University of Wisconsin - Madison

Department of Geoscience, UW Geology Museum

Lewis G. Weeks Hall
1215 W. Dayton St.
Madison, WI 53706

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www.geologymuseum.org

Feb. 20, 2016

Brent H. Breithaupt
Regional Paleontologist
B.L.M. – Wyoming State Office
5353 Yellowstone Rd.
P.O. Box 1828
Cheyenne, WY 82003

Dear Brent,

I am submitting the attached application for an excavation permit on lands administered by the Bureau of Land Management. There are two locations in relatively close proximity (<500 m apart) within the Popo Agie Formation of Fremont County, WY; the site is on the outskirts of the town of Dubois. The site was discovered during a surface survey of the Popo Agie Formation under BLM Permit PA13-WY-212. The coordinates for the sites are:

- 'Serendipity Site (D-1)' (43°31'34.06"N, 109°37'57.81"W)
- 'Nobby Knob' (43°31'18.47"N, 109°37'42.36"W)

These sites are described in the final report for the above permit (BLM Permit PA13-WY-212). During our initial survey we documented a number of vertebrate burrows (thought to be lungfish) with minor amounts of fragmentary bone associated. Subsequent work on the specimens has yielded an extraordinary preservation of a community of a new genus of small Stereospondylii (there are only two known genera from the Triassic of North America). This is a very important site, not only for the understudied Triassic Chugwater Group, but it also provided insights to behavior as recorded in a unique trace and body fossil assemblage. We are requesting a permit for excavation of this locality.

The proposed research will be conducted over the next three years, starting summer 2015, with a proposed end date of September of 2018. We will be in the field for 3 to 5 weeks each summer, although excavation, at this point, will likely be conducted for no more than one to two weeks per season. There is one additional co-applicant: Dr. Rich Slaughter.

A letter of support is included in the application. If you have any questions or would like more information on any aspect of our application or research agenda please do not hesitate to contact us. Thank you for reviewing this application, and we look forward to hearing back from you.

All the best,

David Lovelace, Ph.D.

Form 8270_1 (Temporary December 1994)

United States
Department of the Interior
Bureau of Land Management

Office Use Only
Application Number:

Paleontological resources Use Permit Application

Sec. 302(b) of PI 94-579, October 21, 1976, 43 U.S.C. 1732

1a. Applicant: David M. Lovelace, PhD	1b. Affiliation: UW-Madison Geology Museum
2. Mailing Address Office: 1215 W. Dayton St., Madison Wi 53706 Field Party:	3. Telephone number Office: (608) 890-4949 Fax: (608) 262-0693 Field Party: Fax: (307) 921-1726

4. Nature of paleontological fieldwork proposed:
a. Survey and limited surface collection ☐ **or** b. Excavation ☑

5. Location of proposed work (attach topo map copy with project boundaries):
Two Localities. 'Little Amphibian Site' and 'Nobby Knob'; Dubois, WY. See also attached

6.a Purposes and methodology of proposed work (attach separate sheet).
See attached

7. Dates of proposed work:
Start: July 20, 2016 End: December 31, 2018

8. Name(s) of individual(s) responsible for planning, supervising, and carrying out fieldwork.
Dr.'s David Lovelace, Rich Slaughter

9. Name and address of repository.
University of Wisconsin-Madison Geology Museum
1215 W. Dayton Street
Madison, WI 53706

10. Additional materials required:
a. Resume for each individual named in Line 1a and Line 8: b. Summary of organizational capabilities: c. Summary of organizational history: d. Written certification, signed by a properly authorized official of the repositor named in Line 9, attesting to the repository's willingness to accept any collections, and as applicable, records, data, photographs, and other documents generated during the proposed work, and to assume permanent curatorial responsibility for such materials on behalf of the United States Government.

11. Signatures: _____ Applicant (Line 1a) _____ Co-applicant(s)	12. Dates: _____ _____

Section 6

Form 8270-1, BLM Paleontological Resources Use Permit Application

Purpose:

The Late Triassic Popo Agie Formation is the uppermost unit of the Chugwater Group in Wyoming; it has long been overlooked in lieu of its more productive counterpart in the southwestern US, the Chinle Formation. Over the last several years my research group has been systematically surveying outcrops of the formation in central and west-central Wyoming, with an eventual goal of surveying as much of this unit as access allows. One significant reason that the Popo Agie is often overlooked is the paucity of vertebrate fossils. While it is certainly less fossiliferous than the Chinle, our efforts are proving the Popo Agie Fm to be an extraordinarily valuable resource for understanding Late Triassic paleoecology and diversity. In addition to the flora and fauna that we have observed, there is strong biostratigraphic data (soon to be further tested by a radiometric study) that suggests the Popo may actually be the oldest of the Late Triassic terrestrial strata in the western US.

The two sites we propose to excavate are located very near the town of Dubois, WY. The first locality (aka, BLM fossil localities: Serendipity Site/D-1/D-15) is actually a stratigraphic bed that extends 70 meters along a north south trend. While we don't intend to excavate the whole length of the bed extensively, this entire interval is a zone of incredible interest. The second locality (Nobby Knob) is 600 meters to the southeast and is located at the base of an isolated 'badlands' style mudstone knob. The mudstone overlies a competent intraformational silty-conglomerate that forms a platform with some breadth. The Following descriptions will discuss the two localities, their unique circumstances, and a methodology proposed for each site. Potential problems will be outlined for consideration by the appropriate authorities. We wish to maximize collection potential while minimizing public impact (both visual and to the long-term safety of the sites).

