

**Fossil field collection and
field site 3D reconstruction
including present paleo
databases and standards**

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Dinosaur Excavation Project

The Project

- Conducting a taphonomic study
- Upper Cretaceous dinosaur fossils
- Eastern Wyoming
- Excavation began in 1995, using traditional methods
- On-site for one month every summer
- Census varies between 15 and 60 participants











Our Goals

- Faithfully and consistently record all observable specimen data
- Remove all bottlenecks in fossil excavation efficiency
- Provide access to the data to all interested parties
- Encourage interest in taphonomy by public

Meticulous Accounting

- necessary for keeping track of a large number of specimens in a potentially chaotic environment
- every specimen, large or small, gets a field card with a pre-printed unique specimen number
- specimen number is the key for everything we do in our workflow

Data Collection

- In 2000, we adopted Real-Time Kinematic Differential GPS data collection for every fossil
 - Eliminated traditional string grid
 - Eliminated measurement and transcription error
 - Enabled accurate 3D renderings of quarries
- Since 2000, we have collected 20,000 specimens using these techniques

Data Collection

- RTK DGPS
 - GPS base station at known, fixed location
 - Transmits calculated GPS error correction data via radio link
 - GPS rover subtracts correction from computed location
 - Enables accuracy to within 2mm!





Specimen Cards

- every specimen field card has a corresponding entry on the quarry leader's clipboard
- specimen card contains:
 - specimen number in large type
 - date
 - collector name
 - field identification
 - built-in centimeter scale for measuring small specimens

Field Notebook

- each collector keeps a field notebook where additional notes are recorded
- field notebook contains:
 - everything from field card
 - rough sketch with north arrow
 - notes on soil composition, nearby specimens, etc...
- To Emilio's point yesterday, our field notebooks are an important double-check for our digital data
 - database also contains column for field notebook page number

Collection Procedure

- affix specimen label on specimen
- specimen card with specimen
- wrap aluminum foil around specimen with label and card inside
- affix label on outside of foil
- write collector name and specimen number on outside of foil





GPS Procedure

- Set the GPS point description to specimen number
- Record several points per specimen
- Essentially creating a rough 3D model, in situ

Photography Procedure

- Include specimen card in photograph
- Photograph specimens from directly above
- Ensure total shade or total sun

End-of-Day Procedures

- All recovered specimens brought to campsite
- Export GPS point data to CSV file
- Rename all specimen photographs to specimen number
- Save GPS data and image files on local laptop, Dropbox, and upload to University server
- Run file reconciling script

Reconciling Script

- Created a reconciling script to find specimens missing photographs or GPS
- Reconciles all photograph file names against the contents of the GPS data files
 - Finds photographs with no matching GPS points
 - Finds GPS points with no matching photographs
- Useful for catching typos while they are still correctable



Internet Access

- we are in a remote area, but have managed to bring in a connection
- 30-mile wifi link
- Relayed to campsite via another antenna

