

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

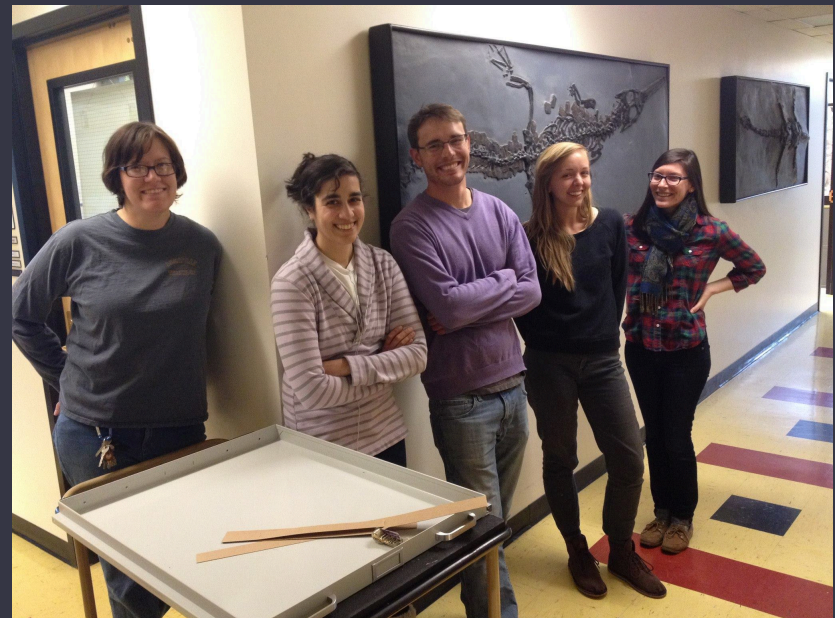


Lindsay Walker, Dena Smith, & Talia Karim
University of Colorado Museum of Natural History
