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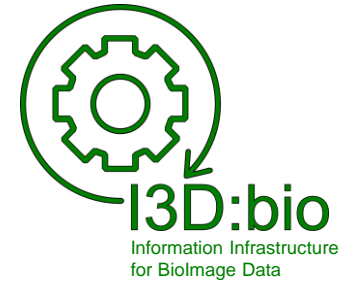
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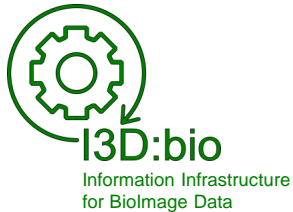
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Research Data Management for Bioimage Data at the **ADD INSTITUTE HERE**

Metadata Curation: Key-Value Pairs



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Adapted from: Schmidt C., Bortolomeazzi M., Boissonnet T., Fortmann-Grote C. *et al.* (2023). I3D:bio's OMERO training material: Re-usable, adjustable, multi-purpose slides for local user training. Zenodo. DOI: 10.5281/zenodo.8323588
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Metadata details in form of Key-Value Pair annotation

Key-Value Pairs allow (standardized) annotation of detailed metadata

Consists of

- **Key:** Denotes a real-world object or an abstract concept that can be assigned a specific value (of several or many possible values)
- **Value:** Number or text string that specifies the object denoted under „Key“

Examples:

Key: „cell type“ **Value:** „CD4+ T cell“

Key: „disease model“ **Value:** „experimental autoimmune encephalomyelitis“

Key-Value Pairs are part of the metadata (here: in OMERO.web)

Key-Value Pairs can be annotated

- at the Image level
- at the Dataset level
- at the Project level

The screenshot shows the OMERO.web webclient interface. On the left, a file tree lists datasets under 'Mary Mayperson', including '20171123_M36_1_D0h_pERK.czi'. The main area displays a grid of image thumbnails. On the right, the 'General' tab of the metadata panel is active, showing details for the selected image. The 'Key-Value Pairs' section is expanded, displaying a table of metadata.

Key-Value Pairs

Key	Value
primary_AB	anti-p-ERK1/2 (Cell Signaling)
secondary_AB	goat anti-rabbit Alexa-Fluor-647
Cell type	CD4+ T cells
Organ	spleen
Organism	Mus musculus
Strain	C57BL/6

