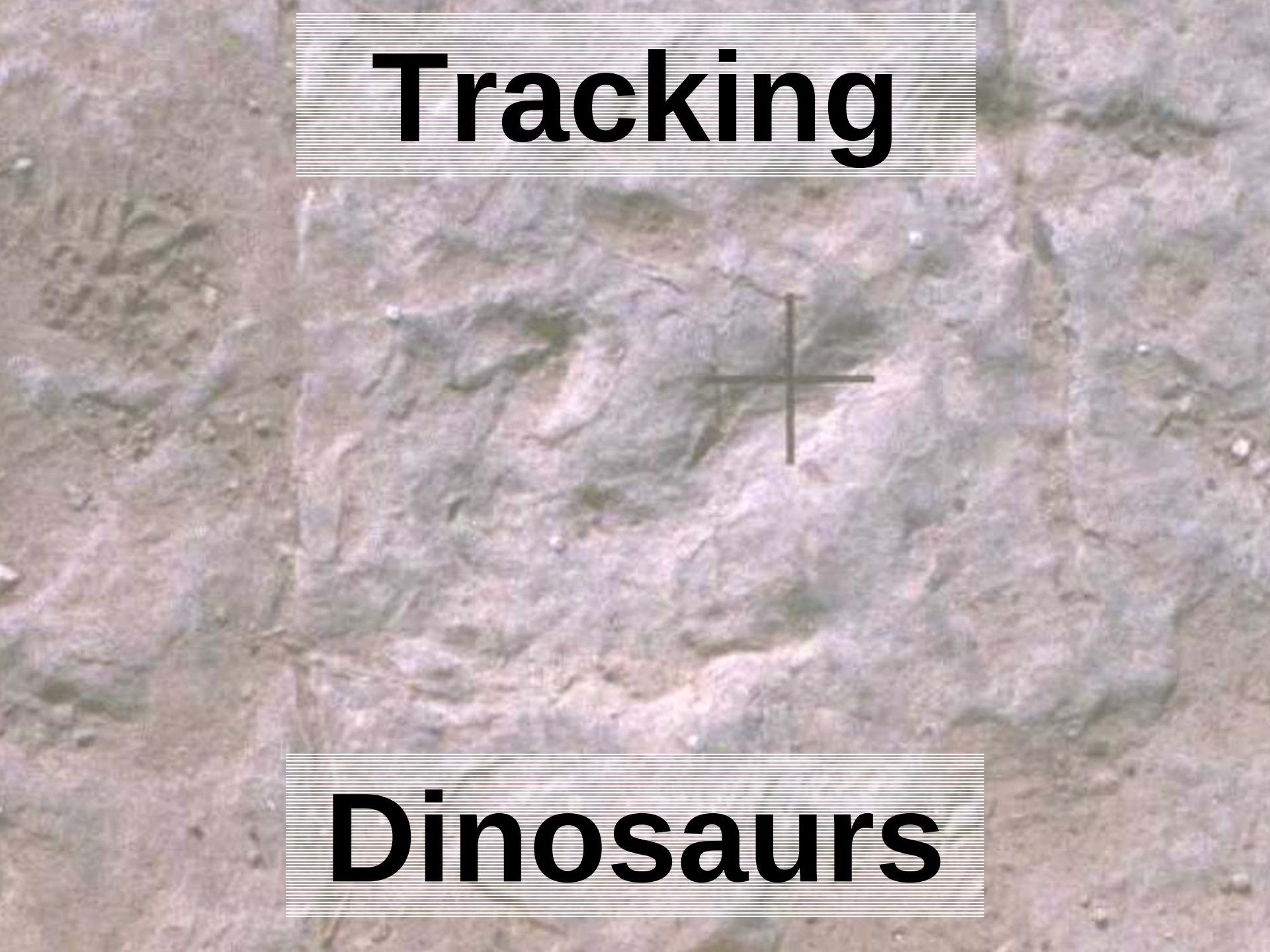
Tracking



Dinosaurs

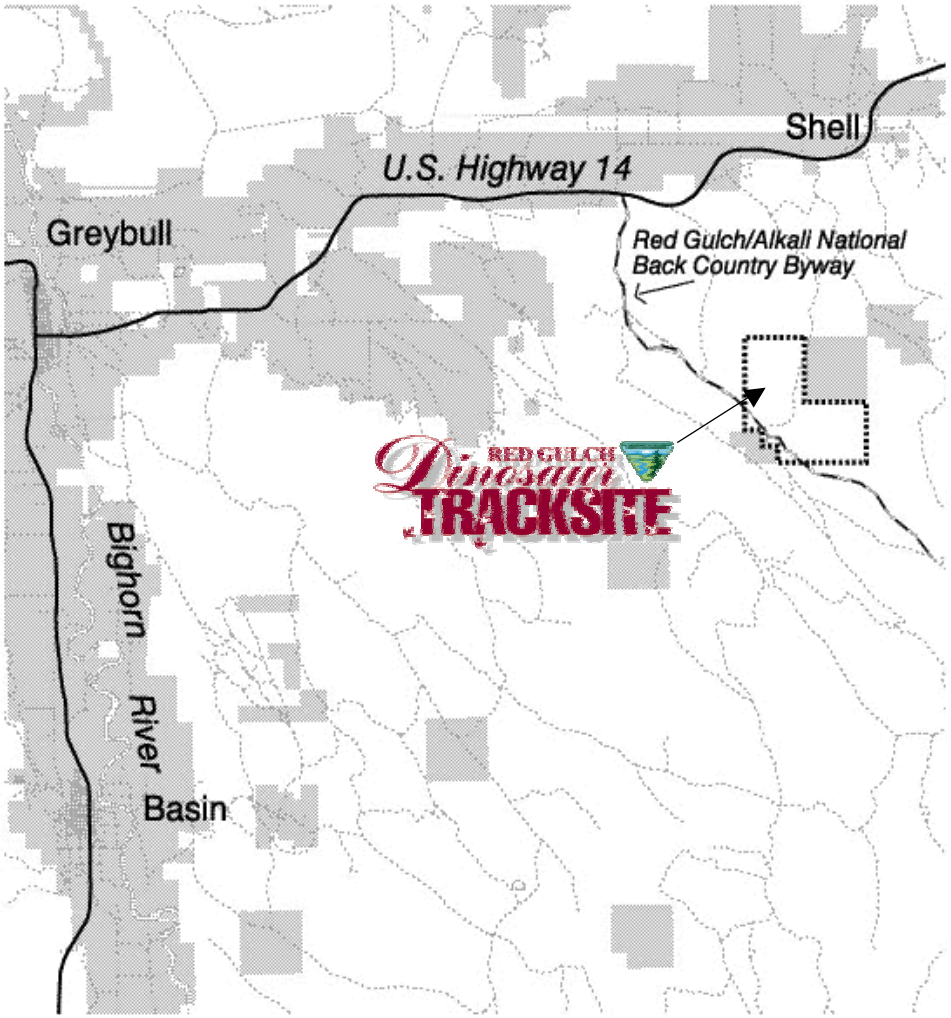
Significance of the Red Gulch Dinosaur Tracksite

- Location
- Access
- Extent
- Geologic Age
- Geologic Environment
- Scientific Investigation
- Level of Documentation
- Use of GIS
- Resource Management