SPNHC 30th Annual Meeting · May 21, 2015

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

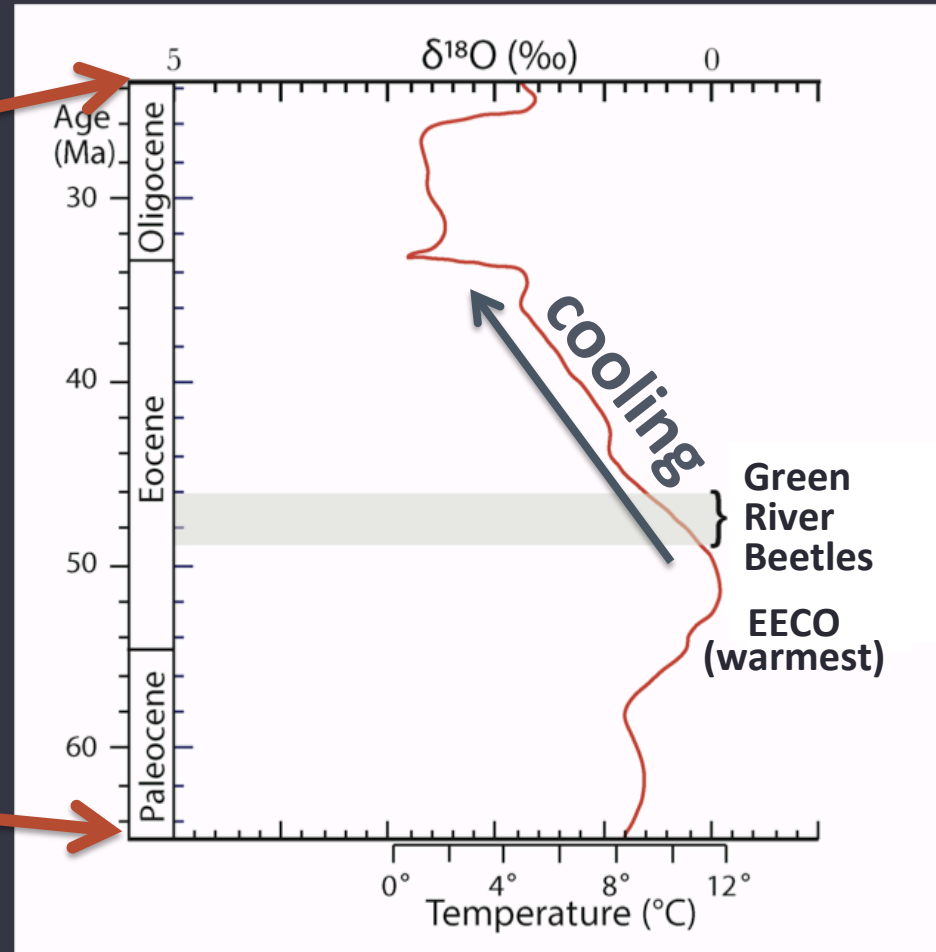
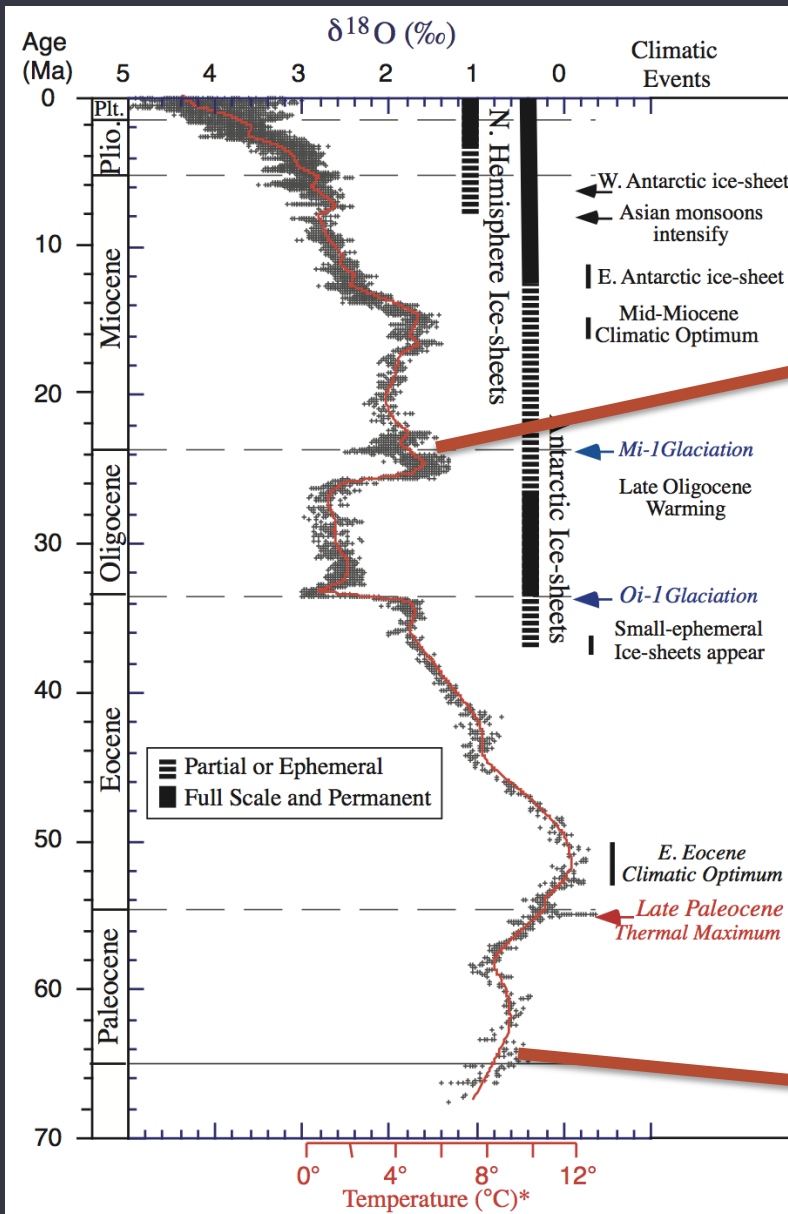
All major insect
orders