End-of-Day Procedures

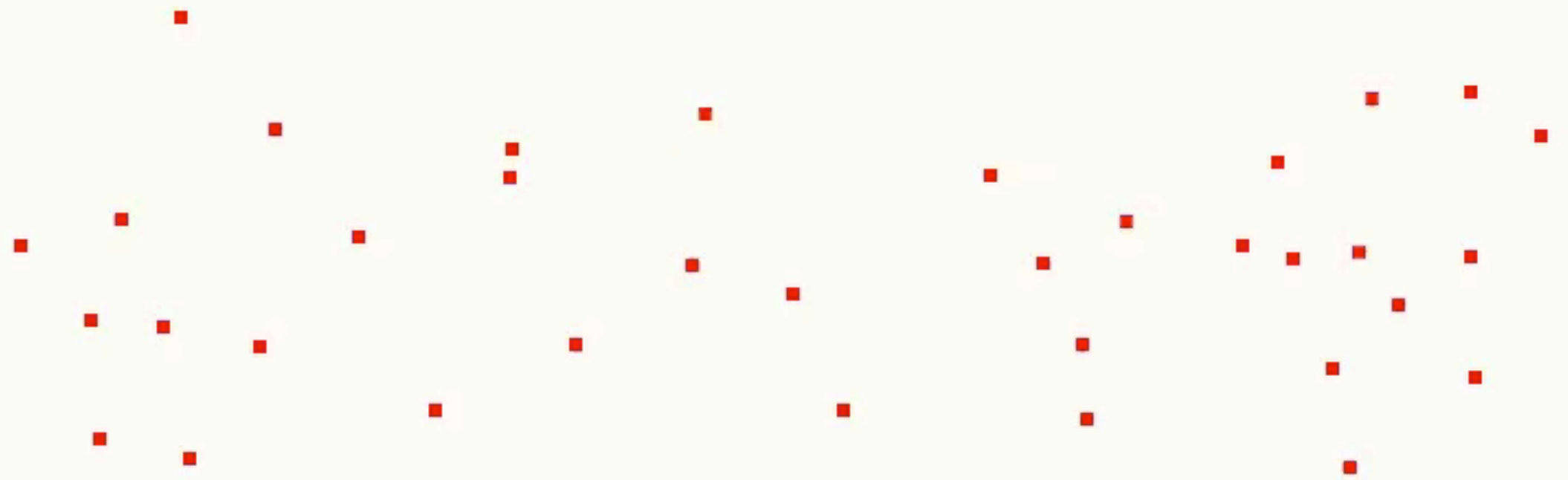
- Every specimen brought back to camp is checked off the quarry clipboard before being packed in boxes for transport back to lab
- Ensures that no specimens are left unaccounted for
- Each box is numbered, and the box that each specimen is placed into is noted on the quarry clipboard list

End-of-Season Procedures

- Scan field notebooks
- Stabilize and repair specimens
- Formal identification
- Database entry
- Multi-angle photographs
- Goal is to process all specimens before the start of the next field season

Georeferencing

- Every specimen photograph is georeferenced to its 3D positional data
 - Background image elements removed
 - Correlate each point in the photograph to corresponding point in the positional data set
 - Repeat for every fossil found
 - Render 3D views of resulting fossil assemblage