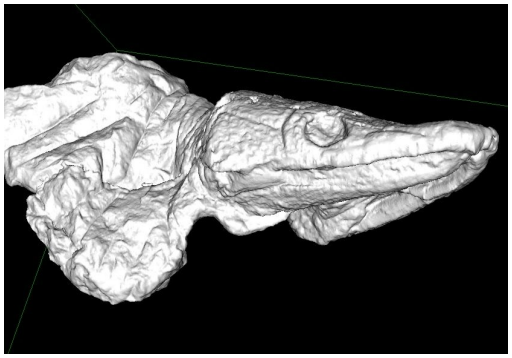
SERENDIPITY SITE:

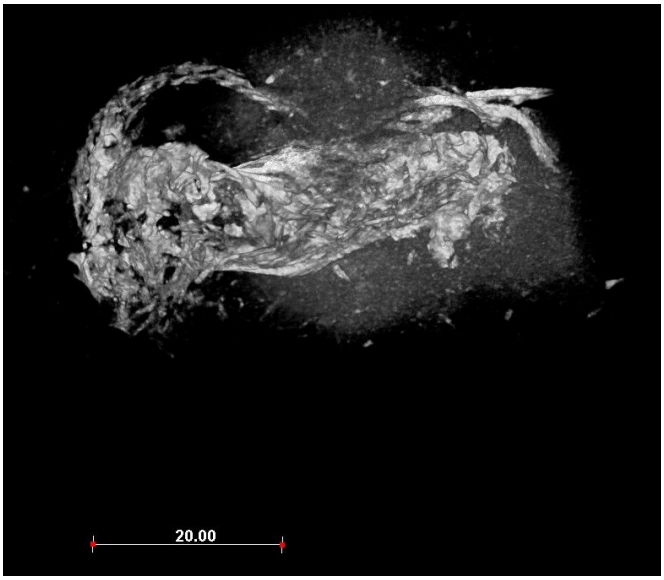
Site Description

The D-1 locality was described in 2013 under my PA13-WY-212 surface collection permit (43°31'34.06"N; 109°37'57.81"W). The specimens collected were round vertical burrows with diameters that ranged from 4-10 cm, each specimen had evidence of bone on the exterior surfaces or on the broken surfaces. All specimens were ex-situ and collected as float, although observations of in-situ burrows and bone were made and the interval of interest was defined. Total time on this outcrop was limited to just several hours. We returned to the site in 2015 to resurvey the bed and mudstone knob to the southeast. D-15 was a new collection of float material with bone fragments visible. Again, no in-situ bone was collected. It was not until the end of our time on the outcrop that we found a loose block (30x15x20 cm) just to the side of (what we assume to be) an unsanctioned 'road' where it cuts through the bed of interest. There were several small fragments of bone, and one nice burrow with a smaller diameter (2.5 cm) that was still embedded in the block. We collected this specimen as well. It was not until returning to the lab that we discovered what was awaiting us in the block (now known as

the Serendipity Block). I began to remove extraneous material to observe the morphology of the burrow and inadvertently discovered the skull (~ 6 cm) of a new genus of latiscopid temnospondyl. There are only two other latiscopids known from North America in the lowest Dockum Group, TX.

I also noticed some small fragments of bone on the burrow wall at this time (after some of the surrounding rock was removed). I mechanically prepared the skull and articulated pectoral girdle and other associated postcrania and had it CT scanned at the UW-Madison's Hospital. We had a micro-CT scan performed at University of Utah's Geology Department once we realized the importance of this specimen.

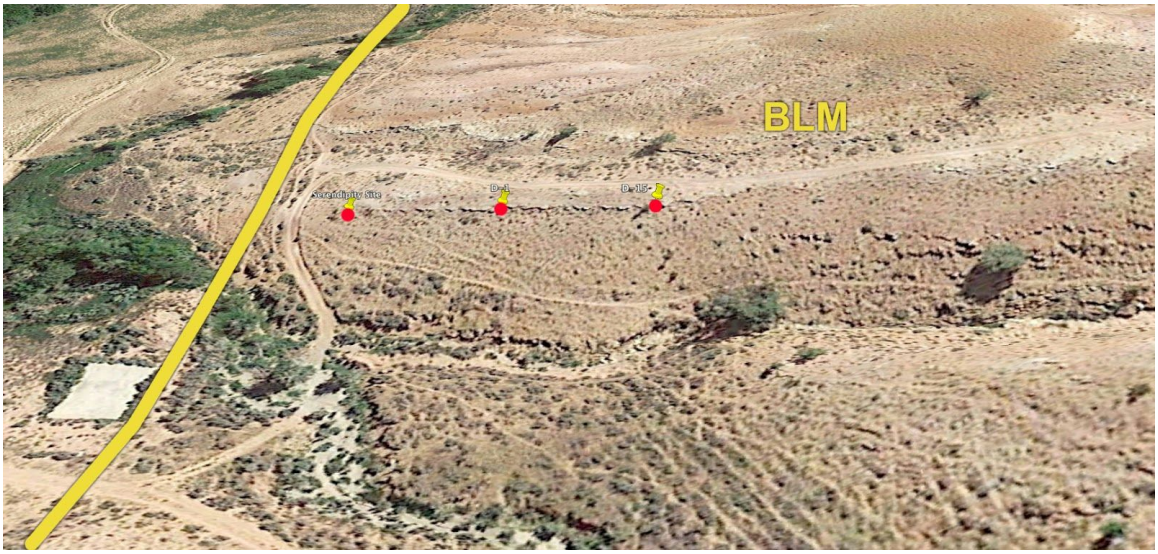




Another skull and postcrania, similar in size and morphology to the first, were found on the other side of the block. In addition, just two weeks ago we received micro-CT data of the small burrow from the University of Calgary; it clearly demonstrates a fully articulated temnospondyl? skeleton that is about 3 cm long (sans skull). Three partially articulated skeletons were found in the Serendipity Block. Medical CT scans of the original burrows from 2013 were revisited, and although poorly resolved, we could clearly see additional skulls and some postcrania (now that we knew what we were looking at) in the those blocks. Several of these specimens were prepared are currently being scanned at the micro-CT facility in Calgary.

