# The Multispecies Ovary Tissue Histology Electronic Repository (MOTHER): Share your ovary histology slides with the world

Karen H. Watanabe[1], Yian Ding[1], Wenli Ma[1], Suzanne W. Dietrich[1], James P. Sluka[2], Mary B. Zelinski[3]

[1]Arizona State University, [2]Indiana University, & [3]Oregon National Primate Research Center

## Introduction (http://mother-db.org)

The Multispecies Ovary Tissue Histology Electronic Repository (MOTHER) is an online repository of ovary tissue histology digital images. Its goal is to maximize the value returned from studies generating ovary tissue histology slides by openly sharing digital images and metadata about each slide. Applications include:

- comparative studies of female reproductive strategies;
- the development of computational models to test hypotheses related to ovarian development and female reproduction;
- use as an educational resource

To accomplish this goal, **we need contributions from collaborators worldwide**. Learn how you can be a part of the MOTHER project.

## Methods
### Database Development and Data Flow

MOTHER-DB will store the slide image metadata and links to the slide images that can be searched online. Figure 1 shows a data flow diagram for the project. This poster focuses on the first four components under development (numbered red stars in Figure 1).

1. Slide metadata structure was determined by our leadership team. This is information about the histology slides that we believe will be useful to a broad audience.
2. Metadata is structured using XML, leveraging EML for data provenance. The ezEML tool enhanced with MOTHER will assist scientists with the specification of their slide metadata.
3. To enhance Lucene web-based searches of content in OSF, user-defined tags need to be defined for OSF projects.
4. The curation process uses Python applications to access slide images and metadata from collaborators' OSF projects.
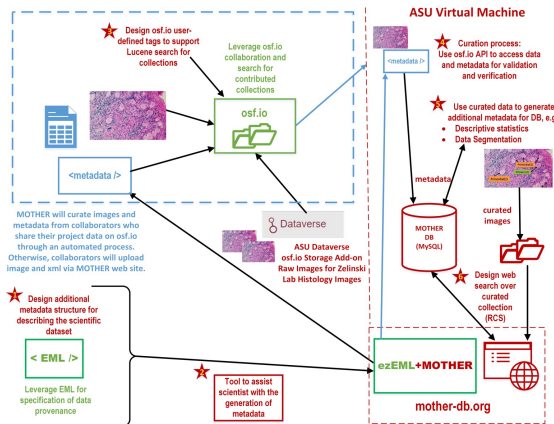


Figure 1: MOTHER data flow. EML = Ecological Metadata Language (Jones et al., 2019); OSF = Open Science Framework (Center for Open Science, 2020); DB = database. Red highlights components that will be developed in this project. Green indicates reuse of existing tools. Blue indicates user-supplied data.

## Methods (continued)
### Populating MOTHER with Macaque Ovary Histology Images

Ovary histology slides and metadata for macaques (Cynomolgus, Japanese, and Rhesus) were provided by M. Zelinski. See Figure 2 for a description of how slide images were obtained, and how the metadata are entered into MOTHER-DB.

#### Slide scanning procedure

1. ASU students and K. Watanabe scan slides at 10x magnification following protocol available at https://osf.io/q8bwv.
2. Workflow logs track slides scanned and checks for image quality, follicle identification and counting.
3. Slide images uploaded to ASU Dataverse (stored here due to OSF 50 GB limit)
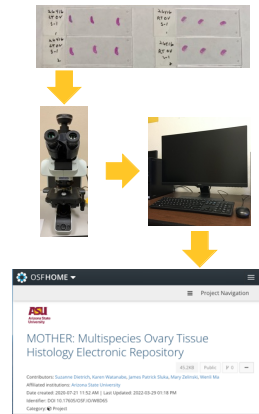4. Slides in Dataverse are uploaded to MOTHER OSF project (https://osf.io/w8d65/)



Figure 2: Flow diagram for populating MOTHER with histology images.

#### Metadata procedure

1. Transfer EML+MOTHER XML file (Figure 3) for each image.
2. Validate the XML file
3. Incorporate metadata from XML file into MOTHER-DB using Python and SQL.



Figure 3: EML+MOTHER XML file for metadata transfer to MOTHER-DB.

## Results
### Database Development and Data Flow

Status of components being developed for the MOTHER project (numbered stars in Figure 1).

1. Metadata structure for EML+MOTHER is complete
2. Figure 3 shows a sample of the EML+MOTHER metadata XML file. A tool, ezEML+MOTHER, is under development to assist collaborators with the specification of slide metadata.
3. OSF.io user-defined tags have been defined to assist with searches for MOTHER-related projects.
4. Components 4-6 are still being developed. We have tested the curation process (#4) on macaque images and metadata, and we are ready to start testing our osf.io data transfer protocols on collaborators' data.

## Results (continued)
### Slide Scanning

Slide images were scanned and stored in Dropbox for the MOTHER team to access for follicle identification and counting.
- Cynomolgus macaque – 48 slides scanned
- Japanese macaque – 112 slides scanned
- Rhesus macaque – 167 slides scanned

### OSF MOTHER Project

View our OSF Project, MOTHER: Multispecies Ovary Tissue Histology Electronic Repository at (https://osf.io/w8d65/). A small sample set of the scanned slide images and metadata for each species is available publicly. Once curation is complete, all images and metadata will be available.
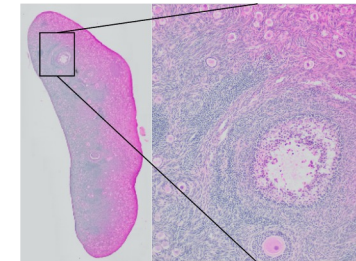


Figure 4. Japanese macaque histology slide scanned at 10X magnification.

## How to Contribute Slides to MOTHER

We look forward to working with you! Following the steps below:

1. If you have digital images of ovary histology slides, create an OSF project to share your slides with the world, and MOTHER.
   a. Upload Open Microscopy Environment (OME) tif files to OSF. **You determine & retain the copyright for your images**
   b. Storage in OSF is limited to 50 GB, so you may need to use a storage add-on, such as Dataverse or Dropbox.
2. Upload slide metadata to your OSF project. Examples are available at https://osf.io/njqy4/.
3. If you are willing to test MOTHER and provide feedback to make it more user-friendly, email Karen Watanabe (karen.watanabe@asu.edu) or Mary Zelinski (zelinski@ohsu.edu).

## References
- Center for Open Science (2020). Open Science Framework. Center for Open Science. Accessed August 12, 2020, at https://osf.io.
- Jones, M. B., M. O'Brien, B. Mecum, C. Boettiger, M. Schildhauer, M. Maier, T. Whiteaker, S. Earl and S. Chong (2019). Ecological Metadata Language version 2.2.0. KNB Data Repository. Accessed August 13, 2020, at https://eml.ecoinformatics.org.

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