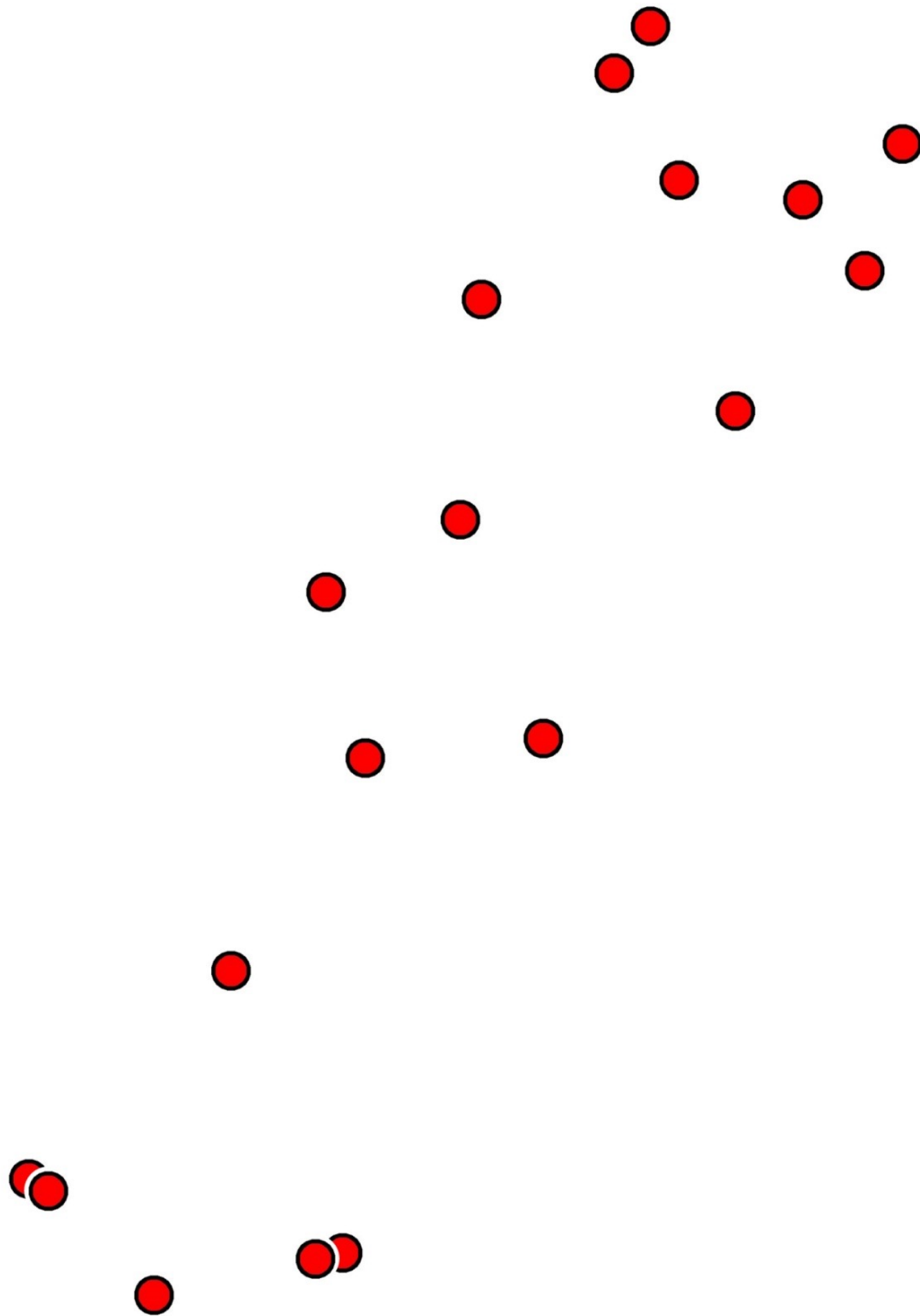




HRS05331
[Faint text]
[Faint text]
[Faint text]



HRS05331

























Curation Process

- Each specimen is curated into our collection and passes through a well-defined workflow
 - Fossils are cleaned, repaired, and stabilized using standard methods and consolidants
 - All observable data entered into database
 - Imaged using a custom-made rotating photographic table, which automatically triggers photos from 32 angles