- Diptera
- Coleoptera
- Hymenoptera



Ron Blakey, Colorado Plateau Geosystems, Arizona, USA

Paleoclimate



Zachos et al. (2001) *Science*, 292

Stratigraphy

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

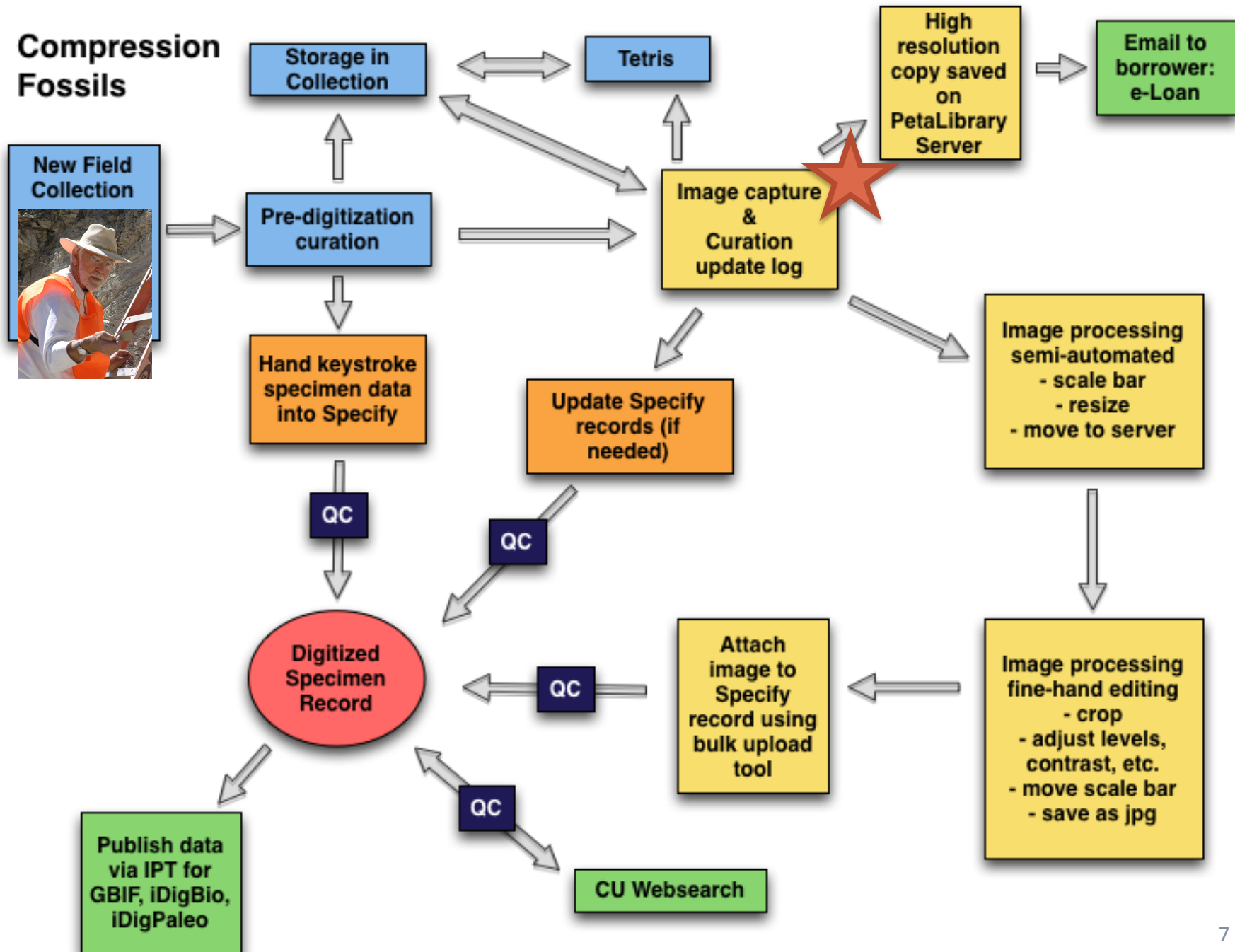
Research Question

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



Green River Formation, Colorado

Compression Fossils



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

CP	Comments	Lindsay	
090820	Curated	✓	
090826	Curated	✓	
090828		✓	beetles curated
090901		✓	beetles curated
090909		✓	beetles curated
090911		✓	beetles curated
091004		✓	beetles curated
091008		✓	beetles curated
100610		✓	beetles curated
100615		✓	beetles curated
100617		✓	beetles curated
100618		✓	beetles curated
100621		✓	beetles curated
100622		✓	beetles curated
100623		✓	?
100625		✓	beetles curated
100629		✓	beetles curated
100630		✓	beetles curated
100713	boxed		
100715	boxed		
100716	boxed		

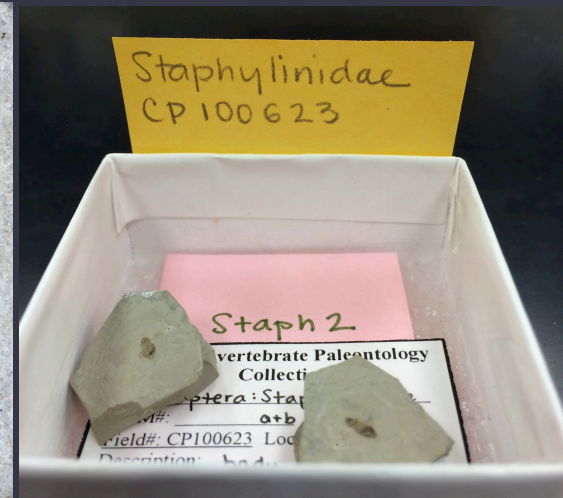
The Digital
Approach:
Advantages?



