has dried out, rendering the examination of these structures difficult to quasi impossible. Another observed limitation is the maceration of the structures, which ultimately hinders a proper documentation and interpretation. While the majority of the slides bear handwritten labels indicating the name of the taxon and the structures contained in the preparations, some bear a writing directly on the glass, either additionally to the label or alone.

In the recent decades, there was a continuous request to remotely access and examine several microscopic preparations of type specimens kept in NHMW in order to complete taxonomic revisions, or species redescriptions or for comparison of taxa. Illustrations of the slides and their contents figured for examples in these recent works on the systematics of Myriapoda (Enghoff & Akkari 2024: fig. 3C; Golovatch & Akkari 2024: figs 2, 4; Wesener et al. 2023: fig. 5A, B, E, F; Antic et al. 2021: fig. 3D; Akkari & Enghoff 2019: fig. 1).

Digitizing the collections of the microscopic slides has become a necessity and this for the following reasons:

1. Providing an overview of the number of the microscopic preparations present in the Myriapod collection the and corresponding represented taxa, including type specimens.
2. Assessing the status of the microscopic preparations and their contents, in case there is a need for reparation.
3. Facilitating and expediting the physical localisation of the slides to answer requests or for the in house ongoing scientific research, and this by a combination of:
    a. Labelling the slides holders and inserting numbers on the drawer's labels. This will avoid going through all the slide holders of all drawers containing species of the same order when in search of a certain specimen.
    b. Switch to digital search of the microscopic preparations and visualisation of their contents. This will further speed up the searching process and also curb any additional damage to the slides via manipulation, and provide a timeless visualisation even in instance of further damage in the course of time
4. Obtaining a digital library of the microscopic preparations and opening the information to a broader scientific audience.

Workflow

In the course of OSCA project (Open Scientific Collections Austria), we had the opportunity to digitize part of the microscopic preparations of the Myriapoda collection. The work has followed three major steps of digitizing 1) the overview of the slides holders closed and open, 2) the overview of the microscopic preparations and 3) detailed documentation of the mounted structures for a detailed scientific examination.

The workflow (Fig. 2) explains the different steps we followed to digitize this part of the and in the following details of the different steps and the equipment we required to perform the different steps.

