


Smithsonian Digitization

Item Driven Image Fidelity (IDIF)

or "Hitting the Digital Capture Sweet Spot"

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The Smithsonian's approach to Mass Digitization is comprehensive. This demonstration specifies the proces necessary to generate "research-worthy" digital images.

1. Approach

We don't just "take a picture", we consider every aspect of the process to achieve our ultimate goal of taking an item from the shelf and making it accessible to the public in 24 hours.

Digital images showing insufficient detail or that are too low in resolution make for a frustrating online experience for the public and researchers alike but capturing at an excessive resolution taxes our storage & network infrastructure unnecessarily. When you're digitizing millions of items that makes a huge difference to our bottom line!

In order to ensure that we're achieving the optimal resolution for any Smithsonian managed mass digitization projects, we go through a rigorous validation process. Item Driven Image Fidelity (IDIF) validation begins with collections staff identifying a representative sampling of the collection that contains the smallest details.

Using an example collection item, the smallest details necessary to be resolved are measured at the micron scale and documented. This measurement translates into PPI (pixels per inch) resolution required to photograph the item's detail. We then validate our ppi resolution through spatial frequency response (SFR) testing.

Images courtesy Cooper Hewitt Design Museum

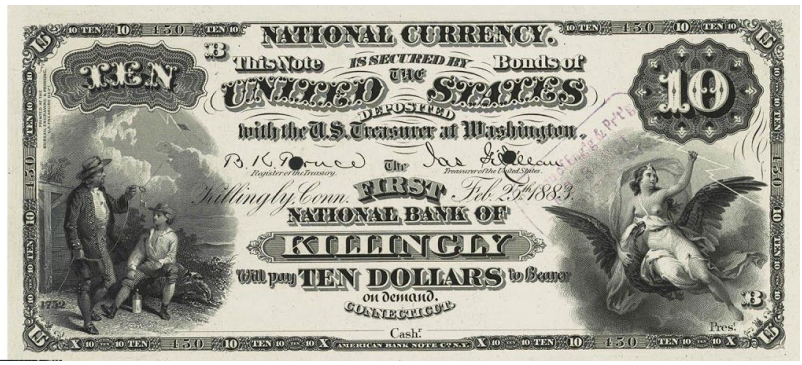


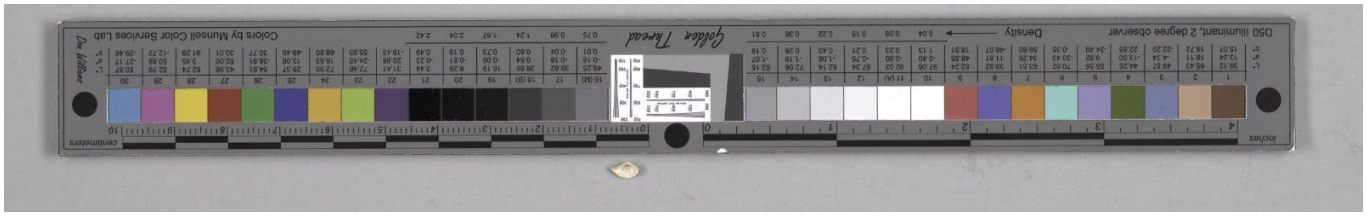
Image courtesy National Museum of American History

2. Process

- IDIF analysis starts by working with the museum's curatorial and/or collections staff to identify a representative sampling of the collection that contains the smallest details. In this example from Paleobiology at the National Museum of Natural History it's a vial containing fossilized seashells *(figure 1)*.

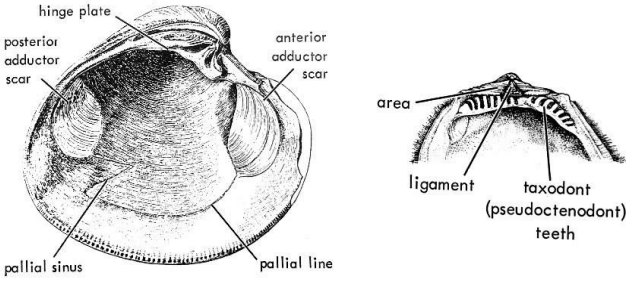
figure 1: Specimen Drawer

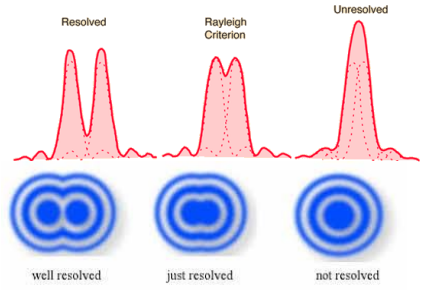
- Next the curator chooses the best represented specimen from the vial



- For bivalve shell identification, taxodont teeth along the hinge plate need to be of resolvable resolution for a research level quality image. "Resolved" has a very specific meaning and is defined by the "Rayleigh Criterion".

figure 4: Bivalve Shell Morphology Diagram





The "Rayleigh Criterion"
Was originally formulated for determining the resolution of two-dimensional telescope images, but has since spread into many other arenas in optics. It is defined in terms of the minimum resolvable distance between two point sources of light and is the generally accepted criterion for the minimum resolvable detail of an item.