The bed of interest is a 50-60 cm thick redbed of very-fine grained sandstone with abundant bioturbation (rhizoliths/burrows). We originally thought that the bed represented a ponded environment, although it lacks typical redox features this is still the dominant hypothesis. It is overlain by a coarser grained fluvial sandstone. Taphonomically it appears to be a population level kill off due to extended drought or shift of water table. These are quite preliminary hypotheses, however.

There is a trail (road?) that follows the top of the dips slope of the overlying sandstone. The trail is clearly used by ATV's and cattle, although it would barely be passable in a high-clearance 4WD due to the creek downcutting through the road; it does not seem that this is an official BLM road. This, and the close proximity to town are the two most obvious concerns. The only other concern is backfilling any potential excavations. The material is quite blocky and may not be conducive to typical excavation.



The above images demonstrate the location with respect to the town's edge, and the road that travels above the proposed site. The bed of interest (where the red dots are) is the red silty sandstone with abundant bioturbation. The minor ledge is the overlying sandstone. Lower image is oblique view facing east.

Methods

The initial plan is to remove a section of the overlying sandstone (3x2 m) to expose the bed of interest in order to map out burrow density and size distribution. Depending on the success of the first pit, we would like to have the ability to do this at

several points along the outcrop, which is effectively 70 meters long. Fortunately the amount of overburden is not extensive, and the bed of interest itself is not very thick. This will minimize the total amount of disturbance. Thus far, the only effective way of locating specimens is by splitting and breaking the layers apart. This is mainly due to the fact that these small skeletons are completely surrounded by a very indurated fine-grained sandstone. Also, considering the amount of effort it will take to split the rock we do not anticipate there being a great deal of total disturbance (15-20 square meters of surface area along the outcrop, and no more than 1 meter in total depth over the three years of the requested permit). The excavations, although close to the road, would not impact the long-term stability of the trail.

What is likely of more concern is the proximity to the town itself. Fortunately, this site is not conducive to easy pilfering like many vertebrate localities. The fossils are small, not easy to spot, and require a considerable effort to prepare, usually involving high resolution computed tomography. Even if members of the public were to poke around in this interval it is unlikely they would be able to disturb anything significantly. This is contrary to almost every site I have worked previously.

Ideally, this study will not only provide information on the burrowing habits of this organism, but also a broader account of population dynamics with the potential for a large number of individual skeletons. This locality has the potential to be one of the greatest sites for investigating and understanding the life history and paleoecology of the poorly understood latiscopid temnospondyls.

Excavations would take place during the last week of July and into the first two weeks of August. If there are other times that this is not reasonable due to potential impact to wildlife we will be certain to avoid those date ranges. Considering the site is literally on the edge of town I would envision this not being too great of a concern, although, as always, we will ensure a responsible and respectful relationship with the environment. This includes cleaning up and back filling excavations to the best of our abilities, minimizing foot traffic impact (the road is an obvious ingress and egress point), and maintaining the leave no trace policy with respect to all non-excavation activities. All fossils will be curated at the UW Geology Museum, Madison, WI.

NOBBY KNOB:

Site Description

The Nobby Knob (NK) locality was initially observed in 2013 during a surface survey of the area (43°31'18.47"N; 109°37'42.36"W). The mudstone prominent that typifies this site was surveyed extensively and a number of isolated ex-situ fragmentary elements were collected under the PA13-WY-212 surface collection permit. Although fragments were collected in 2013, the locality was described as D-2, but this is a larger ex-situ collection for the southern slope of the hill. The variety and scope of elements collected during the surface survey was enough to warrant a more detailed survey of

this specific site. We returned in 2015 to investigate (image to right is 2015)

With a minor amount of disturbance were were able to isolate the layer from which many of the D-2 bones were collected, and were able to remove 4 much larger in-situ specimens (within the confines of a 1x1x1 m test pit), including the posterior skull roof of a medium sized metoposaurid temnospondyl, a complete interclavicle, and a number of vertebral bodies. There were several more elements continuing into the hill that were covered with plaster temporary jackets and reburied to overwinter. The lateral extent of the site is at minimum 3 meters, but likely extends beyond that. We observed at least three individuals; this seems to be a mixed bone bed as nothing appeared to be in articulation within the survey pit. These are the first medium sized temnospondyls from the Popo Agie.

The above image shows the mudstone prominent. the quarry is at the base of the hill on a flat ledge of more competent sandstone.

Methods

Excavation would consist of at least 4 and up to 8 m of lateral excavation. The site is located at the bottom of the hill, and as such there is a reasonable limit to the depth into the hill we could go before the amount of overburden becomes excessive; this would likely be within three meters of depth. The parent matrix is a mudstone that has been (paleo)pedogenically modified and erodes at the surface into typical badlands topography. Natural erosion of the mudstone would help reclaim the site, and there is no vegetation that will be disturbed. Ingress and egress is simplified by the presence of a trail, initially part of the same road above the Serendipity Site, and then splits into smaller one track (motorcycle/cattle trail?) that leads to the base of the outcrop. Excavated matrix, removed by small hand tools, would be transported to a ‘spoils pile’ that would

be used to backfill the quarry each season. Erosion controls would be implemented where possible to protect both the quarry and the local environment.