Pros

High quality
digital vouchers

Facilitates comparisons



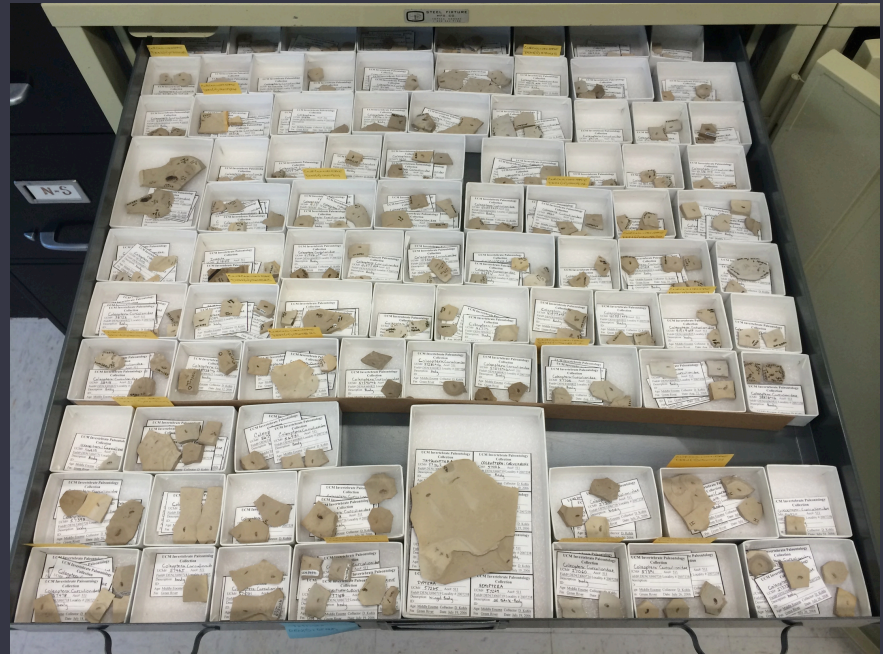
Pros

Ease of access/recall

“Mobile” collection

Unrestricted by
lab space

x10 drawers



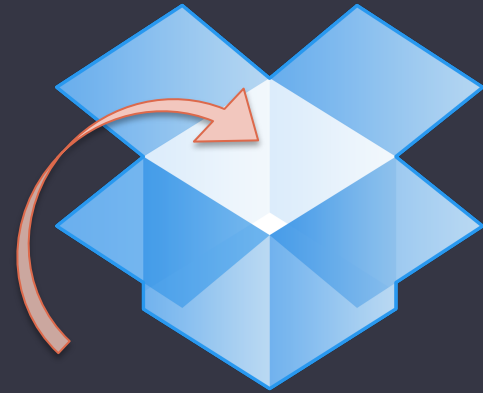
5 TB



1 TB

Pros

Virtual collaboration
& specimen access



Pros

Impetus for QC,
improvements,
& updates

UCM	Updated ID	Tag ✓
41469	Staphylinidae	✓
40425	Carabidae	✓



Pros

Valuable training

- Graduate
- Undergraduate



The Digital Approach: **Challenges?**



Timeline

Ideal \neq Reality

- Learning curves

UT-Austin April 2014
Paleo Imaging Workshop



Timeline

Ideal ≠ Reality

- Downtime

Imaging Timeline

2014:

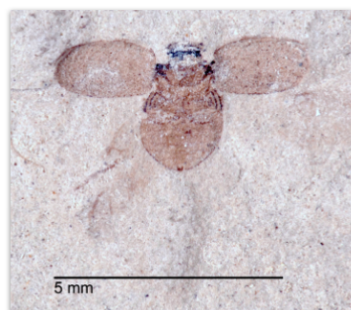
January	February	March	April	May	June
S M			T F S	S M T W T F S	S M T W T F S
5 6			3 4 5	1 2 3	1 2 3 4 5 6 7
12 13 14 15 16 17 18	9 10 11 12 13 14 15	9 10 11 12 13 14 15	10 11 12	4 5 6 7 8 9 10	8 9 10 11 12 13 14
16 17 18 19 20 21 22	16 17 18 19 20 21 22	16 17 18 19 20 21 22	13 14 15 16 17 18 19	11 12 13 14 15 16 17	15 16 17 18 19 20 21
23 24 25 26 27 28	23 24 25 26 27 28	23 24 25 26 27 28 29	iDigBio Workshop	18 19 20 21 22 23 24	22 23 24 25 26 27 28
		30 31		25 26 27 28 29 30 31	29 30
July	August	September	October	November	December
S M T W T F S	S M T W T F S	S M T	T F S	S M T W T F S	S M T W T F S
1 2 3 4 5	1 2	1 2	2 3 4	1	1 2 3 4 5 6
6 7 8 9 10 11 12	3 4 5 6 7 8 9	7 8 9	9 10 11	2 3 4 5 6 7 8	7 8 9 10 11 12 13
13 14 15 16 17 18 19	10 11 12 13 14 15 16	14 15 16 17 18 19 20	12 13 14 15 16 17 18	9 10 11 12 13 14 15	14 15 16 17 18 19 20
20 21 22 23 24 25 26	17 18 19 20 21 22 23	21 22 23 24 25 26 27	19 20 21 22 23 24 25	16 17 18 19 20 21 22	21 22 23 24 25 26 27
27 28 29 30 31	24 25 26 27 28 29 30	28 29 30	26 27 28 29 30 31	23 24 25 26 27 28 29	28 29 30 31
	31			30	

2015:

January	February	March	April	May	June
S M			T F S	S M T W T F S	S M T W T F S
4 5			2 3 4	1 2	1 2 3 4 5 6
11 12 13 14 15 16 17	15 16 17 18 19 20 21	15 16 17 18 19 20 21	12 13 14	7 8 9	7 8 9 10 11 12 13
18 19 20 21 22 23 24	22 23 24 25 26 27 28	22 23 24 25 26 27 28	19 20 21	14 15 16	14 15 16 17 18 19 20
25 26 27 28 29 30 31		29 30 31	26 27 28 29 30	21 22 23	21 22 23 24 25 26 27
				SPNHC	28 29 30