Options to annotate Key-Value Pairs in OMERO

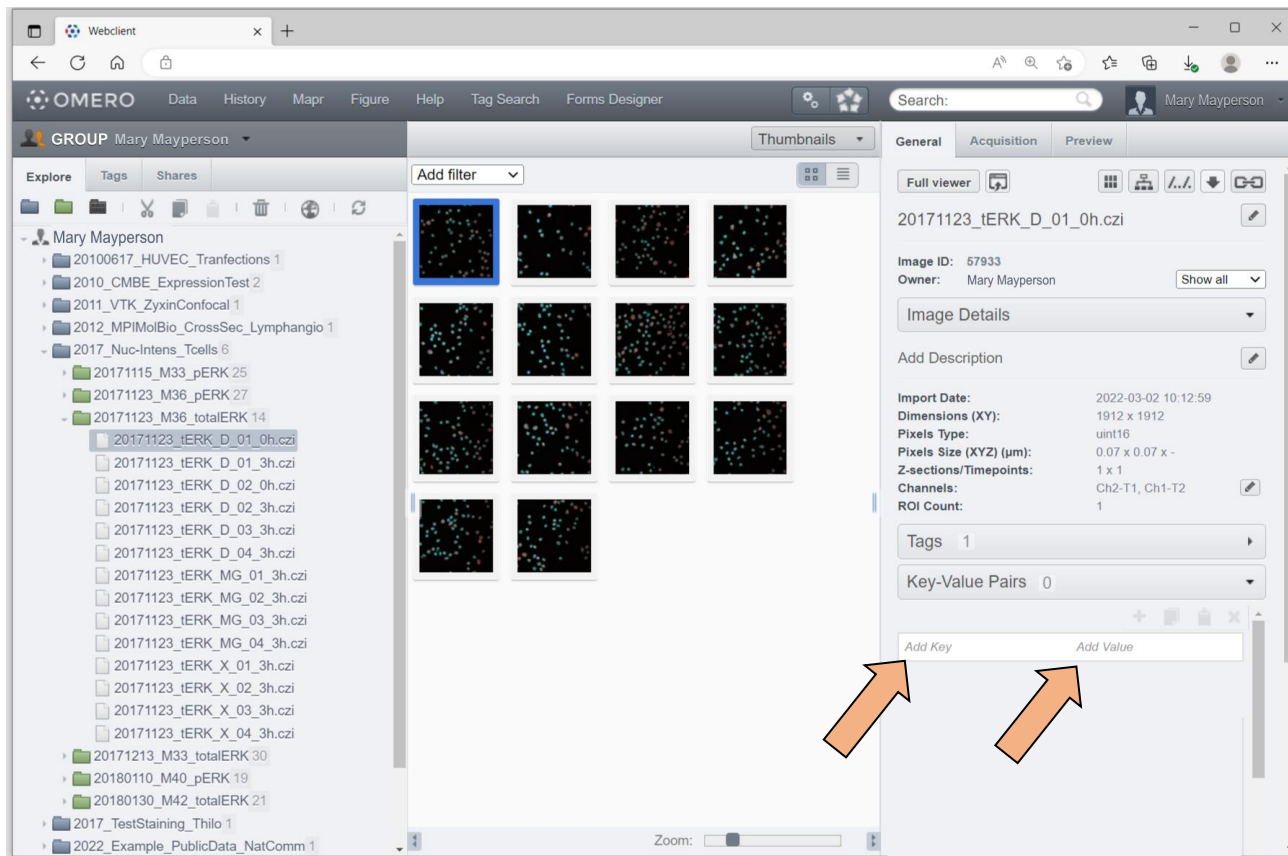
- Manual Key-Value Pair annotation
- Using Bulk Annotation Tools (scripts in OMERO.web, this option is only available if the respective scripts were installed for OMERO.web by the OMERO administrator)
- Using the Metadata Editor Tool OMERO.mde (only during data upload with the OMERO.insight client)

Manual annotation of Key-Value Pairs in OMERO

To add a Key-Value Pair manually, select

- an image
- a collection of images
- a Dataset
- a Project

and fill out the fields under the Key-Value Pairs toggle



Search for a specific Key-Value Pair

Using the combination of

<Key>:<Value>

in the search field allows you to directly search in your data for a specific Key-Value Pair annotation

The screenshot shows the OMERO webclient interface. The search bar at the top right contains the text 'Organ:spleen'. The search results table shows a list of images, with the first result being '20171123_M36_1_D0h_pERK.czi'. The right-hand panel shows the 'General' tab for the selected image, displaying details such as 'Image ID: 57934', 'Owner: Mary Mayperson', and 'Import Date: 2022-03-02 10:13:00'. The 'Key-Value Pairs' section is expanded, showing a table of annotations.