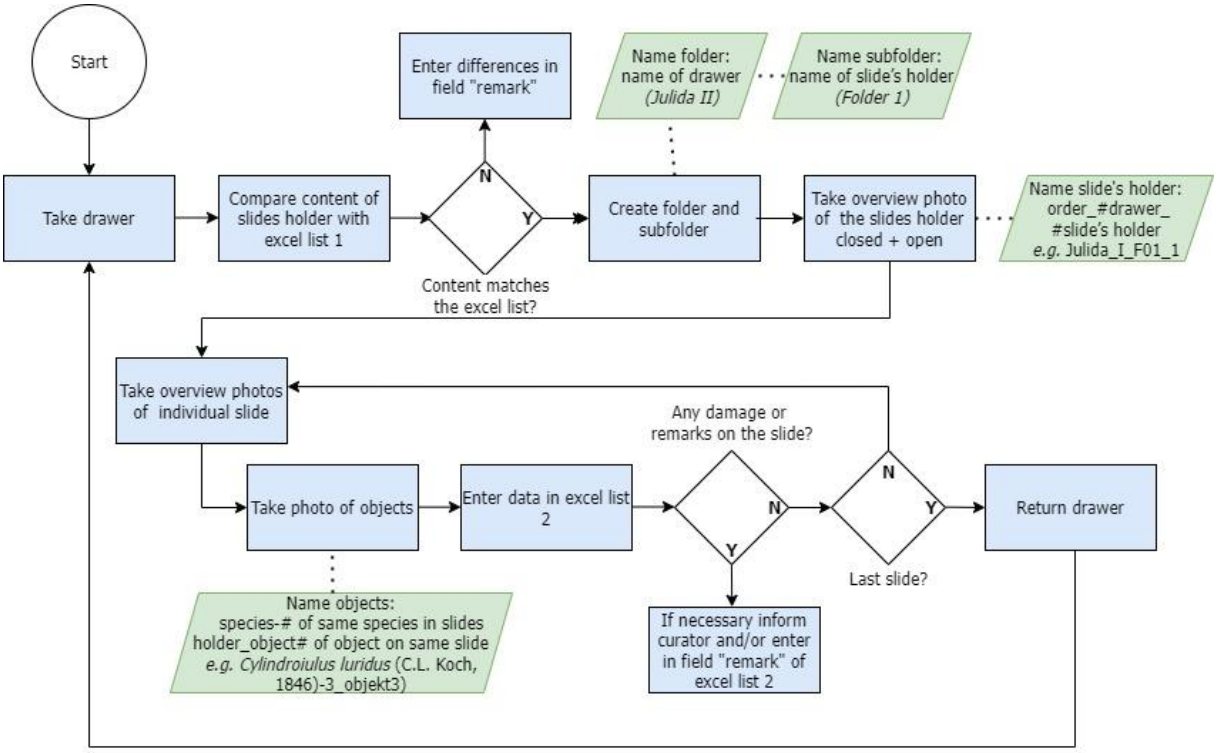

Fig. 2. Workflow of the Digitisation of Microscopic slides in the Myriapod Collection (NHMW)

1. **Digitizing the slides holders**
   a. **Extracting drawers, numbering and photographing of the carton slides holders**

   Drawers were taken out of the cabinet one by one, following the order's names. They were placed near the photographing equipment for the time of databasing. Roman numbers (I, II, III, IV, etc.) were added manually in front of the order's name on each drawer for the different drawers of the same order (Fig. 3), following their placement in the cabinet (top to bottom). Carton slides holders were extracted and photographed one by one using a Nikon D7200 camera mounted on a Stand System Kaiser RTX with a height of 110 cm. Each slides holder was photographed closed to show the name of the taxa on the outside (Fig. 4), then open to illustrate the overview of the slides (Fig. 4) the way they were hitherto placed. Small labels with numbers (Folder 1, Folder 2, Folder 3, etc.) were inserted inside each photographed slides holder, before closing and putting it back in the drawer.

Fig. 3. Drawer of Julida IV, showing the slides holders inside and the label on the front Photo credit N. Akkari

Fig. 4. Slides holder: closed displaying the names of the taxa (left) and open showing the slides it contains (right). Photo credit Johanna Xenia Zhuber-Okrog

b. Databasing

All images were copied to the computer, arranged in separate folders for the different taxonomic orders. Under each order, the images labelled with the corresponding taxonomic order's name, drawer's number (Roman number), folder's number (Arabic number) and then 1 – closed; 2 – open, example "callipodida I_F01_1" and "callipodida I_F01_2" for the first folder of the first drawer of the order Callipodida.

A simple excel spreadsheet was initially created, with the different drawers' numbers and enclosed numbered slides holders. For each folder, we list the species names, those corresponding to type specimens set in bold and underlined, indicating the number of microscopic preparations per taxa, inventory numbers if they bear any and comments.

2. Overview of separate microscopic preparations

a. Photography

The microscopic preparations were individually photographed using a Nikon D7200 with A Nikkor 60 mm 1:2.8 G ED macro lens mounted on a Stand System Kaiser RTX 2 XA with two cold light lamps (Kaiser RB 218N HF). (Fig. 5) After photography, the preparations are returned to the respective slides holders.