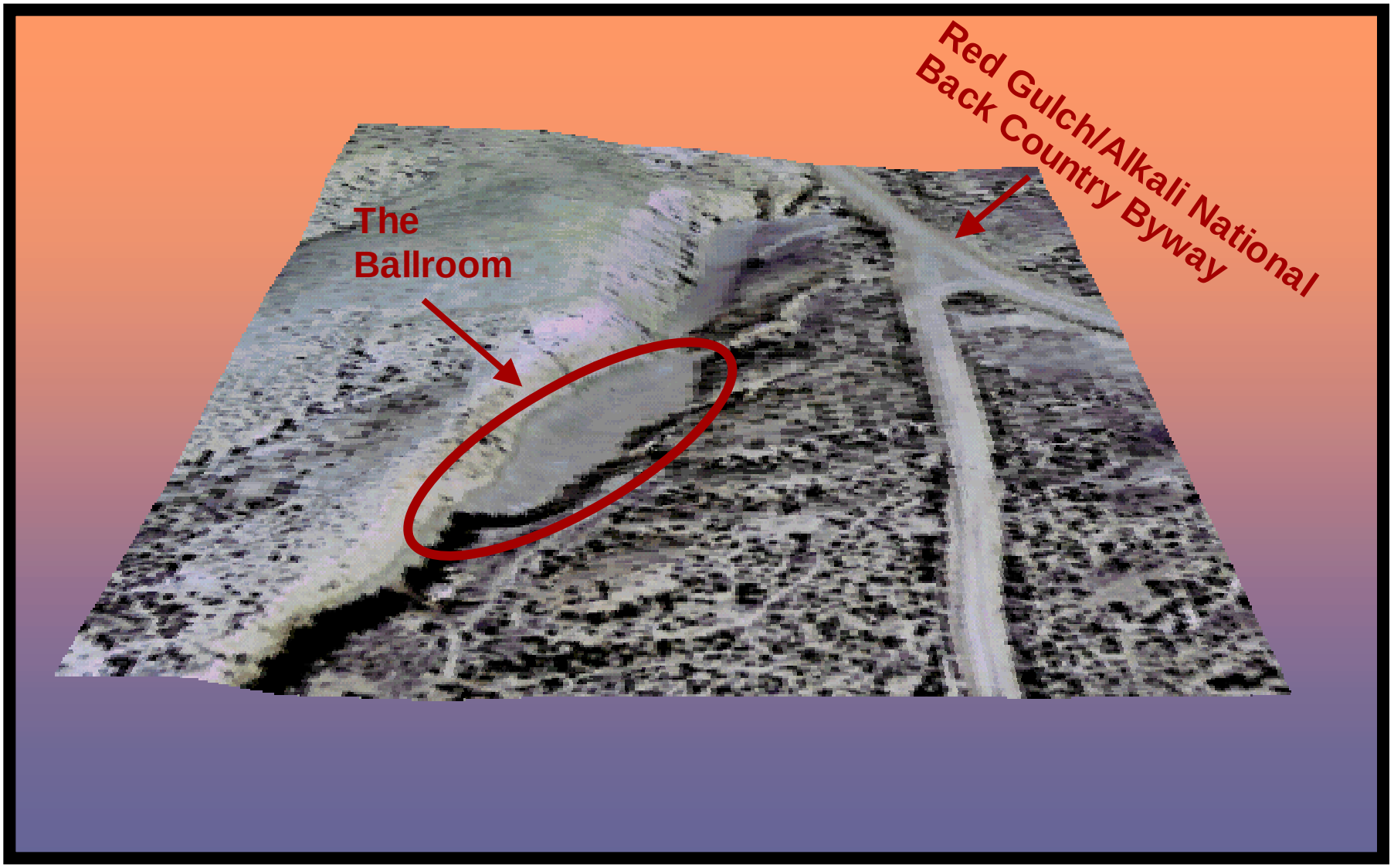
LOCATION

The Red Gulch Dinosaur tracksite is on public land administered by the Bureau of Land Management, Worland Field Office.