The biggest potential problem with this site (that I can foresee) is the proximity to the town of Dubois. Unlike the Serendipity Site, it is a soft material with apparent bone and would be relatively easy to disturb. Backfilling of the site each year might minimize this potential threat, but it would be evident that folks were working out there and may increase local curiosity. Depending on the BLM's thoughts, I would be happy to provide a lecture at the Bighorn Sheep Center, or similar, to promote the research and awareness - but this can be a double edged sword for sure.

Summary:

Both proposed excavation sites (Serendipity Site: SS; and Nobby Knob: NK) listed above would have an overall low environmental impact, though both are exposed to the view of the public. Both sites are quite important and provide a great deal of paleontological information that pertains to the early evolution of the amphibians and the origin of the lissamphibia.

Site Locations:

SS: 43°31'34.06"N; 109°37'57.81"W
NK: 43°31'18.47"N; 109°37'42.36"W

Extent of excavation:

The SS locality requires the potential to excavate several locations along the 70 m of exposed surface, but each area would be limited to a 6 cubic meters, with no more than three excavation sites. The maximum extent of disturbance would be *18 cubic meters*.

The NK quarry would likely have a back wall issue at around 3 meters. The lateral extent would be limited to less than 8 m (if further work is needed an amendment would be requested). The maximum extent of disturbance would be *32 cubic meters*.

Potential problems:

The SS locality is immediately on the edge of town (Dubois), but is only visible to a few houses. There is a 'road' above the bed of interest, but proposed excavations would not impact its safety or long-term stability, but must be considered in this request.

The NK quarry is further from the town (½ km), but is much more visible from further away (as far away as the highway that runs through town).

Dates:

Our typical field season starts around the last week of July through the first two weeks of August.

Section 5
Form 8270-1, BLM Paleontological Resources Use Permit Application

Section 10
Form 8270-1, BLM Paleontological Resources Use Permit Application

10 a. RESUMES OF ALL INDIVIDUALS LISTED ON LINE 1A AND 8B.

See attached resumes and CV's.

10 b. SUMMARY OF ORGANIZATIONAL EXPERIENCE AND CAPABILITIES

The UWGM is part of the University of Wisconsin—Madison, a major research university. UWGM scientists have access to experts in a wide range of disciplines, and numerous state-of-the-art technologies. The Department of Geoscience, of which the UWGM is a part, houses: a TIMS, ICP and stable isotope mass spectrometry labs, an ion microprobe, an SEM lab, an electron microprobe, X-ray diffraction and thin section labs, and a fully-equipped machine shop, all of which have been used by UWGM scientists engaged in vertebrate paleontological research. The nearby Zoological Museum has a large osteological collection that is available for comparative research. The UWGM itself possesses a vertebrate preparation lab and storage space for new specimens. The UWGM staff also includes two vertebrate paleontologists (see attached CVs).

10 c. ORGANIZATIONAL HISTORY

The UWGM has been conducting vertebrate paleontological fieldwork since the 1970s. Most of this work has been done on Federal lands. Between 1992 and 2009, the UWGM sent 15+ expeditions to the Hell Creek Formation of Carter County, Montana. We also carried out excavations in the Morrison Formation near Hyattville, Wyoming each summer between 2003 and 2007.

Specimens collected on these expeditions have been the focus of research, particularly undergraduate research at the University of Wisconsin – Madison. Much of this research has been presented at scientific meetings, and some has taken the form of senior and graduate theses. This collection has also been by many scientists outside of the University of Wisconsin.

More recently (2009-2015), our field program has focused on paleoecological studies in the Triassic of central Wyoming. The UWGM hired a vertebrate paleontologist who is developing an active research program. This program is engaged in paleoecological and paleoenvironmental reconstructions across several key intervals during the evolution of the modern fauna.

10 d. WRITTEN CERTIFICATION:

See attached letter of certification.

GEOLOGY MUSEUM
UW MADISON

DEPARTMENT OF GEOSCIENCE
1215 W. DAYTON STREET
MADISON, WISCONSIN 53706
MUSEUM OFFICE 608.262.1412
COLLECTIONS 608.262.4912
FAX 608.262.0693

Feb. 20, 2016

Brent H. Breithaupt
Regional Paleontologist
B.L.M. – Wyoming State Office
5353 Yellowstone Rd.
P.O. Box 1828
Cheyenne, WY 82003

Dear Mr. Breithaupt,

This letter is to certify that, on behalf of the United States Government, the University of Wisconsin Geology Museum will accept and properly curate all specimens collected under Dave Lovelace's requested permit. The museum also will curate all relevant records generated during the proposed fieldwork including site maps, field notes, and photographs. Our museum already serves as a repository for vertebrate fossils collected on federal land, and our staff is experienced with caring for such material. If you have any questions regarding the museum's willingness and ability to store these collections, please let me know.