57068b_UCM 100mm 1-1
1-4x.jpg



UCM_55719b 100mm 1-1
1-4x.jpg



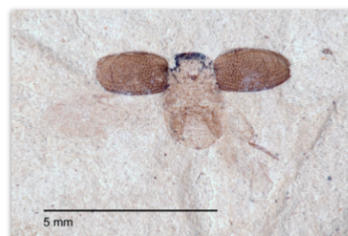
56649b_UCM 100mm 1-1
1-4x copy



57743a_UCM 65mm 1-1
copy



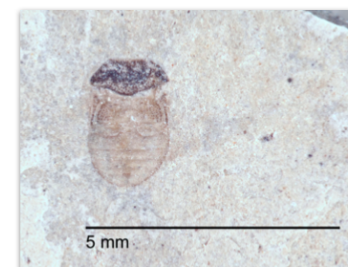
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copy



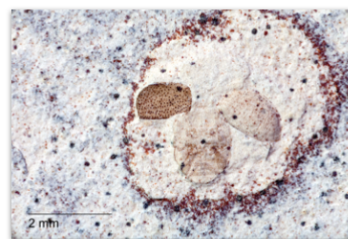
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1-4x.jpg



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1-4x.jpg



53474_UCM 100mm 1-1
1-4x.jpg



54866_UCM 65mm 3-5
1-4x.tif



56618a_UCM 1-4xtele
65mm 3-5x.jpg



56337_UCM 65mm 3-5x
1-4x.tif



77725_UCM 1-4xtele
65mm 3-5x diffuser.jpg



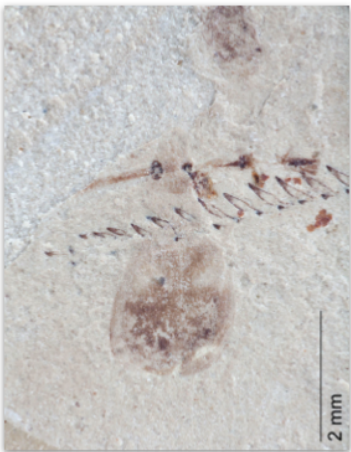
80043a_UCM 1-4xtele
65mm 3-5x.jpg



81251_UCM 1-4xtele
65mm 3-5x.JPG



77759a_UCM 1-4xtele
65mm 3-5x.jpg



77874a_UCM 1-4xtele
65mm 3-5x.jpg



78198_UCM 1-4xtele
65mm 3-5x diffuser.jpg



76101_UCM 1-4xtele
65mm 3-5x.jpg



78593_UCM 1-4xtele
65mm 3-5x.jpg



Habitus



Individual



Protocols

Standardizing

- Magnifications
- Orientations

Fossil Insect Digitization

University of Colorado Museum of Natural History

Invertebrate Paleontology

<http://fossilinsects.colorado.edu>

Last updated: May 11, 2015

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Protocols

Quality Control



out of
focus

cropping?!

Protocols

Standardizing

- file names

QC/Typos

- image = voucher

Format:

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

File Naming 101 “Cheat Sheet”

Naming images:

catalognumber**a/b**_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.
- Grey 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: 12345_UCM 65mm 1x
- **Part/Counterpart**: 12345**a**_UCM 65mm 1x
- **Habitus**: 12345a_UCM_habitus 65 mm 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

Name	Tags
 UCM_46053 65mm 1-1.jpg	DON, 070904, 2mm
 57806	DEN4, 070608
 UCM_39160 65mm 1-1.jpg	DEN4, 060926, 2mm
 UCM_41766 65mm 1-1 copy	DEN4, 060901, 2mm
 55983	DEN2, 070530, 2mm
 UCM_55660 100mm 1-1 1-4x copy	DEN2, 060628, 2mm
 UCM_44539 100mm 1-1 1-4x copy	DEN1, 060601, 2mm
 81000_UCM 1-4xtele 65mm 3-5x.JPG	CP, 100630, 2mm
 81251_UCM 1-4xtele 65mm 3-5x.JPG	CP, 100618, 2mm
 80913	CP, 100610, 2mm
 81099ab_UCM	CP, 091004, 2mm
 80594_UCM 1-4xtele 65mm 3-5x.JPG	CP, 090817, 2mm
 80217	CP, 090803, 2mm
 80016_UCM 1-4xtele 65mm 3-5x.jpg	CP, 090724, 3mm
 80043	CP, 090724, 2mm
 78593_UCM 1-4xtele 65mm 3-5x.jpg	CP, 090629, 2mm, 3mm
 78594_UCM 1-4xtele 65mm 3-5x.jpg	CP, 090629, 2mm
 78198	CP, 090624, 2mm
 77874	CP, 081009, 2mm
 77725-77726	CP, 081008, 2mm
 77759	CP, 081008, 2mm
 77561_UCM 1-4xtele 65mm 3-5x.jpg	CP, 081002, 2mm
 76101_UCM 1-4xtele 65mm 3-5x.jpg	CP, 080922, 2mm