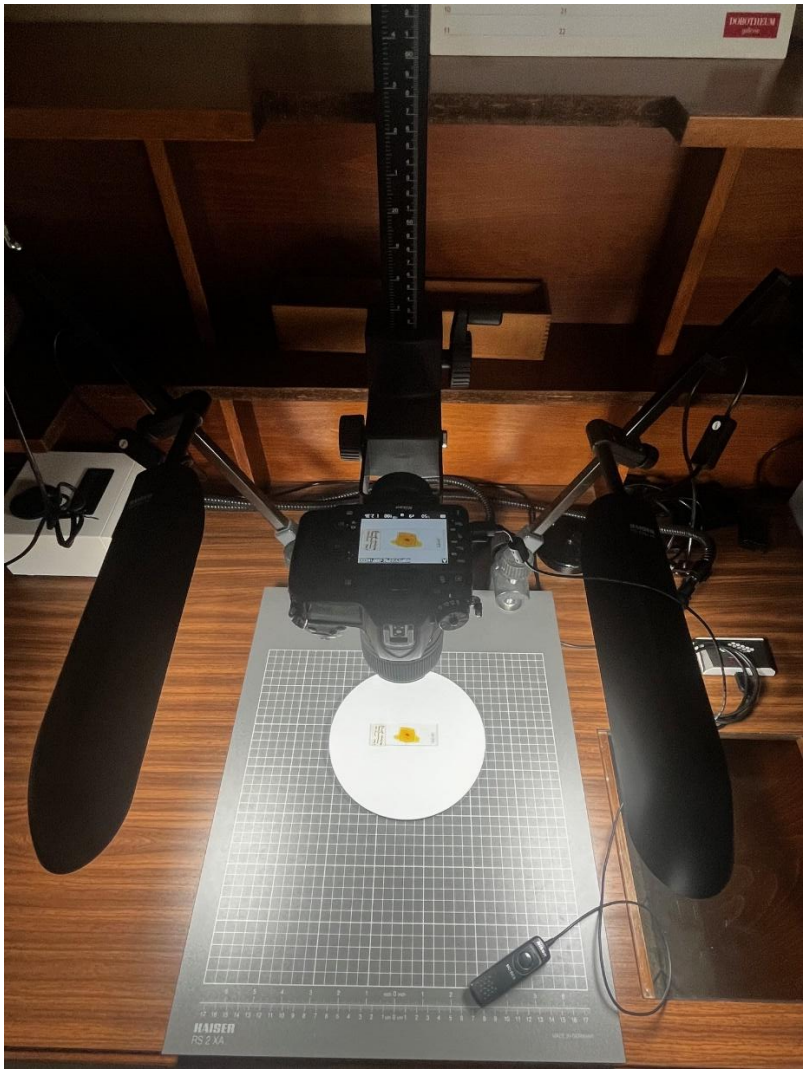

Fig. 5. Nikon D7200 with A Nikkor 60 mm 1:2.8 G ED macro lens mounted on a Stand System Kaiser RTX 2 XA with two cold light lamps. Photo credit N. Akkari

b. Image processing and labelling

All obtained images are transferred from the camera card to the respective folders on the computer, saved and labelled taxon Author- slide Nr_overview.

c. Repairing damaged microscopic preparations

During this steps, microscopic preparations with obvious damage, i.e. broken coverslip or dried medium are transferred to the lab for technical repair. In cases where Canada Balsam has dried out over time, a drop of Xyene (C_8H_{10}) is added to liquefy it. Coverslips have in some cases been replaced where a severe damage has been noticed.

3. Detail imaging of the microscopic slides for scientific research

a. Image capture and labelling

Detailed images of the contents of the microscopic preparations were obtained with a Nikon DS-Ri2 camera mounted on a Nikon SMZ25 stereomicroscope using its integrated Transmitted light from bellow and a LED-ring light Nikon P2-FIR from above (Fig. 6). Images were taken with the NIS-Elements Microscope Imaging Software with an Extended Depth of Focus (EDF) (Fig. 7), with a resolution of (4908x3264), a scale bar was added on each before saving in respective folders. Images are labelled with the name of the species “taxon Author- slide Nr_object in focus”.