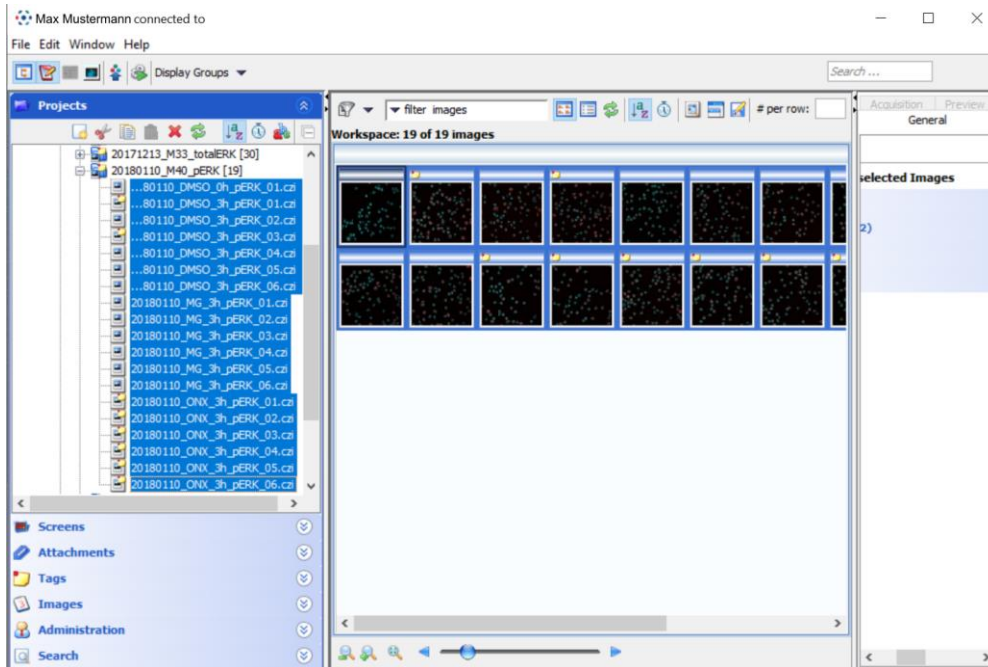
Key	Value
primary_AB	anti-p-ERK1/2 (Cell Signaling)
secondary_AB	goat anti-rabbit Alexa-Fluor-647
Cell type	CD4+ T cells
Organ	spleen
Organism	Mus musculus
Strain	C57BL/6

Key-Value Pair enrichment with OMERO Bulk Annotation Tools

Based on an original script by Christian Evenhuis
<https://github.com/evenhuis/omero-user-scripts>
(Modified by other users' contributions, see
<https://github.com/ome/omero-scripts> for latest version)

Key-Value Pair Annotation with the „KeyVal from csv“ script (1/7)

- 1) Prepare a table with Keys in row 1. The first Key should be „Image“
- 2) Select a group of images in OMERO.insight (*not* in OMERO.web)
- 3) Copy the image names and paste them under the Key „Image“ into a table sheet



	A	B	C	D
1	Image	Organism	Strain	Anatomical structure
2	20180110_DMSO_0h_pERK_01.czi			
3	20180110_DMSO_3h_pERK_01.czi			
4	20180110_DMSO_3h_pERK_02.czi			
5	20180110_DMSO_3h_pERK_03.czi			
6	20180110_DMSO_3h_pERK_04.czi			
7	20180110_DMSO_3h_pERK_05.czi			
8	20180110_DMSO_3h_pERK_06.czi			
9	20180110_MG_3h_pERK_01.czi			
10	20180110_MG_3h_pERK_02.czi			
11	20180110_MG_3h_pERK_03.czi			
12	20180110_MG_3h_pERK_04.czi			
13	20180110_MG_3h_pERK_05.czi			
14	20180110_MG_3h_pERK_06.czi			
15	20180110_ONX_3h_pERK_01.czi			
16	20180110_ONX_3h_pERK_02.czi			
17	20180110_ONX_3h_pERK_03.czi			
18	20180110_ONX_3h_pERK_04.czi			
19	20180110_ONX_3h_pERK_05.czi			
20	20180110_ONX_3h_pERK_06.czi			
21				
22				
23				
24				
25				
26				