Sincerely,

Carrie A. Eaton
Curator, UW-Madison Geology Museum

Curriculum Vitae

David Michael Lovelace
lovelace@geology.wisc.edu
Museum Scientist, UW-Madison Geology Museum
1215 West Dayton Street, Madison WI 53706
Phone: 608-890-4949

Education

- **Ph.D.** Geology (2012, University of Wisconsin-Madison)
  Title: *Triassic Macrostratigraphy of the western United States and the ichnology, paleoecology, and paleoenvironments of the Early and Middle Triassic of the Chugwater Group, Wyoming*
- **M.S.** Geology (2010, University of Wyoming)
  Title: *Direct electrochemistry of mitochondrial cytochrome c and three membrane-bound cytochromes from dissimilatory iron reducing bacteria on hematite and ITO electrodes*
- **B.S.** Geology (2003, University of Wyoming)
- **B.S.** Zoology (2003, University of Wyoming)
- **B.S.** Biology (2003, University of Wyoming)

Geology Related Work Experience

2008-Present UW Geology Museum
Research Scientist (2012-present): Manage preparation laboratory, mentor students, conduct summer field program, and conduct research on museum collections, and explore new avenues of research.
Prep Lab Manager (2008-2012): Managed volunteer preparators, curatorial duties, and outreach events.

2009 BP Internship
Intern: BP North American Gas division, Arcoma group. Using 3D seismic, well logs, and production data to characterize an undeveloped horizon for potential incorporation into drilling plans

2006-2008 Big Horn Basin Foundation
Director: Oversight of operations for the non-profit educational foundation, development of programs, and coordinated university partnerships and international collaborations.

2000-2003 USDA Forest Service
Laboratory technician: field acquisition and laboratory analysis of stream bedload, discharge, and spatiotemporal variability of log debris along three reaches of high altitude post-fire riparian zones.

1994-1999 Baker Atlas Wireline Division, Baker Hughes Int.
1999-2000, Wireline Operator
1994-1996, 1998-1999 **(Western Geophysical);** Geophysical Trainee

Academic Positions:

Present Museum Scientist, UW Geology Museum
2011 Instructor, University of Wisconsin-Madison (Sedimentology/Stratigraphy)
2010 Instructor, Madison Area Technical College (Physical Geography)
2008 Adjunct Faculty, Central Wyoming College (Historical Geology)
2007 Adjunct Faculty, Central Wyoming College (Physical Geology)

Selected Awards and Grants

2012 Outstanding Student Research Paper (Geoscience Dept. UW-Madison)
2011 Stanley A. Tyler Award for Excellence in Teaching, UW-Madison
2010 GSA Graduate Student Research Grant (Triassic Chugwater Group; paleosols)
2009 AAPG Research Grant (Triassic Chugwater Group)
2004 Top Field Geologist Award (University of Wyoming Dept. of Geoscience)

Teaching (TA) Positions

University of Wisconsin-Madison: 2009-2011 (Geoscience 107: Life of the Past; 3 semesters)
2008-2009 (Zoology 430: Comparative anatomy of the vertebrates; 1 semester)
University of Wyoming: 2004-2005, (Foundation of Geology I; 2 semesters); 2003-2004, (Discovering Science; 3 semesters); 2002, Geology 1100 (Physical Geology; 2 semesters)
Casper College: 1999-2001, Geol 1100 (Physical Geology; 5 semesters)

Publications

Lovelace, D.M., and Doebbert, A.C., 2015, A new age constraint for the Early Triassic Alcova Limestone (Chugwater Group), Wyoming: Palaeogeography Palaeoclimatology Palaeoecology, v. 424, no. C, p. 1–5, doi: 10.1016/j.palaeo.2015.02.009.

Lovelace, D.M., 2014, Developmental failure of segmentation in a caudal vertebra of *Apatosaurus* (Sauropoda), The Anatomical Record, v. 297, p. 1262-1269, DOI 10.1002/ar.22887.

Thomson, T., and **Lovelace, D.M.,** 2014, Swim track morphotypes and new track localities from the Moenkopi and Red Peak formations (Early Triassic) with preliminary interpretations of aquatic behaviors, *in* Fossil footprints of western North America, Lockley, M.G., and Lucas, S.G., eds., *New Mexico Museum of Natural History and Science Bulletin*, n. 62, p. 103-128

Lovelace, D.M., and Lovelace, S.D., 2012, An Early Triassic invertebrate and vertebrate ichnoassemblage from the Red Peak Formation (Chugwater Group), central Wyoming, PALAIOS, v. 27, p. 636-657

Lovelace, D.M., 2012, An archosaurian adventure: Integrating the evolutionary history and paleoecological context of the dinosaurs, Evolution: Education and Outreach, v. 5, n. 3, p. 508-509

Jennings, D.S., **Lovelace, D.M.,** and Driese, S.G., 2011, Micromorphology and Geochemistry of Upper Jurassic-Lower Cretaceous Wetland Paleosols and Associated Lacustrine Deposits from the Morrison Formation, North Central Wyoming, USA, Sedimentary Geology; v. 238, p. 23-47; 10.1016/j.sedgeo.2011.03.005

Lovelace, David M., 2010, A Bulldog of Your Owen: The Philosophies Behind the Huxley–Owen Debate, *Evolution:Education and Outreach*, vol. 3 pp. 291-292

Lovelace, David M., Hartman, Scott A., and Wahl, William R., 2007, Morphology of a specimen of *Supersaurus* (Dinosauria, Sauropoda) from the Morrison Formation of Wyoming, and a re-evaluation of diplodocid phylogeny. Arquivos do Museu Nacional, Rio de Janeiro, v.65, n.4, p.527-544

Lovelace, David, 2006, An Upper Jurassic Morrison Formation fire-induced debris flow: taphonomy and paleoenvironment of a sauropod dinosaur (Sauropoda, *Supersaurus vivianae*) locality in east-central Wyoming: *in* Paleontology and Geology of the Upper Jurassic Morrison Formation, Foster, J.R., and Lucas, S.G., eds., *New Mexico Museum of Natural History and Science Bulletin* 36, p.47-56