Organization

File Management

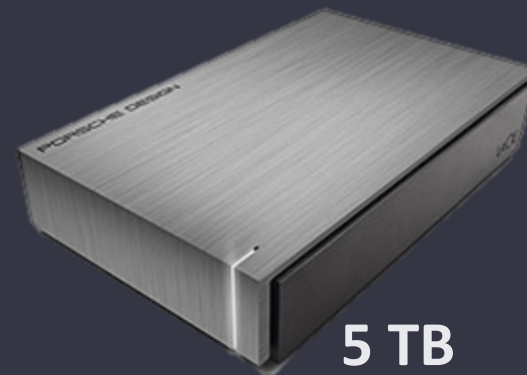
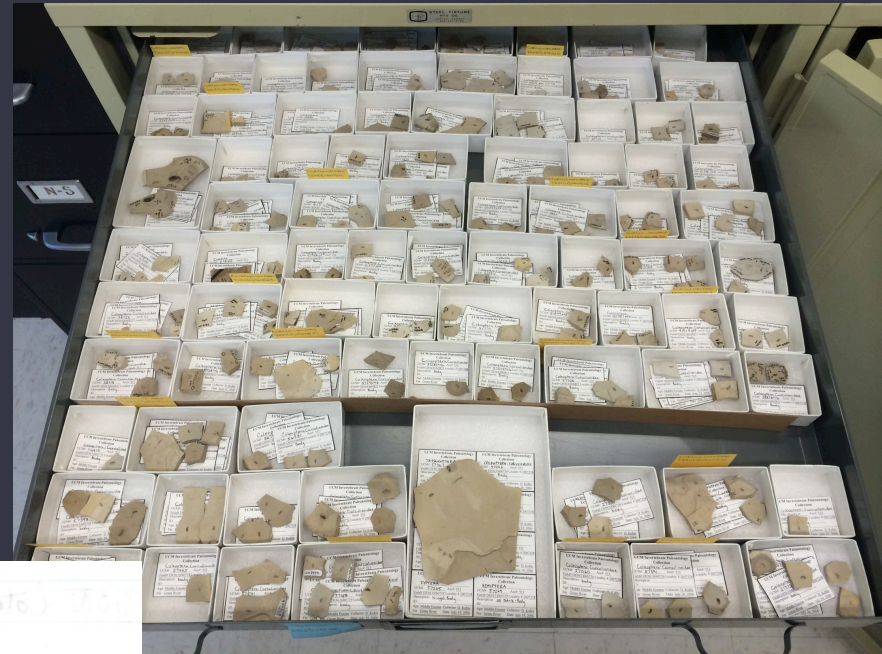
- Organization
- Batch retrieval

Log Book:

Date - Initials - Locality - Taxon

F 1/30 LW	Den (3-4) Curculionidae (cont'd) <i>rigata</i> <i>Ud</i>
M 02/02 AP	DEN (2) Diptera misc. individuals. Mostly Cecidomyiidae.
Tu 2/3 LW	Den (4) Curculionidae (cont'd) until 3pm CP Coleoptera, misc families.
W 2/4 AP	DEN (2) Diptera misc. individuals.
Th 2/5 NR	DON Coleoptera, found in collection

x10s of drawers...

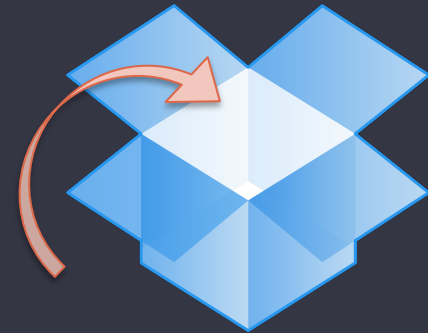


5 TB

Collaboration

File Management

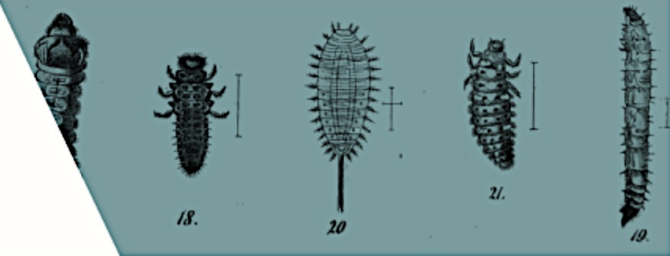
- Batch retrieval
- Organization
- **Sharing**



iDigPaleo: *Coming soon!*



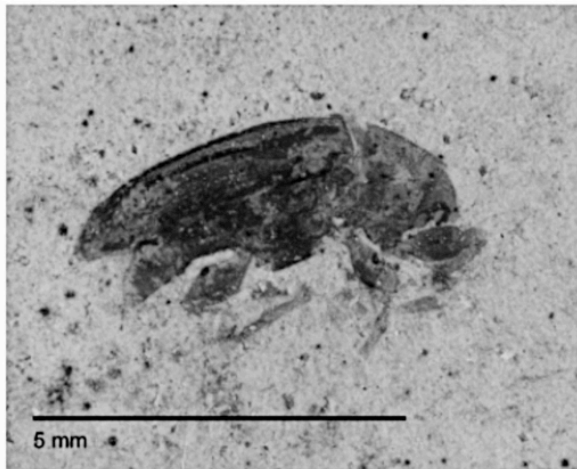
Making data and images of millions of insect specimens available on the web



[ABOUT](#) [NEWS](#) [BROWSE](#) [JOIN](#) [EDUCATION](#)



<<
BACK



COMMENTS (0)

SHARE

Curculionidae

CUMNH UCM 37044

University of Colorado Museum of Paleontology

Identifier: Levy, Rick

TAXONOMY

Invertebrates > Arthropoda > Insecta > Coleoptera > Curculionidae

STRATIGRAPHY

Chronostratigraphy

Paleogene, Eocene M

Lithostratigraphy

Green River Formation, Parachute Creek?