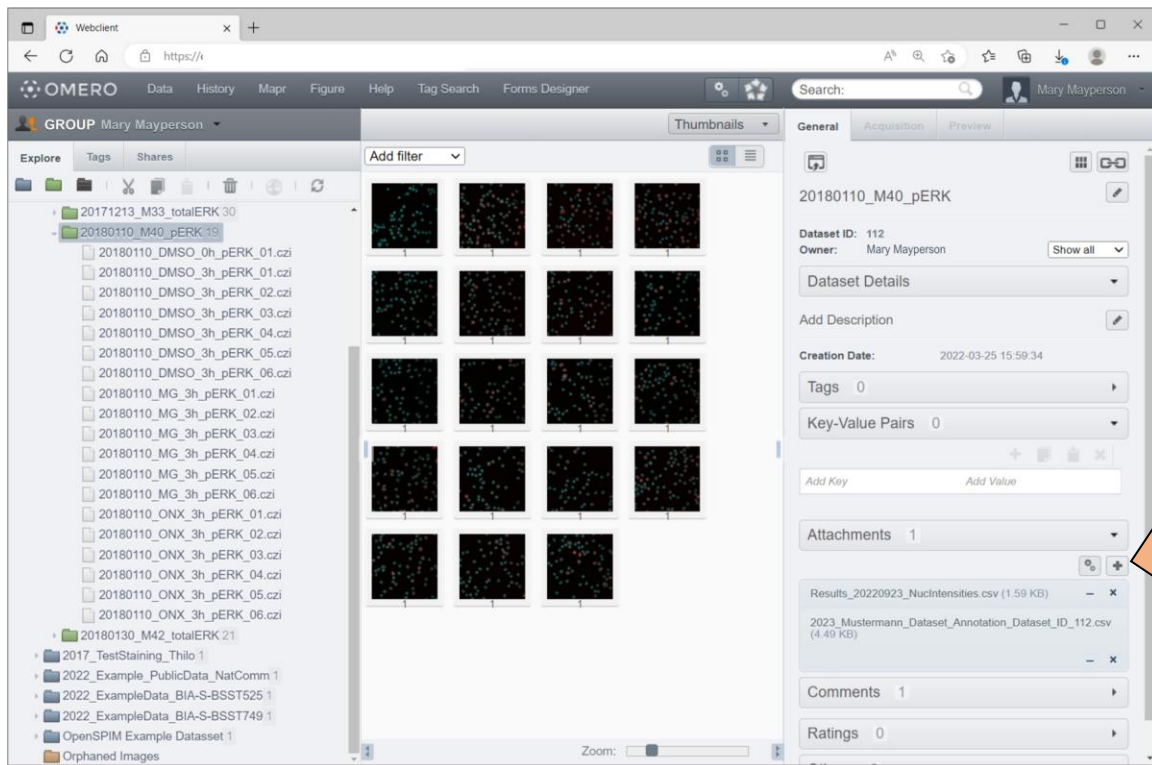
Key-Value Pair Annotation with the „KeyVal from csv“ script (2/7)

- 4) Fill the Values for each Key and each image as necessary
- 5) Save the table as CSV (Comma delimited) (*.csv)

	A	B	C	D	E	F	G	H	I	J
1	Image	Organism	Strain	Anatomical structure	Cell Type	Cell Activation	Concentrated - Cell Activation	Unit - Concentrated - Cell Activation	Time - Cell Activation	Compound Based Treatment
2	20180110_DMSO_0h_pERK_01.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	unstimulated		0 ug/mL	0 h	polar aprotic solvent
3	20180110_DMSO_3h_pERK_01.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	polar aprotic solvent
4	20180110_DMSO_3h_pERK_02.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	polar aprotic solvent
5	20180110_DMSO_3h_pERK_03.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	polar aprotic solvent
6	20180110_DMSO_3h_pERK_04.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	polar aprotic solvent
7	20180110_DMSO_3h_pERK_05.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	polar aprotic solvent
8	20180110_DMSO_3h_pERK_06.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	polar aprotic solvent
9	20180110_MG_3h_pERK_01.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
10	20180110_MG_3h_pERK_02.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
11	20180110_MG_3h_pERK_03.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
12	20180110_MG_3h_pERK_04.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
13	20180110_MG_3h_pERK_05.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
14	20180110_MG_3h_pERK_06.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
15	20180110_ONX_3h_pERK_01.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
16	20180110_ONX_3h_pERK_02.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
17	20180110_ONX_3h_pERK_03.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
18	20180110_ONX_3h_pERK_04.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
19	20180110_ONX_3h_pERK_05.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
20	20180110_ONX_3h_pERK_06.czi	Mus musculus	C57BL/6	Spleen	CD4-positive, alpha-beta T cell	antibody-mediated anti-CD3 anti-CD28	5, each	ug/mL	3 h	enzyme inhibitor
21										
22										
23										
24										
25										
26										
27										
28										

Key-Value Pair Annotation with the „KeyVal from csv“ script (3/7)