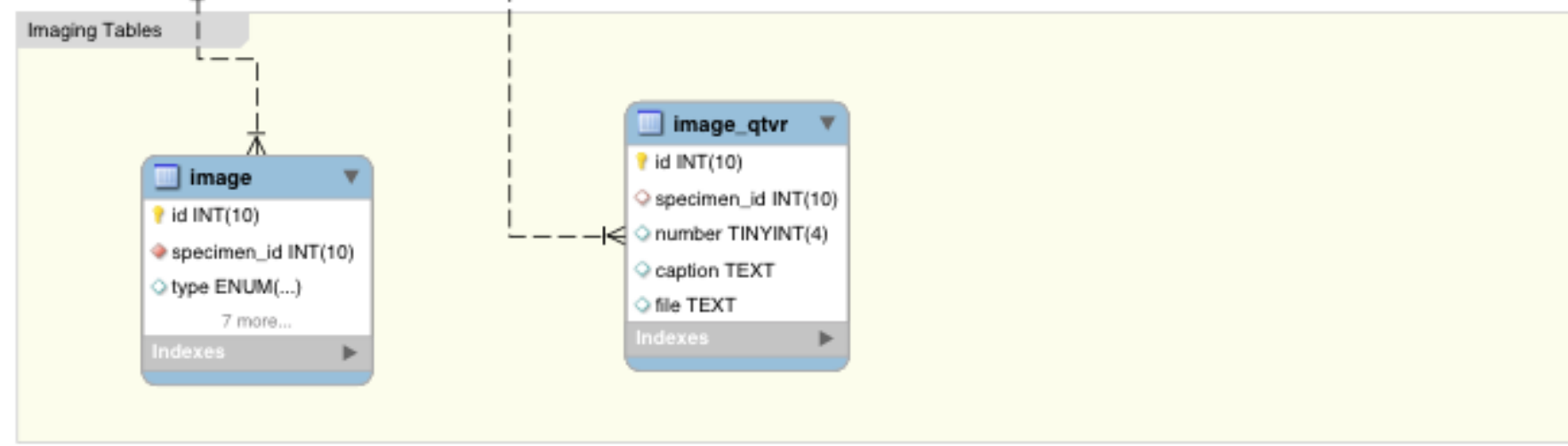
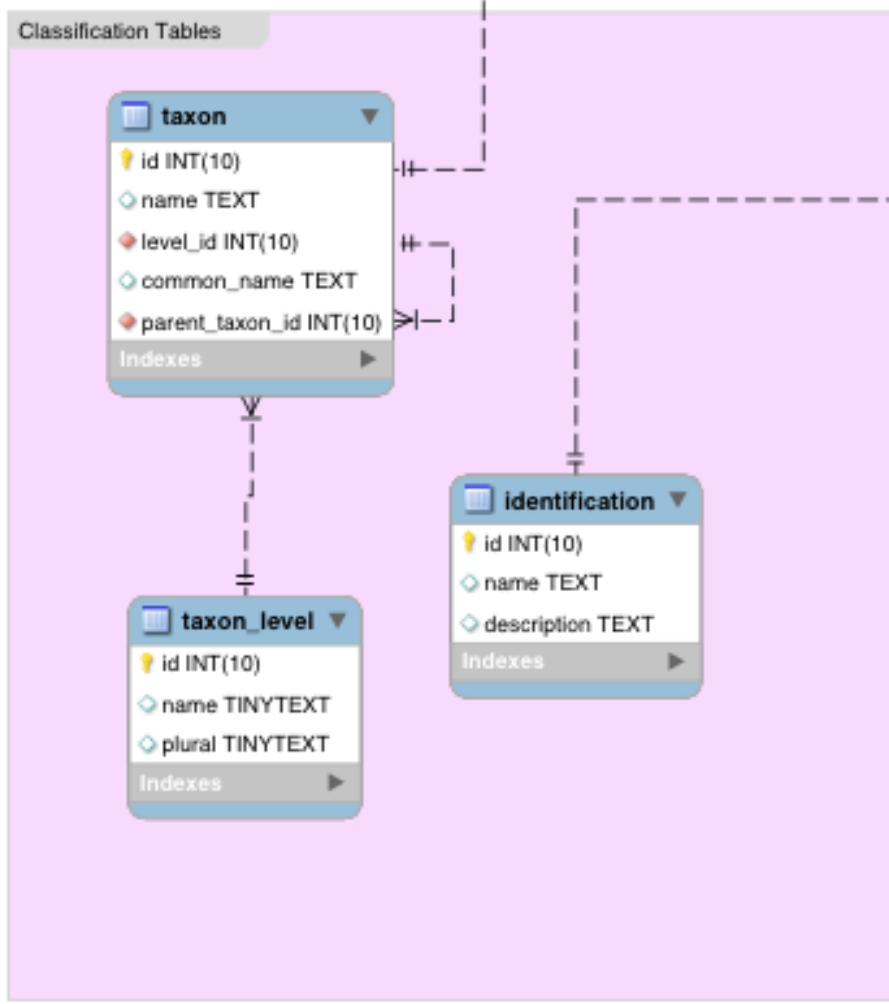