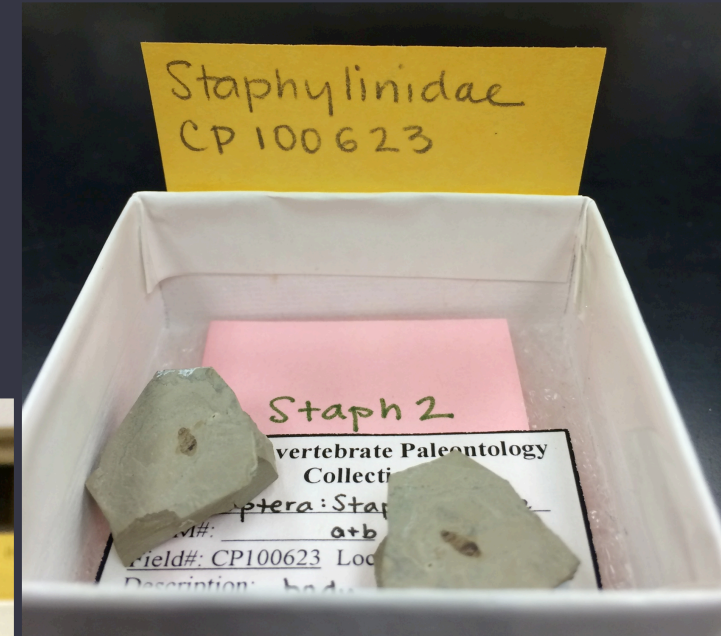
LOCALITY

North America > USA > CO > Garfield > DON - Donnell Site

>
NEXT

Imaging Wrap-Up

Remediation & Post-imaging curation



Total Images

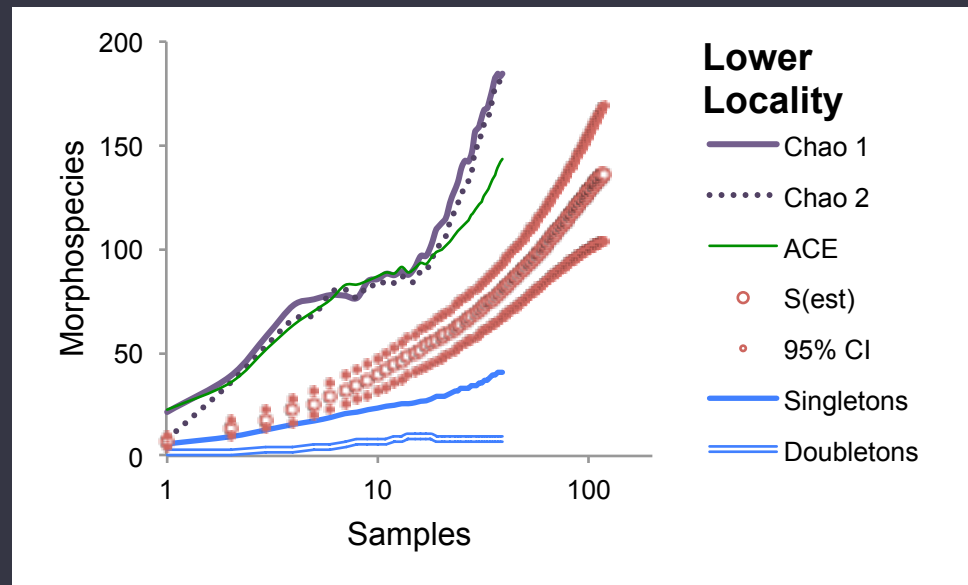
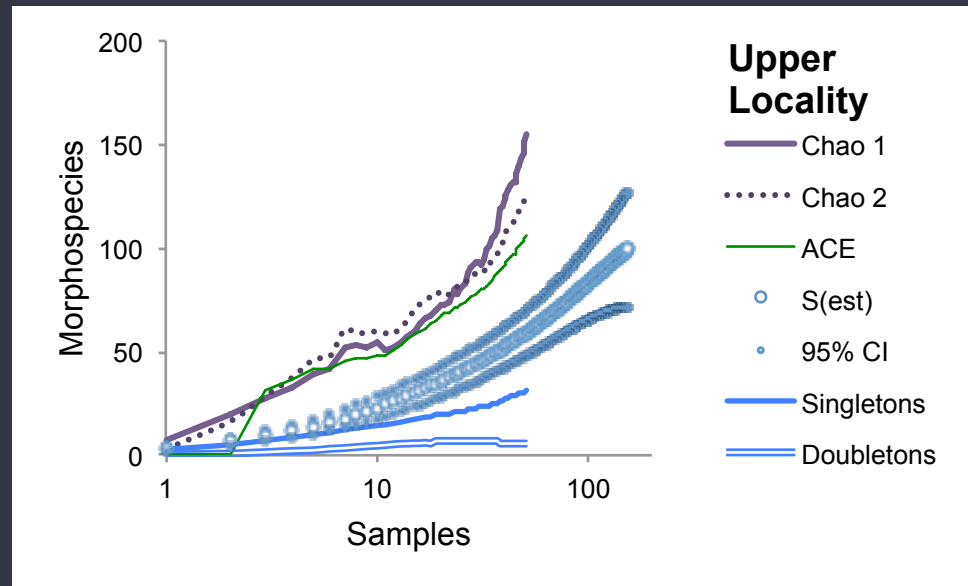
Locality	Collecting Days	Imaged Coleoptera
Upper	51	737
Lower	39	1356
Total	90	2093