6) Go to the Dataset in OMERO.web

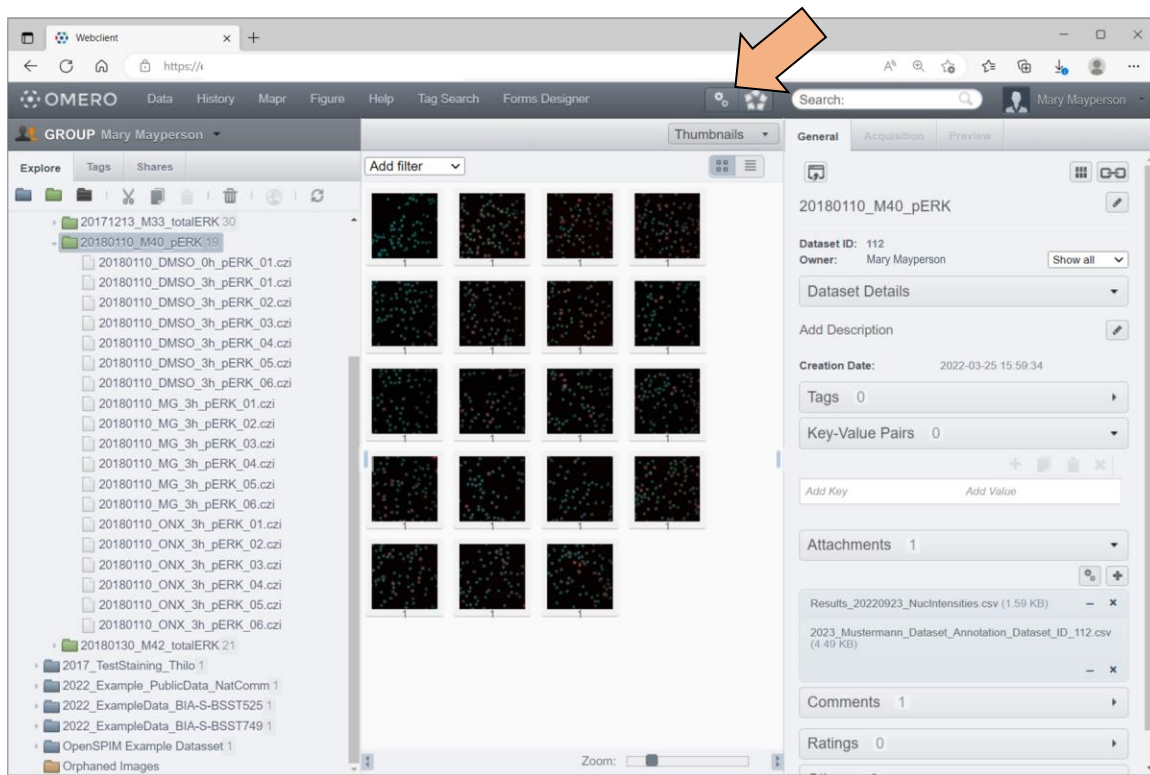



Select the Dataset that contains the images for annotation (do not select an individual image!)

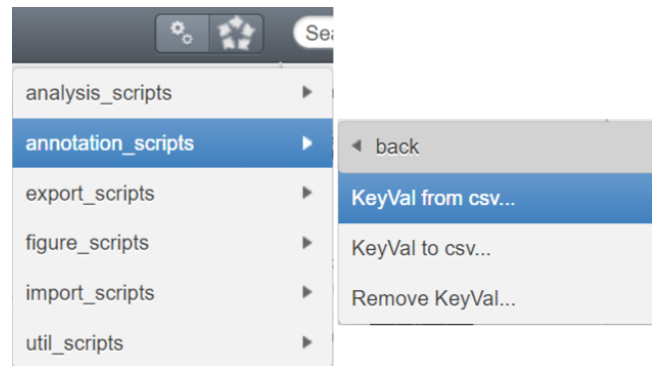
Upload the CSV-table as an attachment to the Dataset

Key-Value Pair Annotation with the „KeyVal from csv“ script (5/7)



8) Go to the Dataset in OMERO.web



9) Go to the scripts ()
go to
annotation_scripts
go to
KeyVal from csv...