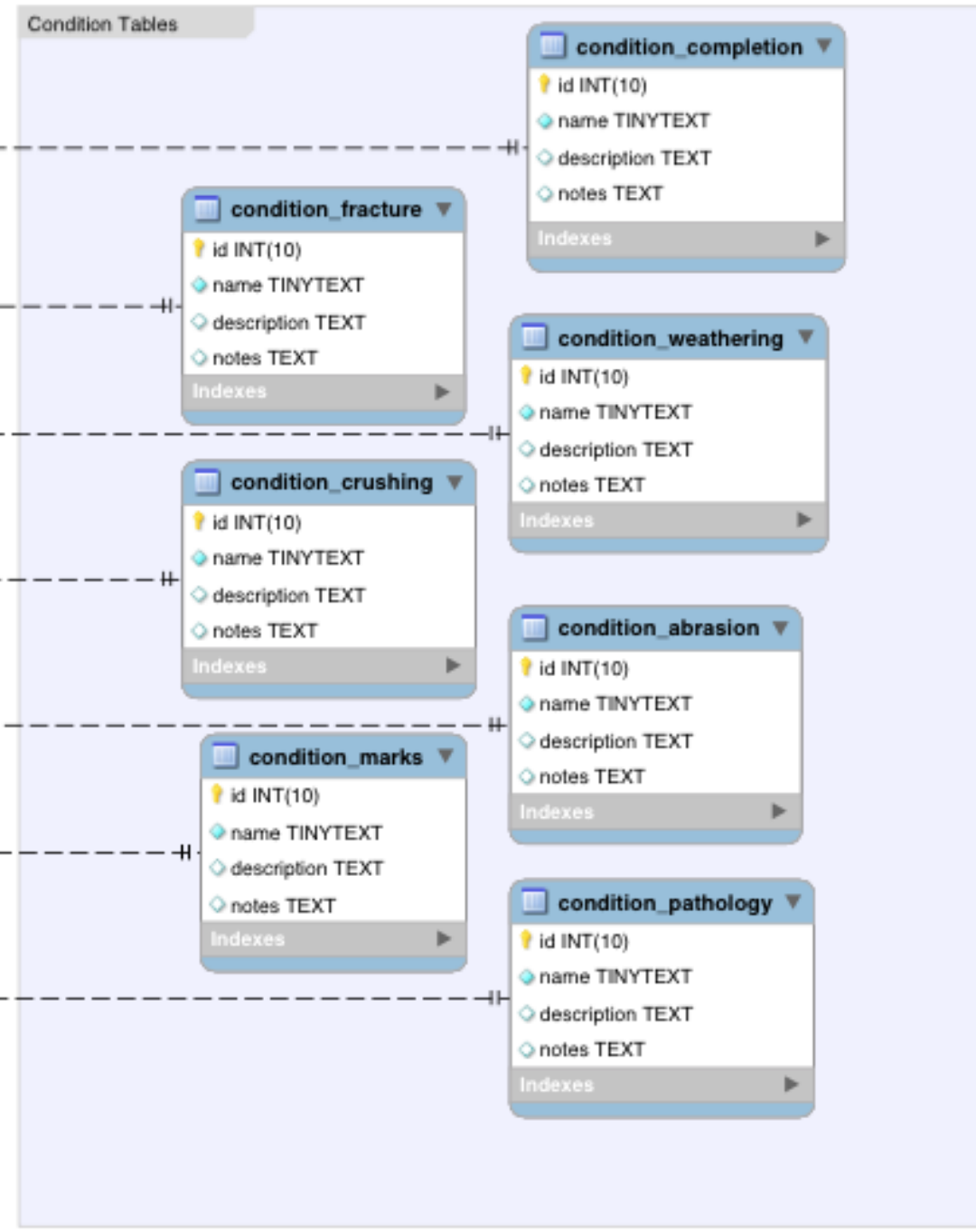
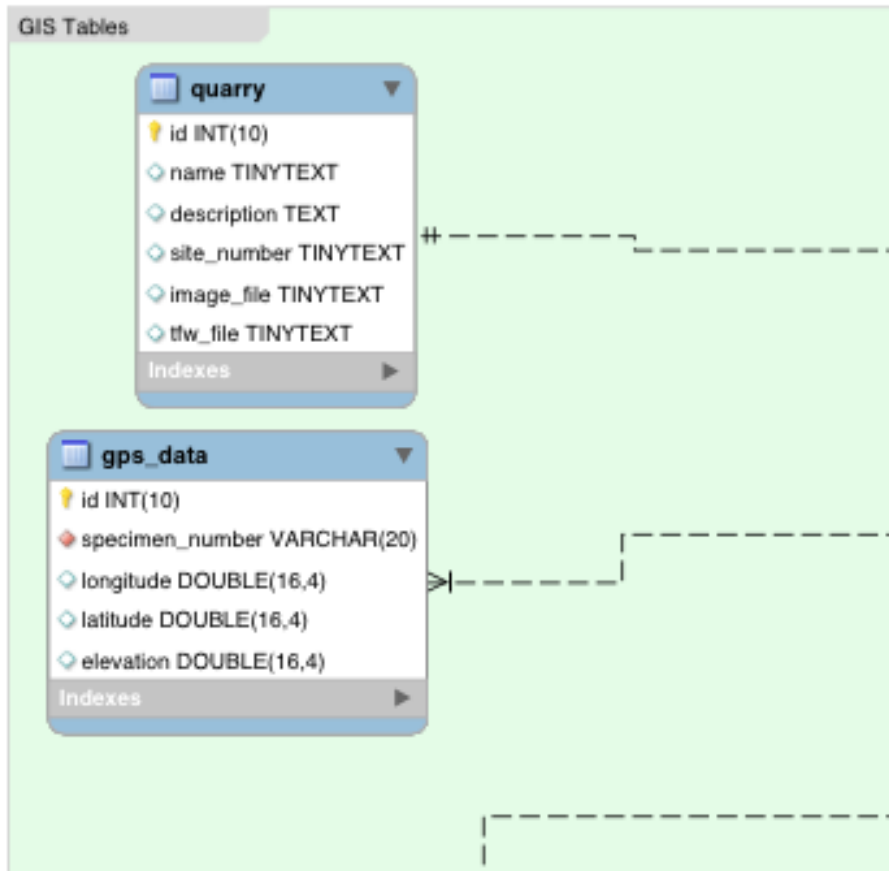