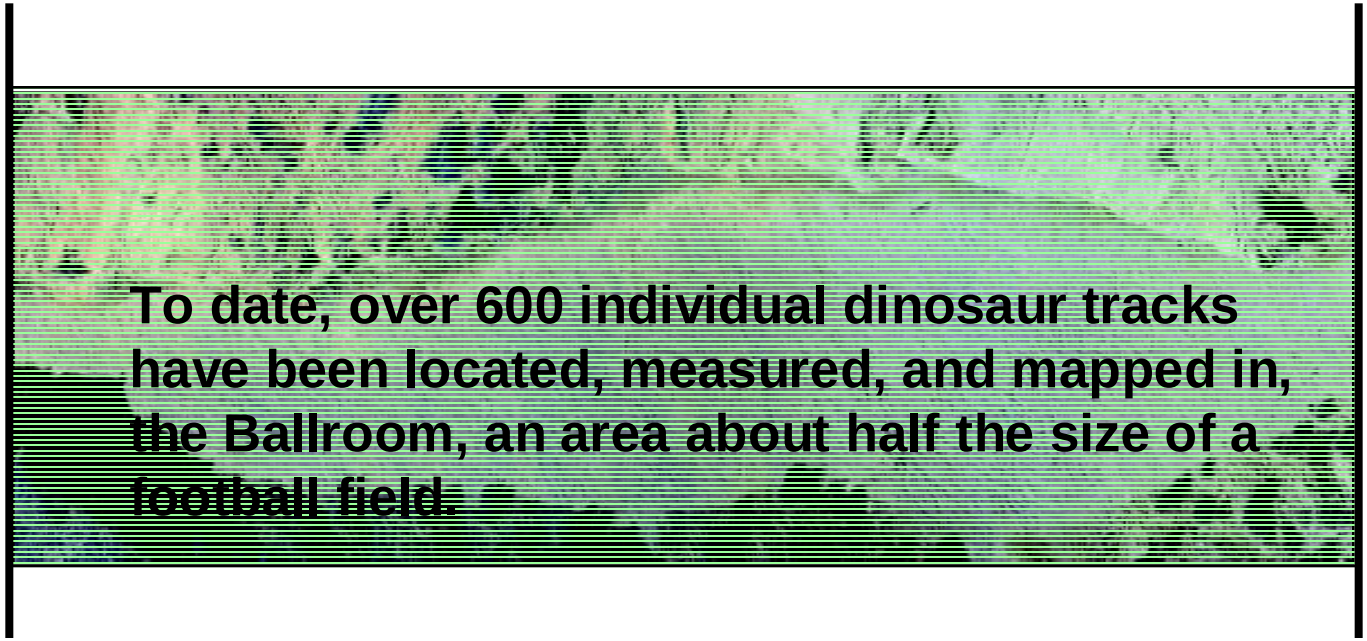
ACCESS



Situated along BLM's Red Gulch/Alkali National Back Country Byway

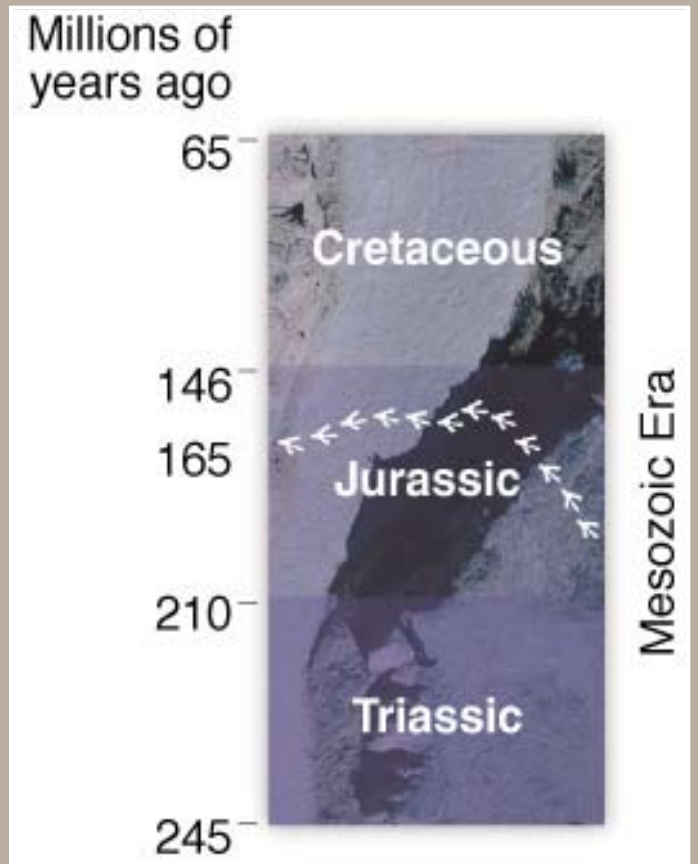

Red Gulch/Alkali National
Back Country Byway
The
Ballroom

EXTENT



Most extensive dinosaur tracksite in Wyoming.