Optional:

Mark the table using the  icon
followed by  before step 9

Key-Value Pair Annotation with the „KeyVal from csv“ script (6/7)

10) Enter the File Annotation (**Annotation ID:**) if you have not marked the table (☒)

Run Add Key Val from csv - Profil 1 - Microsoft Edge

https://omero-pr

Add Key Val from csv

This script processes a csv file, attached to a Dataset
Authors: Christian Evenhuis
Contact: <https://forum.image.sc/tag/omero>

Data Type:

IDs:

File OR

Annotation:

[View Script](#)

9) Run the script to upload the Annotations
Review the script result:

Activities

☒ Add Key Val from csv
Added kv pairs to 19/19 files

Dataset ID: 112
Owner: Mary Mayperson

Dataset Details

Add Description

Creation Date: 2022-03-25 15:59:34

Key-Value Pair Annotation with the „KeyVal from csv“ script (7/7)

11) Check the images for successful Key-Value Pair population

The screenshot shows the OMERO web interface. On the left, a file tree lists various microscopy images. The main area displays a grid of image thumbnails. The right panel shows the details for the selected file, '20180110_DMSO_3h_pERK_04.czi'. Below the file details, the 'Key-Value Pairs' section shows a table with one entry:

Key	Value
Organism	Mus musculus

An orange arrow points from the image grid to this table.

Optional:

You can also remove all the Key-Value Pairs. Mark the files for which KV-Pairs should be deleted and go to: Scripts

→ annotation_scripts

→ Remove KeyVal...

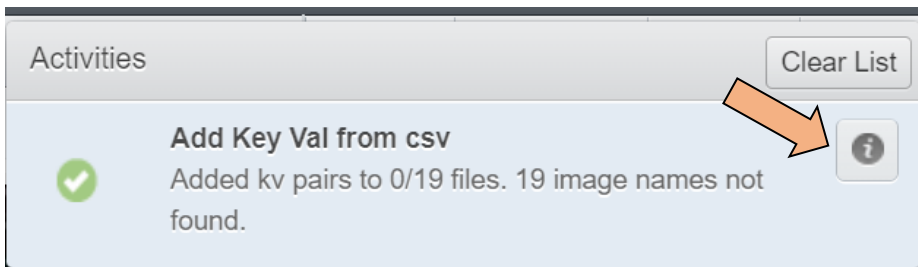
The screenshot shows the 'Scripts' menu in the OMERO interface. The menu is open, showing a list of script categories. The 'annotation_scripts' category is selected, and the 'Remove KeyVal...' option is highlighted.

Key-Value Pair Annotation with the „KeyVal from csv“ script **NOTE!**

The script for Key-Value-Pair Annotation from csv must be installed for your OMERO instance. Please consult with your OMERO administrator if missing

Important:

Sometimes, the „KeyVal from csv“ script may fail:



```
script params
File_Annotation 46978
IDs [112]
Data_Type Dataset
set ann id 46978
Original File 162024 2023_Test13-5_Mustermann_Dataset_ID_112.csv
Failed to sniff delimiter, using ','
header ['Image;Organism;Strain;Anatomical structure;Cell Type;Cell Activation;Concentrated
(Cell Activation);Unit (Concentrated - Cell Activation);Time (Cell Activation);Compound
Based Treatment;Treatment protocol;Test']
image_index: 0 well_index: -1 plate_index: -1
Image not found: 20180110_DMSO_0h_pERK_01.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_01.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_02.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_03.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_04.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_05.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
```

Reason:

German and English Excel versions use different delimiters in the CSV file. While the script tries to identify the correct delimiter, it may occur that the delimiter is not correctly determined. This might result in an upload failure if the default delimiter is not the delimiter used in your csv for field separation. Please consult with your OMERO administrator if this issue occurs!

At a glance: Key-Value Pair Annotation with OMERO.mde (or MDEmic)

Import Data

Window Help

Import Data: Membrane Dye Database

Select data to import and monitor imports.