Wegweiser, Marilyn D., Hartman, Scott A., and **Lovelace, David M.**, 2006, Duckbill dinosaur chin skin scales: ups, downs and arounds of surficial morphology of Upper Cretaceous Lance Formation dinosaur skin. *in* Late Cretaceous vertebrates from the Western Interior, Lucas, S. G., and Sullivan, R. M., eds., *New Mexico Museum of Natural History and Science Bulletin* 35, p. 119-125

Eggleston Carrick M., Khare, Nidhi, and **Lovelace, David M.**, 2006,Cytochrome c interaction with hematite (alpha-Fe2O3) surfaces, *Journal of Electron Spectroscopy and Related Phenomena*, v. 150 p. 220–227

Khare, Nidhi, **Lovelace, David M.**, Eggleston, Carrick M., Swenson, Michael, and Magnuson, Timothy S., 2006, Redox-l inked conformation change and electron transfer between monoheme c-type cytochromes and oxides. *Geochimica et Cosmochimica Acta*, v. 70, p.4332–4342

Khare, Nidhi, Eggleston Carrick M., **Lovelace, David M.**, and Boese, Steven W., 2006, Structural and redox properties of mitochondrial cytochrome c co-sorbed with phosphate on hematite (a-Fe2O3) surfaces. *Journal of Colloid and Interface Science*, v. 303, p. 404–414

Khare, Nidhi, Eggleston, Carrick M., and **Lovelace, David M.**, 2005, Sorption and direct electrochemistry of mitochondrial cytocrhome c on hematite surfaces, Clays and Clay minerals, v. 53

Selected Presentations

Lovelace, D.M., and Butler, R., 2013, Quantifying Triassic sedimentation across the western United States: perception, preservation, and paleontology, Journal of Vertebrate Paleontology, Program and Abstracts, p. 164-165

Lovelace, D.M., 2013, Triassic macrostratigraphy of the western United States, *Ciências da Terra*, STRATI 2013 1st International Congress on Stratigraphy, Volume Especial VII, p 185

Lovelace, D.M., and Lovelace, S.D., 2009, Vertebrate tracks of the Early Triassic Red Peak Formation, central Wyoming, USA, Geological Society of America Abstracts with Programs, v. 41, no. 4, p. 70

Lovelace, David M., 2009, Somatic resegmentation error: a congenital physical anomaly in a specimen of *Apatosaurus*, Journal of Vertebrate Paleontology, Vol. 29, Supplement to No. 3, p. 137A

Lovelace, David M., 2007, Trampled by turtles: turtle tracks from the Red Peak Formation (Southern Big Horn Basin, Wyoming). Journal of Vertebrate Paleontology, Vol. 27, Supplement to No. 3, p. 107A

Lovelace, David, 2006, An articulated partial postcranial skeleton of a small ornithopod (C.F. Othnielia) Dinosaur (Morrison Formation; Alcova, Wyoming), Journal of Vertebrate Paleontology, v. 26, n. 3A, p 91A

Lovelace, David, Hartman, Scott, and Wahl, William Jr., 2005, Revised osteology of Supersaurus vivianae, Journal of Vertebrate Paleontology, Vol. 25, n. 3A, p 84A-85A

Hartman, Scott, **Lovelace, David**, and Wahl, William Jr., 2005, Phylogenetic assesment of a maniraptoran from the Morrison Formation, Journal of Vertebrate Paleontology, Vol. 25, Supplement to n. 3, p 67A-68A

Lovelace, David, 2005; Supersaurus vivianae: history, morphology, and phylogeny, Boletim de Resumos - II Congresso Latino-Americano de Paleontologia de Vertebrados, Kellner, Henriques, and Rodrigues eds., Museu Nacional, Rio de Janeiro, 285p. (pg.158-159)

Lovelace, David, 2004; Taphonomy and paleoenvironment of a Late Jurassic dinosaur locality in the Morrison Formaiton of East-Central Wyoming, Journal of Vertebrate Paleontology, v. 24, S n. 3, p 85A

Richard Walter Slaughter

UW-Madison Geology Museum
1215 West Dayton Street
Madison, Wisconsin 53706

Phone: (608) 262-2399
FAX: (608) 262-0693
E-mail: rich@geology.wisc.edu

Current Position

Director of Geology Museum, 2004 - present.
Department of Geoscience, University of Wisconsin – Madison

Education

Ph.D., 2001, Geology, University of Iowa, NSF Fellow
B.A., 1995, Geology, Augustana College, Illinois, *summa cum laude*

Dissertation: Terminal Pleistocene and Holocene mammal remains from Bogus Cave, Jones County, Iowa.

Previous Academic Positions

University of Wisconsin – Madison, Department of Geoscience
Assistant Director of Geology Museum
Managed the museum's educational programs, 2001 - 2003.

University of Iowa, Museum of Natural History
Research Assistant
Developed and constructed exhibits for the Hageboeck Hall of Birds, 2000 - 2001.

University of Iowa, Department of Geology
Instructor
Soil Systems as Teaching Tools, 2 credits, Summer 2001.
Paleoecology of Quaternary Mammals, 3 credits, Fall 1999.

Teaching Assistant
Evolution and History of Life, Spring 1997 and Spring 2000.
Introduction to Geology, Fall 1996.

Teaching at the University of Wisconsin-Madison

Geology 107: Life of the Past (3 credits)

Taught each fall and spring semester, Spring 2004 – Spring 2012.