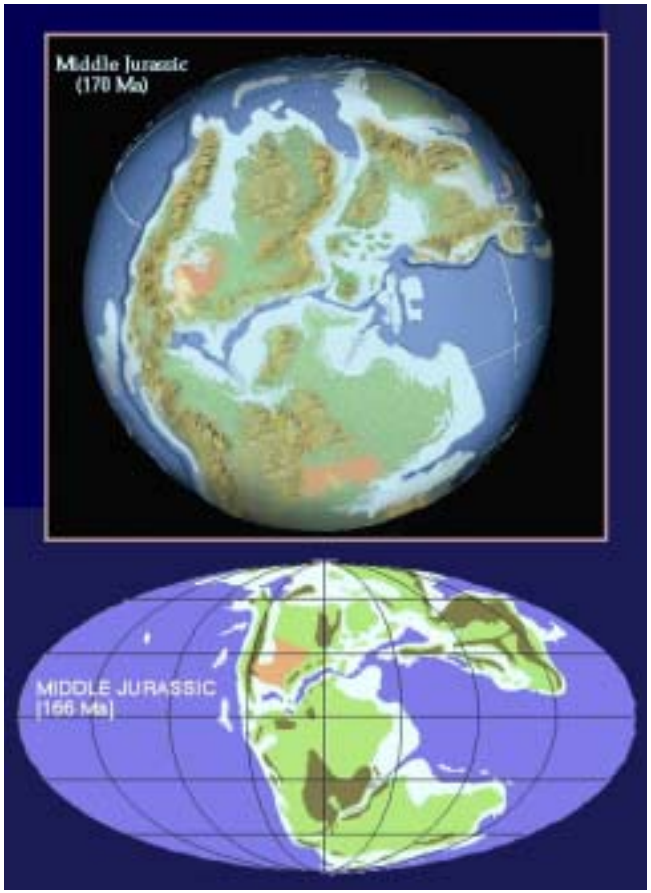
GEOLOGIC AGE



Graphic courtesy of Monica Pratt, editor ArcUser Magazine, and ESRI

Little is known about Mid-Jurassic Dinosaurs.

GEOLOGIC ENVIRONMENT



http://www.ucmp.berkeley.edu/Paleonet/

Previously believed that Wyoming was covered by an ocean during the Middle Jurassic.

SCIENTIFIC INVESTIGATION

The Science team includes members from the University of Wyoming, South Dakota School of Mines, Dartmouth University, Indiana University, Kansas State University, Rocky Mountain College, the Smithsonian Institution, and BLM.

Geologic Core Samples

LEVEL OF DOCUMENTATION

- Traditional measuring and mapping based on a one meter grid system.

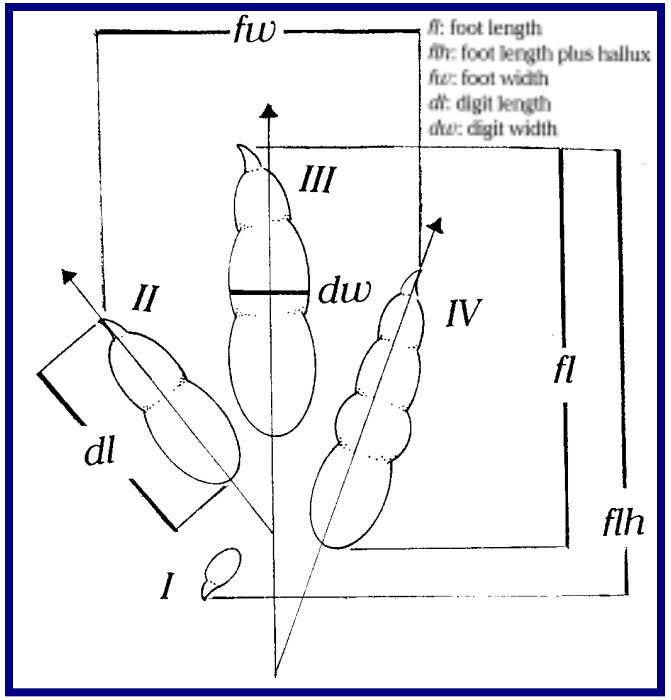
- Geographic coordinate collection using GPS and Total Station.

- Photogrammetric documentation at a variety of scales.

Traditional Measuring and Mapping

Beth Southwell, of the University of Wyoming Geological Museum, makes detailed measurements of the dinosaur footprints, while Brent Breithaupt, director of the University of Wyoming Geological Museum, records the data.