Select Data to Import Specify MetaData

ImportQueue

- 4i BODIPY Ctl.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 24h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 24h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY Ctl.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 72h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 72h.tif [Group: OE0629, Project: 20]
- 4i BODIPY KSR 15% 72h.tif [Group: OE0629, Project: 20]
- 4i BODIPY KSR-PTX 72 h.tif [Group: OE0629, Project: 20]

[OME:Model]{0}

- [OME:Image]{0}
- [OME:Experiment]{0}

[OME:Image]{0}

Name:

Description:

Acquisition Time:

Dim X x Y:

Pixel Depth:

Pixel Size (XY):

Dim Z x T x C:

Time Increment: ms

Stage Label (XY): reference frame

[OME:Objective]{0}

ID:

Model:

Manufacturer:

Nominal Magnification:

Calibration Magnification:

Lens NA:

Immersion:

Correction:

Working Distance:

Iris:

User::Refraction Index:

User::Medium:

User::Correction Collar:

Reset object tree

Setup: Membrane Dye Database Configuration... ☐ show only required Menu... Clear Input Cancel All Import

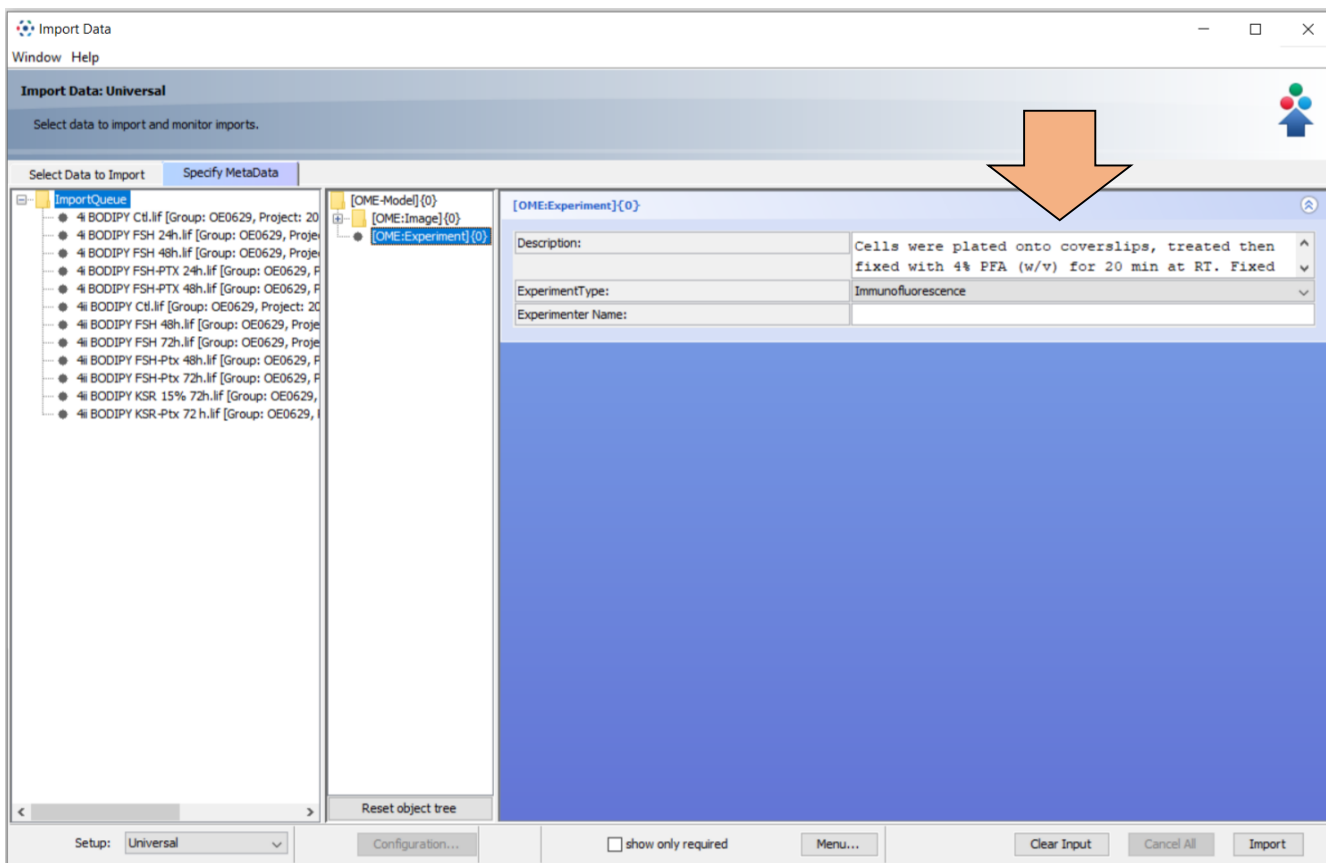
In **OMERO.insight**,
go to the

Specify MetaData

tab before importing
the selected import
queue.

(OMERO.mde is
integrated into the
OMERO.insight client)

At a glance: Key-Value Pair Annotation with OMERO.mde (or MDEmic)



Use the entry masks of OMERO.mde's user interface to review the automatically extracted metadata from the files and to annotate metadata before import.

(OMERO.mde is fully configurable and complies with the OME Data Model)

Review the Key-Value Pairs after upload (here: OMERO.web)

The screenshot displays the OMERO.web webclient interface. On the left, a file tree under 'Mary Mayperson' shows a folder 'Figure 4.192' containing a list of image files. The file '4i BODIPY FSH 24h.tif [Series019]' is selected. The main area shows a grid of 24 image thumbnails. An orange arrow points from the selected file in the list to the detailed view on the right. The right panel shows the 'General' tab for the selected image, displaying metadata such as 'Image ID: 58364', 'Owner: Mary Mayperson', 'Acquisition Date: 2021-05-07 14:04:05', and 'Import Date: 2022-08-02 14:33:31'. Below