Putting Our Images to Work:
Using Digitized Fossil Beetles to Study a Global Climate Transition

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University of Colorado Museum of Natural History
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Who...? Why...?

Museum & Field Studies Graduate Program:

- Collections assistantships
- Collections-based research

M&FS Paleo/Collections Section
Imaging at UCM

UCM Fossil Insects
- Compression
- Amber

Themed Collections Network (TCN):
- Fossil Insect Collaborative
Locality

Middle Eocene
(∼ 49-47 Ma)

Western Interior

All major insect orders
- Diptera
- Coleoptera
- Hymenoptera
Paleoclimate

Cenozoic Marine Isotope Record

Zachos et al. (2001) Science, 292
Stratigraphy

- Onset of global cooling
- One insect community
- Sequential deposition
Research Question

Did global cooling alter the diversity of Coleoptera (beetles) in Colorado during the middle Eocene?

Green River Formation, Colorado
Starting Point

2006-2010 Collecting
= 2 collections = 90 field days

Rationale
- Paleoclimate tie-in
- High-quality/unbiased
- Imaging priority

David Kohls
Curation Needs

1st Locality
• Curated
• Partially imaged

2nd Locality
• Some curation
• No images

Teamwork!
LW, Talia, 1 volunteer,
~2 students

2nd Locality Curation Queue
The Digital Approach: Advantages?
Pros

High quality digital vouchers
Facilitates comparisons
Pros

Ease of access/recall

“Mobile” collection

Unrestricted by lab space

x10 drawers

5 TB

1 TB
Pros

Virtual collaboration & specimen access
Impetus for QC, improvements, & updates

<table>
<thead>
<tr>
<th>UCM</th>
<th>Updated ID</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>41469</td>
<td>Staphylinidae</td>
<td>✓</td>
</tr>
<tr>
<td>40425</td>
<td>Carabidae</td>
<td>✓</td>
</tr>
</tbody>
</table>

Pros

76958 78183 57712 38716
Pros

Valuable training
  • Graduate
  • Undergraduate
The Digital Approach: Challenges?
Timeline

Ideal ≠ Reality
• Learning curves

UT-Austin April 2014
Paleo Imaging Workshop
Timeline

Ideal ≠ Reality

• Downtime

2014:

January

February

March

April

May

June

July

August

September

October

November

December

2015:

January

February

March

April

May

June

July

August

September

October

November

December
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Protocols

Quality Control

cropping?!

out of focus
Protocols

Standardizing
  • file names

QC/Typos
  • image = voucher

Format:
cat#_UCM 1-4xtele 65mm 3-5x

File Naming 101
“Cheat Sheet”

Naming images:
catalognumber/UCM_habitus-space/1-4xtele-space/lens-space/magnification-space/suffix(es)

- Bold fields indicate required information.
- Colored fields should be added only when applicable.
- Gray text indicates a space (never a period, which may be confused for a file extension and cause errors).
- The tables in the following pages indicate the preferred formatting for different magnifications in file and folder names. These pages are included as pictorial guide to each lens and its magnification options.
- The lowest catalog number associated with a given habitus shot will be the UCM # used in the file name.
- Suffixes can be appended to file names if multiple images of a specimen (or habitus versions) are saved.
  Examples:
  - "reverse" = specimens on both sides of one piece of shale
  - "alt" = alternative view
  - "diffuser" = diffuser applied

Example: 65 mm lens with 1x magnification
  • Basic format: 12345a_UCM 65mm 1x
  • Part/Counterpart: 12345a_UCM 65mm 1x
  • Habitus: 12345a_UCM_habitus 65mm 1x
  • Teleconverter in use: 12345a_UCM_habitus 1-4xtele 65mm 1x
  • Multiple orientations or lighting options: 12345a_UCM_habitus 1-4xtele 65mm 1x alt
  • Reverse sides (e.g. shale has specimens on both sides): 12345a_UCM_habitus 1-4xtele 65mm 1x alt reverse

Naming folders:
yearmonthday-space/1-4xtele-space/lens-space/magnification-space/photographer’s initials

Example: All images taken on June 9, 2014 with teleconverter and 65 mm lens at 1x magnification by Lindsay
  • 20140609 1-4xtele 65mm 1-1x LJW