Estimated Diversity

Comparisons

- Sampling effort
- Estimated richness
- Abundances

Improved IDs

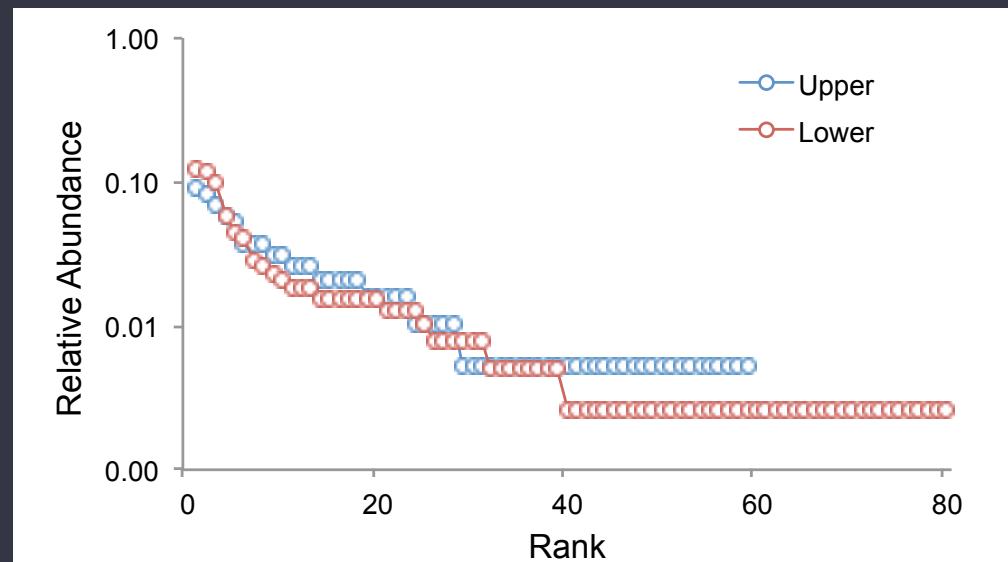
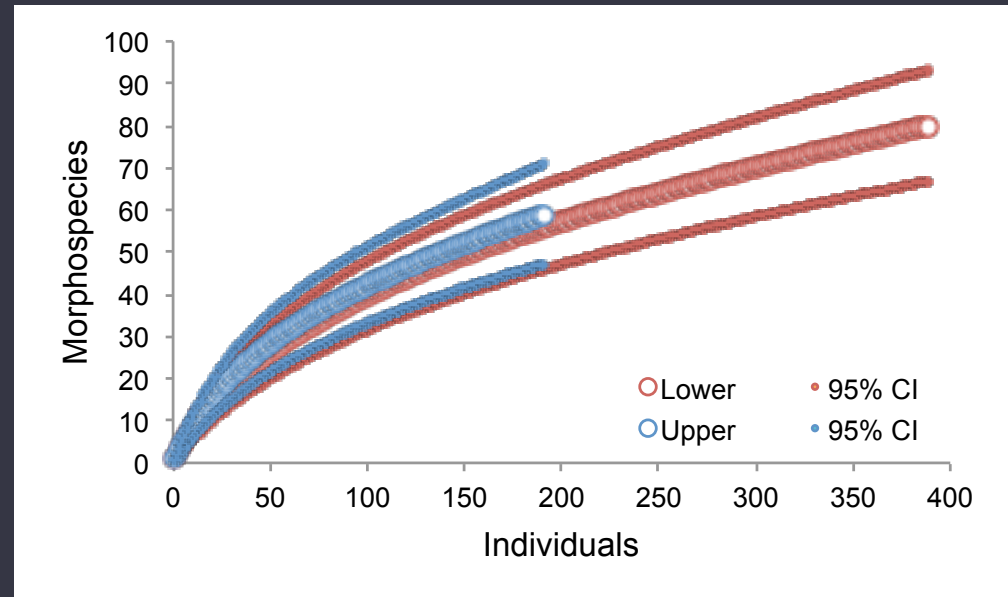


Estimated Diversity

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?



LW