Semesters Taught	Cumulative Enrollment	Overall Class GPA	Overall Mean Score for Teaching Quality (max = 5)
17	1012	2.70	4.84

Undergraduate Senior Theses in Paleontology
2009-10: Roxanne Riesberg, Nicholas Wiersum
2008-09: Lisa Lesar
2004-05: Adam Behlke
2003-04: Daniel Hyslop, Simon Masters

Directed Studies in Paleontology for Undergraduates
2011: 1 student, 1 credit total
2009: 1 student, 3 credits total
2008: 1 student, 1 credit total
2006: 3 students, 6 credits total
2004: 7 students, 23 credits total
2003: 3 students, 4 credits total

Teaching at the University of Wisconsin-Madison (continued)

Field Methods in Vertebrate Paleontology

This course took place in north-central Wyoming and involved excavating Late Jurassic dinosaur fossils from the Morrison Formation. June 2003 - 2007.

Research Interests

The kinds of questions I am most involved in addressing are: How have vertebrate communities in the Midwest changed over the past 30,000 years? What caused the extinction of mastodons, giant beavers, and many other large mammals at the end of the Ice Age? To help answer these questions I excavate and study bones from late Quaternary deposits in caves and fissures.

Paleontological Field and Lab Experience

- Organized and helped lead a two-week expedition to central Wyoming to collect Early Triassic reptile tracks. June 2010.
- Have excavated late Pleistocene and Holocene vertebrate remains from more than twenty sites in the Upper Midwest. 1997 – 2010.
- Helped coordinate and run excavations at the Quammen Site and the Westphal Quarry – two Late Jurassic dinosaur localities in the Morrison Formation of Wyoming. June 2003 – 2007.
- Have supervised ~40 student volunteers in the UW-Madison Geology Museum's fossil preparation lab. 2005 – present.

Outreach Activities

Wisconsin Vertebrate Fossil Project

Principal investigator for this NSF-funded program in which Wisconsin high school students and their teachers excavated and interpreted late Quaternary vertebrate fossils from caves in the Driftless Area. January 2003 - December 2004.

Workshops and Courses in Vertebrate Paleontology for K-12 Teachers

Ice Age Wisconsin. Wisconsin Society of Science Teachers Annual Convention, Wisconsin Dells, WI. March 2003.

Exploring Wisconsin's Ice Age Fossils. Wisconsin Society of Science Teachers Annual Convention, Madison, WI. April 2002.

Public Preentations on Vertebrate Paleontology (last five years)

Death by Asphalt: Ice Age Fossils from the Tar Pits of California. Down to Earth Lecture Series – Number 6, UW-Madison Geology Museum. September 2012.

Ancient Bones from Twilight Zones: An Introduction to the Paleontology of Caves. Neville Public Museum Geology Club Monthly Meeting. June 2012.

Mammoths, Mastodons and Mega-Beasts of the Ice Age. Founder's Day Celebration for the Los Angeles Chapter of the Wisconsin Alumni Association. This talk was delivered in the Page Museum at the La Brea Tar Pits. May 2012.

Mammoths, Mastodons, and Other Mega-Beasts of the Ice Age. Down to Earth Lecture Series – Number 1, UW-Madison Geology Museum. May 2010.

Dinosaurs and Other Fossil Finds from the Westphal Quarry of Wyoming. Northwest Illinois Rock and Mineral Club Annual Show. November 2008.

Dinosaurs Great and Small: Recent Discoveries at the Westphal Quarry, Wyoming. Badger Lapidary and Geological Society's Annual Show. March 2008.

Richard W. Slaughter

Professional Affiliations: American Alliance of Museums, Wisconsin Federation of Museums

Honors and Scholarships

University Housing Honored Instructor Award, 2008, 2010, 2011.
UW-Madison Early Career Academic Staff Excellence Award, 2007.
Samuel Calvin Award – Outstanding Geology Ph.D. Student, 2001.
Iowa Fellowship, University of Iowa, 1995 - 1999.
National Science Foundation Graduate Research Fellowship, 1995 - 1998.

Published Works

Kuchta, M., R. Slaughter, and D. Geary. 2007. Full-glacial gastropods and rodents from Kulas Quarry, Wisconsin. *Current Research in the Pleistocene*, 24: 170-172.

Slaughter, R. and J. Skulan. 2001. Did human hunting cause mass extinction? Letter in *Science*, 294 (5546): 1459-1462.

Slaughter, R.W. and S.P. Jones. 2000. A late-glacial record of *Dicrostonyx* from Honey Dipper Den, Jones County, east central Iowa. *Current Research in the Pleistocene*, 17: 133-135.

Collins, J.M., R.W. Slaughter, D.L. Asch, K.K. Hirst and J.L. Cordell. 1997. A brief evaluation of the Carroll Rock Shelter, Dubuque County, Iowa. *Journal of the Iowa Archeological Society*, 44: 84-101.

Hammer, W.R., W.J. Hickerson and R.W. Slaughter. 1995. Evidence of theropod behavior from the Jurassic of Antarctica. *Antarctic Journal of the United States*, 30 (5): 55-56.

Hammer, W.R., W.J. Hickerson and R.W. Slaughter. 1994. A dinosaur assemblage from the Transantarctic Mountains. *Antarctic Journal of the United States*, 29 (5): 31-33.

Open File Reports

Slaughter, R.W. 2002. The impact of vandalism on the bone deposits in Fern Bluff Cave, Linn County, Iowa. Manuscript on file, Office of the State Archaeologist, University of Iowa.

Slaughter, R.W. 2000. Report on the vertebrate remains from sites 13HA181 and 13HA385, Hardin County, Iowa. Manuscript on file, Office of the State Archaeologist, University of Iowa.

Slaughter, R.W. 1998. Report on the 1996 vertebrate assemblage from the Gillett Grove (13CY2) Oneota Site, Clay County, Iowa. Manuscript on file, Office of the State Archaeologist, University of Iowa.