this, the 'Key-Value Pairs' section shows a table with one entry: 'MDE' added by 'Mary Mayperson'. The description for this entry reads: 'Cells were plated onto coverslips, treated then fixed with 4% PFA (w/v) for 20 min at RT. Fixed cells were incubated with 5 µg/ml BODIPY 493/503 (Thermo Fisher Scientific) for 25 min at RT in the dark. Coverslips were mounted onto slides using Fluoromount G with DAPI (ThermoFisher Scientific) and cells imaged via confocal microscopy.'

Note:
MDE-generated
Key-Value Pairs
cannot be edited
manually after
import!

Using ontologies with Key-Value Pairs in OMERO

For humans, natural language terms are good to understand the data.

For computers, natural language terms can be ambiguous.

- Unique identifiers are optimal for **machine readability** but are hard for humans to read. (e.g., a URI or URL)

OMERO does not provide a direct connection between the Key-Value Pair terms and ontologies so far.

→ **What are the current recommendations?**

Ontology-based Annotation in OMERO - recommendation

To create machine-actionable metadata for your data, make use of **ontology terms** and **ontology term source references**:

- Use the ontology-derived term for a specific Key as the Value
- Add the ontology term URL as the Value for a second Key using the same <Key> + „Term Accession Number“

KEY

Biological entity

Biological entity Term Accession Number

VALUE

T cell receptor complex

http://purl.obolibrary.org/obo/GO_0042101

How should data be annotated to be sufficiently enriched?

The specific content of your annotation depends on your

- research field
- experimental setup
- analysis strategy
- intended reuse potential for your data.

Bioimaging-specific recommendations:

- Sarkans et al. (2021) REMBI: Recommended Metadata for Biological Images – enabling reuse of microscopy images in biology. *Nat Methods*, Dec;18(12):1418-1422.
doi: [10.1038/s41592-021-01166-8](https://doi.org/10.1038/s41592-021-01166-8).
- Hammer et al. (2021) Towards community-driven metadata standards for light microscopy: tiered specifications extending the OME model. *Nat Methods*, Dec;18(12):1427-1440.
doi: [10.1038/s41592-021-01327-9](https://doi.org/10.1038/s41592-021-01327-9).