Online Database

- The online database consists of two parts
 - The backend database engine
 - The frontend website

Backend Database

- Originally designed in 2004
- Consists of 46 relationally interlinked tables
- Of those, 17 tables contain fossil data
- Normalized using standard techniques
 - “Fourth Normal Form” (*Ronald Fagin, 1977*)
 - No duplicated data between tables



Database Normalization

- Any piece of data that appears more than once has been put into its own separate parent table and linked to from one or more child tables
- Normalization is absolutely vital for maintaining data integrity
- Requires deep understanding of dataset
- Results in clean data, easily expandable schema, and fast operation

Frontend Website

- Multiple frontends
 - One for data-entry and administration
 - One for public browsing and research

Website Features

- Browse and search all specimens on any criteria
- View all specimen metadata
- Positional mapping of every specimen with respect to others found in same quarry
- Photographic 360 degree viewing of most specimens



Browse Collection



Research Query



Login



The Online Fossil Museum collection has been developed to fulfill the mission and purposes of the Departments of Geology and Biology and the Hanson Research Station in harmony with the University's mission of education, research and service.

The SWAU collections are the property of Southwestern Adventist University, the EHRC collection is the property of the Earth History Research Center, and the HRS collection is the property of the Hanson Research Station.

Approximately ninety percent of the entire paleontological collection are fossil vertebrates. The most significant part of the vertebrate collection is the HRS vertebrate collection from the Upper Cretaceous Lance Formation of Wyoming.

The Collection houses type specimens and makes them accessible to the scientific community as prescribed by the International Code of Zoological Nomenclature (Recommendation 72F). The University is committed to maintaining the Repository as a permanent educational and research facility.

Specimens are collected, prepared, and curated in accordance with the Society of Vertebrate Paleontology Statement of Ethics.

Turtle scapula

The unusual shape of the turtle scapula reflects the unusual function required in an animal whose pectoral and pelvic girdles are inside its ribcage (shell).



Click image to Zoom.

3D Viewer

Matches the conditions.

Returns rows per page.