Whelan, M.K., R.W. Slaughter and J.R. Krieg. 1997. Report on the preliminary vertebrate faunal analysis from the Knutson Dam site – 21BL4. Manuscript on file, U.S. Forest Service, Chippewa National Forest, Minnesota.

Slaughter, R.W. 1996. Report on faunal remains from site 13DB486, Dubuque County, Iowa. Manuscript on file, Office of the State Archaeologist, University of Iowa.

Invited Lectures

Ice Age Fossils from North American Caves. Keynote address at the 2007 Wisconsin Speleologogical Society Annual Meeting. September 2007.

Ancient Bones from Twilight Zones: An Introduction to the Paleontology of Caves. Keynote address at the 2006 Guild of Natural Science Illustrators Annual Conference. August 2006.

Late Pleistocene and Holocene Bone Deposits in Midwestern Caves. Department of Geology, University of Wisconsin – Oshkosh. November 2002.

Presentations at Professional Meetings

Kuchta, M., D. Geary, and R. Slaughter. 2009. Paleoenvironmental significance of Late Pleistocene terrestrial gastropods from alluvium and colluviums in the Driftless Area of Wisconsin and Minnesota. Geological Society of America North-Central Section Meeting, Rockford, IL. *Geological Society of America Abstracts with Programs*, 41 (4): 5.

Kuchta, M., D. Geary, B. Diem, and R. Slaughter. 2007. Taphonomy of terrestrial gastropods at the Big Platte Locality, southwestern Wisconsin. Annual Meeting of the Geological Society of America, Denver. *Geological Society of America Abstracts with Programs*, 39(6): 401.

Kuchta, M., D. Geary, and R. Slaughter. 2006. Late Pleistocene gastropods from alluvium in the Driftless Area of Minnesota and Wisconsin. Annual Meeting of the Geological Society of America, Philadelphia. *Geological Society of America Abstracts with Programs*, 38(7): 118.

Slaughter, R.W. 2002. Taphonomy of terminal Pleistocene and Holocene bone deposits in Bogus Cave, east-central Iowa. Annual Meeting of the Society of Vertebrate Paleontology, Norman, OK. *Journal of Vertebrate Paleontology*, 22(3): 108A.

Skulan, J. and R. Slaughter. 2002. An exploratory survey of vertebrate paleontological resources in Wisconsin caves. Annual Meeting of the Society of Vertebrate Paleontology, Norman, OK. *Journal of Vertebrate Paleontology*, 22(3): 107A.

Slaughter, R.W. and S.C. Wallace. 2000. Freaks and Squeaks: Abnormalities in Late Holocene vole teeth from eastern Iowa. Annual Midwest Regional Meeting of the Division of Vertebrate Morphology, Society for Integrative and Comparative Biology, Rock Island, IL. No abstract.

Slaughter, R.W. and K.B. Tankersley. 1999. Fluoride analysis of late Wisconsinan and Holocene micromammal teeth from Bogus Cave, east-central Iowa. Annual Meeting of the Society of Vertebrate Paleontology, Denver, CO. *Journal of Vertebrate Paleontology*, 19(3): 76A.

Semken, H.A. Jr., S.A. Behrends, S.C. Wallace, and R.W. Slaughter. 1999. Comparison of paleoecological interpretations derived from two juxtaposed, contemporaneous micromammal faunas collected from cultural and non-cultural associations, Great Plains of North America. XV International Congress, International Union for Quaternary Research, Durban, South Africa. *Book of Abstracts*, 163.

Collins, J.M. and R.W. Slaughter. 1997. Late Woodland faunal exploitation as viewed from a Dubuque-area rock shelter. Paper presented at the 109th Annual Meeting of the Iowa Academy of Science, Clarke College, Dubuque, Iowa.

Collins, J.M. and R.W. Slaughter. 1996. An interesting rock shelter assemblage from northeastern Iowa. Annual Plains Anthropological Conference, Iowa City, IA. *Program and Abstracts*, 65.

Hammer, W.R., W.J. Hickerson and R.W. Slaughter. 1995. Scavenging and (?) choking Jurassic theropods from Antarctica. Geological Society of America North-Central/South-Central Sections Meeting, Lincoln, NE. *Geological Society of America Abstracts with Programs*, 27(3): 55.

Slaughter, R.W., W.J. Hickerson and W.R. Hammer. 1994. Analysis of Antarctic theropod teeth based on serration densities and patterns. Geological Society of America North-Central Section Meeting, Kalamazoo, MI. *Geological Society of America Abstracts with Programs*, 26(5): 61.

Grants Received

Collaborative research: development of paleo-proxy to test the sensitivity of the Southern Greenland Ice Sheet to future warming. (Co-PI, Focus: Education and Public Outreach).
$15,420 for E/PO Activities – National Science Foundation. September 2009 – present.

Detection of the signatures and environments of life on Earth and other planetary bodies from their organic and mineralogical records. (Co-I, Focus: Education and Public Outreach).
$325,400 for E/PO Activities – NASA Astrobiology Institute. November 2007 – present.

Wisconsin Vertebrate Fossil Project: Engaging High School Students and Their Teachers in Field-based Exploration and Research (Principal Investigator).
$144,545 – National Science Foundation, January 2003 – December 2004.

Equipment for Cave Exploration and Resarch (PI).
$10,000 – Evjue Foundation, 2002.

Faunal Transitions Across the Pleistocene-Holocene Boundary in the Midwest (PI).
$71,150 – NSF Graduate Research Fellowship, 1995 – 1998