Tips!
  • Sort images by date to avoid typos and formatting errors when naming files. (When exporting a new image, you can then select the most recently saved image and autofill many of the fields in the file name.)
Organization

File Management
- Organization

Catalog #
- = file name

Field #
- = tag

<table>
<thead>
<tr>
<th>Name</th>
<th>Tags</th>
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</thead>
<tbody>
<tr>
<td>UCM_46053 65mm 1-1.jpg</td>
<td>DON, 070904, 2mm</td>
</tr>
<tr>
<td>57806</td>
<td></td>
</tr>
<tr>
<td>UCM_39160 65mm 1-1.jpg</td>
<td>DEN4, 070608</td>
</tr>
<tr>
<td>UCM_41766 65mm 1-1 copy</td>
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<tr>
<td>55983</td>
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<td>UCM_55660 100mm 1-1 1-4x copy</td>
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<tr>
<td>UCM_44539 100mm 1-1 1-4x copy</td>
<td></td>
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<tr>
<td>81000_UCM 1-4xtele 65mm 3-5x.JPG</td>
<td></td>
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<td>81251_UCM 1-4xtele 65mm 3-5x.JPG</td>
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<td>81099ab_UCM</td>
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<td>78594_UCM 1-4xtele 65mm 3-5x.JPG</td>
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<tr>
<td>78198</td>
<td>CP, 090624, 2mm</td>
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<td>77874</td>
<td>CP, 081008, 2mm</td>
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<td>77725-77726</td>
<td>CP, 081008, 2mm</td>
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<td>77759</td>
<td>CP, 081008, 2mm</td>
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<td>76101_UCM 1-4xtele 65mm 3-5x.JPG</td>
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</table>
Organization

File Management

• Organization
• Batch retrieval

Log Book:
Date - Initials - Locality - Taxon

<table>
<thead>
<tr>
<th>Date</th>
<th>Initials</th>
<th>Locality</th>
<th>Taxon</th>
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</thead>
<tbody>
<tr>
<td>F 11/30 LW</td>
<td>DEN (3-4) Curculionidae (cont'd)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M 02/6 AP</td>
<td>DEN (2) Diptera misc. individuals. Mostly Cecidomyiidae.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tu 2/3 LW</td>
<td>Den (4) Curculionidae (cont’d) until 3pm CP Coleoptera, misc families.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W 2/4 AP</td>
<td>DEN (2) Diptera misc. individuals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tu 5/6 NR</td>
<td>DON Coleoptera, found in collection</td>
<td></td>
<td></td>
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Collaboration

File Management
• Batch retrieval
• Organization
• **Sharing**
iDigPaleo: Coming soon!
Imaging Wrap-Up

Remediation & Post-imaging curation
## Total Images

<table>
<thead>
<tr>
<th>Locality</th>
<th>Collecting Days</th>
<th>Imaged Coleoptera</th>
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<tbody>
<tr>
<td>Upper</td>
<td>51</td>
<td>737</td>
</tr>
<tr>
<td>Lower</td>
<td>39</td>
<td>1356</td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td><strong>2093</strong></td>
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Estimated Diversity

Comparisons
• Sampling effort
• Estimated richness
• Abundances

Improved IDs
Estimated Diversity

Comparisons
- Sampling effort
- Estimated richness
- Abundances

Improved IDs
Conclusions

Inputs
- 90 field days
- 2 collections
- 1.25 years
- LJW et al.

Outputs
- 2100 beetle images
- ~4 students trained
- Protocols + workflow
- Collections improved
- 1 MS thesis
Acknowledgements

**Funding:** Fitzgerald Travel Grant; UCM Student Research Award; National Science Foundation

**Field collection:** David Kohls

**LW’s Thesis Committee:** Dena Smith, César Nufio, Herb Meyer

**Curation logistics:** UCM invert paleo staff, students, volunteers

**Coleopterists:**
- Steve Davis (AMNH), Vladimir Gusarov (U. Oslo),
- Terry Erwin (NHMU), Michael Ivie (Montana State)

**Land access:** Encana Corporation
Questions?