64 Specimens Found
1 Pages

1

Conditions New Edit Del

Identification
Matches
femur

Clean Condition List

#	Specimen Number	Field Number	Museum Location
1	HRS00001	N118E846-1999-2	37D SWAU
2	HRS00159	947-138-2C9	23 SWAU
3	HRS00182	none	23 SWAU
4	HRS00186	none	23 SWAU
5	HRS00262	none	SWAU
6	HRS00602	HRS00602	12G SWAU
7	HRS00779	HRS00779	37E SWAU
8	HRS00845	HRS00845	37C SWAU
9	HRS01065	HRS01065	38E SWAU
10	HRS00561	HRS00561	37C SWAU
11	HRS00520	HRS00520	(37B SWAU) Newcastle Museum - 6/08
12	HRS01507	HRS01507	37B SWAU
13	HRS00597	HRS00597	22 SWAU
14	HRS00596	HRS00596	22 SWAU
15	HRS00595	HRS00595	22 SWAU
16	HRS00594	HRS00594	22 SWAU
17	HRS00593	HRS00593	22 SWAU
18	HRS00592	HRS00592	22 SWAU
19	HRS00499	HRS00499	37C SWAU
20	HRS02213	HRS02213	

Column List

- Check the Columns to be displayed.

- Specimen Number
- Field Number
- Museum Location
- Quarry
- Taxon
- Identification
- Description
- Notebook Page
- Notes
- Stratigraphy
- Formation
- Length
- Width
- Thickness



HRS08438

Taxon: lancensis
 Name: maxillary
 Recovered:
 Quarry: Stair
 Collector: Karen Boich
 Identifier: Art Chadwick



HRS16780

Taxon:
 Name:
 Recovered:
 Quarry:
 Collector:
 Identifier:



HRS18438

Taxon:
 Name:
 Recovered:
 Quarry:
 Collector:
 Identifier:



HRS28438

Taxon:
 Name:
 Recovered:
 Quarry:
 Collector:
 Identifier:

Taxon:
 Name:

Specimen Number HRS08438
 Field Number HRS08438
 Museum Location 24G SWAU
 Date Recovered
 Date Prepared
 Quarry Stair
 Taxon lancensis
 Taxon Certain
 Identification Field maxillary
 Lab Identification maxillary
 Lab Identification Certain
 Description
 Notes From N. lancensis "Zury" found by Zury Franco in 2001
 Notebook Page 49
 Stratigraphy Maastrichtian
 Formation Lance
 Length 38
 Width 17
 Thickness 4
 Side R
 Position
 Hardener Cyanoacrylate

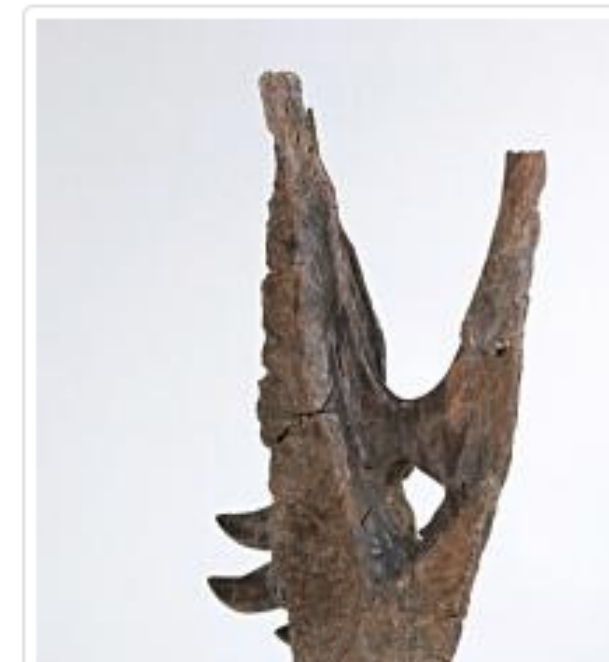


Map



360 View

Click images to zoom



Media



Map



360 View

Click images to zoom







Team

Art Chadwick, PhD, Director

- Geologist, Taphonomist, Molecular Biologist

Larry Turner, PhD, Co-Director

- Astrophysicist

Justin Woods, Co-Director

- Computer Scientist, Workflows



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