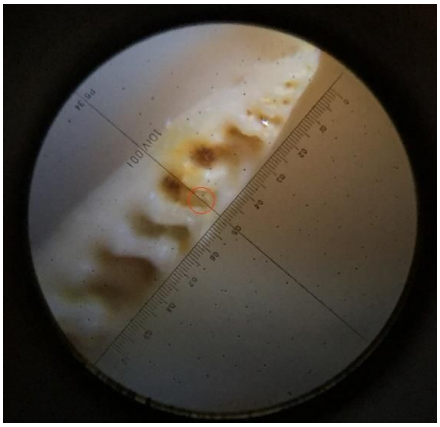


Figure 4.a Magnified view showing approximately 80 micron detail taxodont teeth along the hinge plate on a bivalve specimen

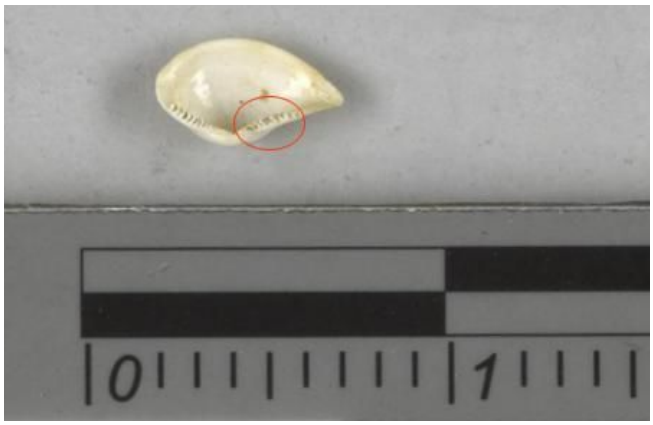
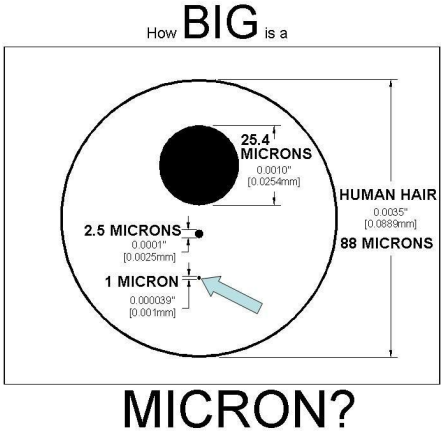


Figure 4.b – Image at 100% showing resolvable & identifiable of taxodont teeth along the specimen's hinge plate

- For the NMNH specimens, details in the **80 micron range** have been identified by collections staff as the smallest details of interest in the specimen to be captured.

- Therefore the SFR (aka resolution) required to capture the smallest measured detail of 80 microns is **317 ppi**

Calculation: 25,400 microns per inch ÷ micron measurement (example 80) = 317 ppi

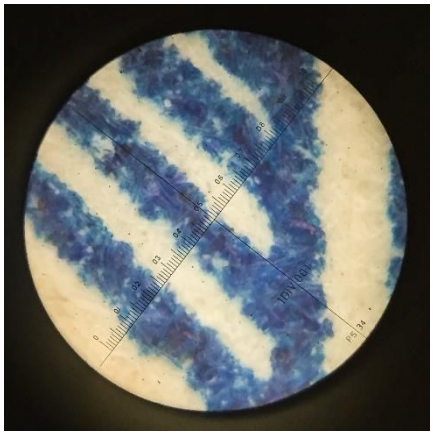


3. Results

The IDIF analysis results in a project-specific imaging standard by which we measure capture quality for all Smithsonian managed mass digitization projects. Our process ensures that fine specimen or item details are resolvable for remote researchers to do meaningful work with collections even if they are half a world away.

Other examples utilizing IDIF with museum collections:

National Postal Museum



Detail of *a single stamp on the sheet of 120 stamps* – measurement of engraving line on right is 50 microns
(Magnified view at right taken from hatched region near "E E F" at center)

The SFR (aka resolution) required to capture the smallest measured detail of 50 microns is 508 ppi.

National Museum of Natural History - Botany

NMNH Botany Project:
42 micron detail of Cibotium glaucum spores

The SFR required to capture the width of a 42 micron fern spore is 603 ppi

Further Reading

Establishing Spatial Resolution Requirements for Digitizing Transmissive Content: A Use Case Approach
Don Williams, Image Science Associates, Rochester, NY USA; Michael Stelmach, Consultant, USA; and Steven Puglia, Library of Congress, Washington, DC USA

Film Grain, Resolution, and Fundamental Film Particles
Tim Vitale, Paper, Photographs & Electronic Media Conservator, Emeryville, CA USA

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