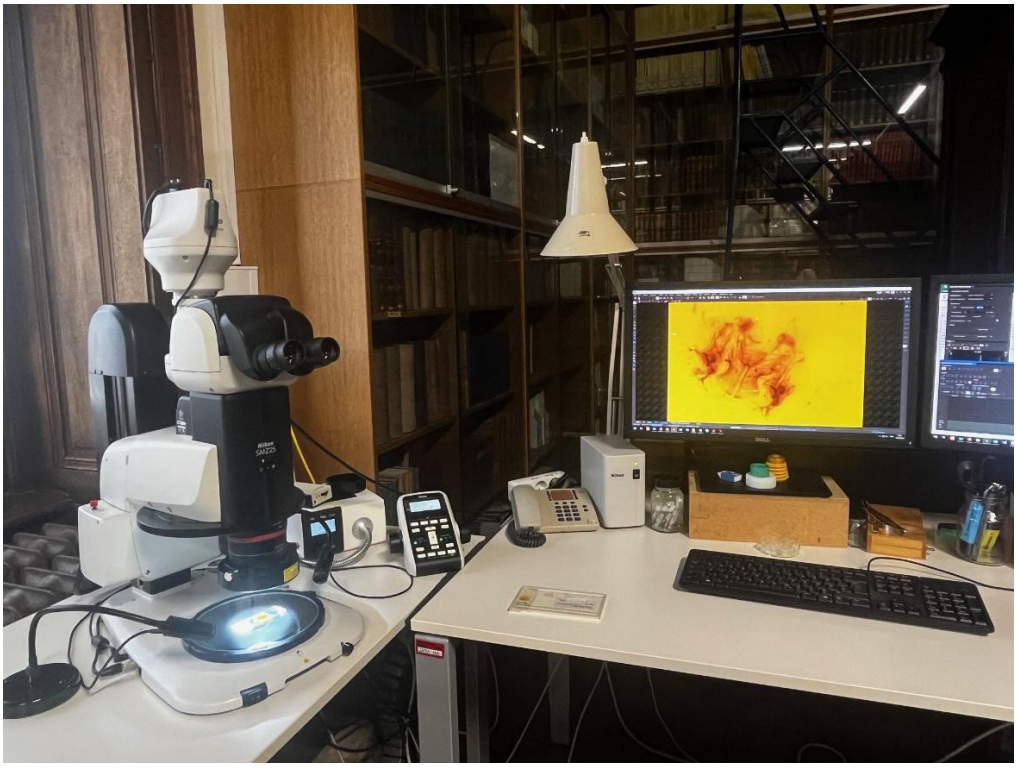

Fig. 6. Nikon DS-Ri2 camera mounted on a Nikon SMZ25 stereomicroscope. Photo credit N. Akkari

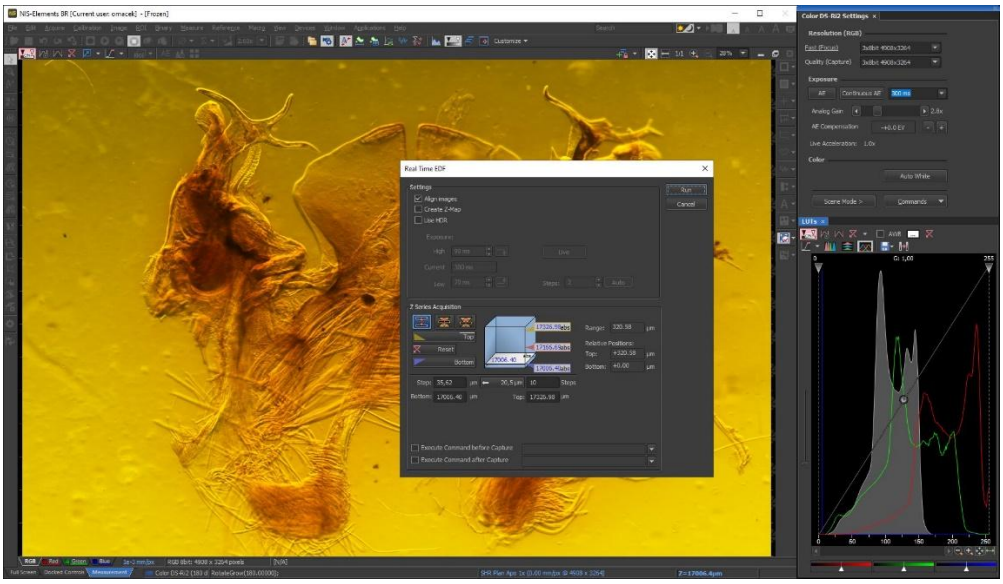

Fig. 7. NIS-Elements Microscope Imaging Software

b. Databasing

The objects are then listed by a customized batch script getting all the names of photos and their storage location. This list is then used for excel summarizing the number of slides and providing for OSCA's template, including the object names, the Photographer, Licenses and Photo storage.

If modifications and repairs on the objects were made, the remarks are also manually entered into the database of the NHMW 3Zoo CentralCollect (MS-Access System).

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