The first step in examining the tracksite was to clear the surface of overlying debris. After the site was cleared, it was studied using traditional vertebrate ichnology mapping and measuring methods and recorded using mylar tracings, and photography.



A 1-meter grid system was used on the track-bearing surface and the tracks were sketched onto a map at a 1 inch equals 1 meter scale. Descriptive notations were made and up to 17 numerical measurements were taken on each individual track including number, size, shape, and arrangements of digits, with special attention to the presence of claw marks, drag marks, digital pads, skin impressions, and any anomalous features.

Recorded by: Date:

#	#
DL1	DL1
DW1	DW1
DL2	DL2
DW2	DW2
DL3	DL3
DW3	DW3
DL4	DL4
DW4	DW4
FW	FW
FL	FL
FLH	FLH
1>3	1>3
2>3	2>3
3>4	3>4
2>4	2>4
AZ	AZ
DEPTH	DEPTH
COMMENT	COMMENT

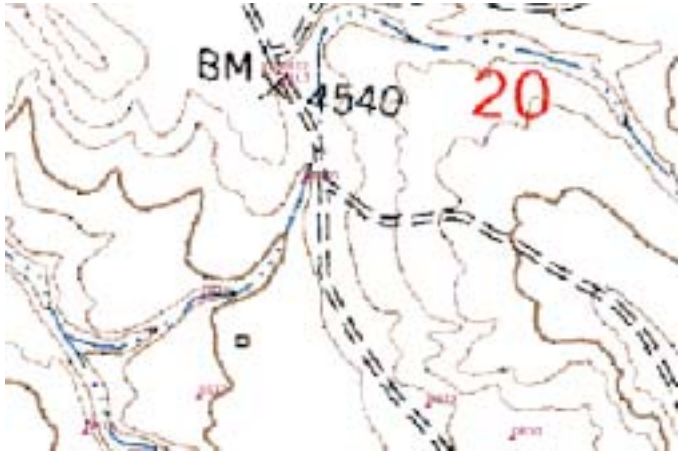
#	#
DL1	DL1
DW1	DW1
DL2	DL2
DW2	DW2
DL3	DL3
DW3	DW3
DL4	DL4
DW4	DW4
FW	FW
FL	FL
FLH	FLH
1>3	1>3
2>3	2>3
3>4	3>4
2>4	2>4
AZ	AZ
DEPTH	DEPTH
COMMENT	COMMENT

The lengths and widths of individual digits, as well as the overall foot length, width, and depth, were measured. The angles of divarication between each digit were listed, along with the orientation direction of the midline of the foot, to study the direction of rotation of each foot.

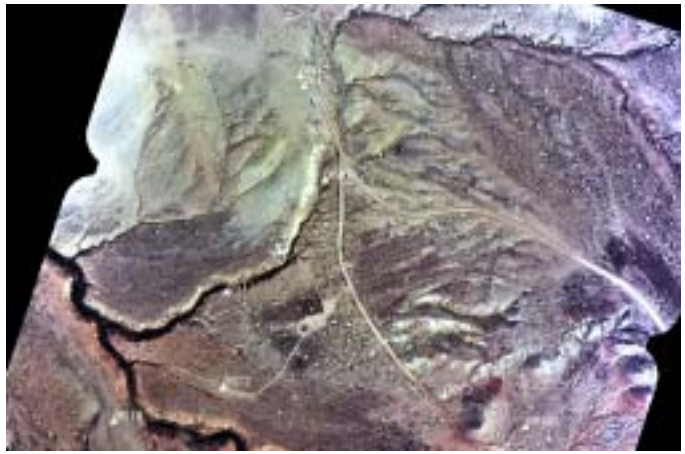
This data was then entered into a spreadsheet.

GPS Coordinate Collection

Mike Londe of the Bureau of Land Management, Wyoming State Office, uses Global Position System (GPS) technology to collect coordinate values for locations identified on the large format aerial



GPS ground control locations displayed on a portion of the Manderson NE, WY, USGS quad, dated 1960.



GPS ground control locations displayed over a 1:3000 scale large format aerial photograph of the Red Gulch Dinosaur Tracksite. The image has been rectified and georeferenced

Track Coordinate Collection

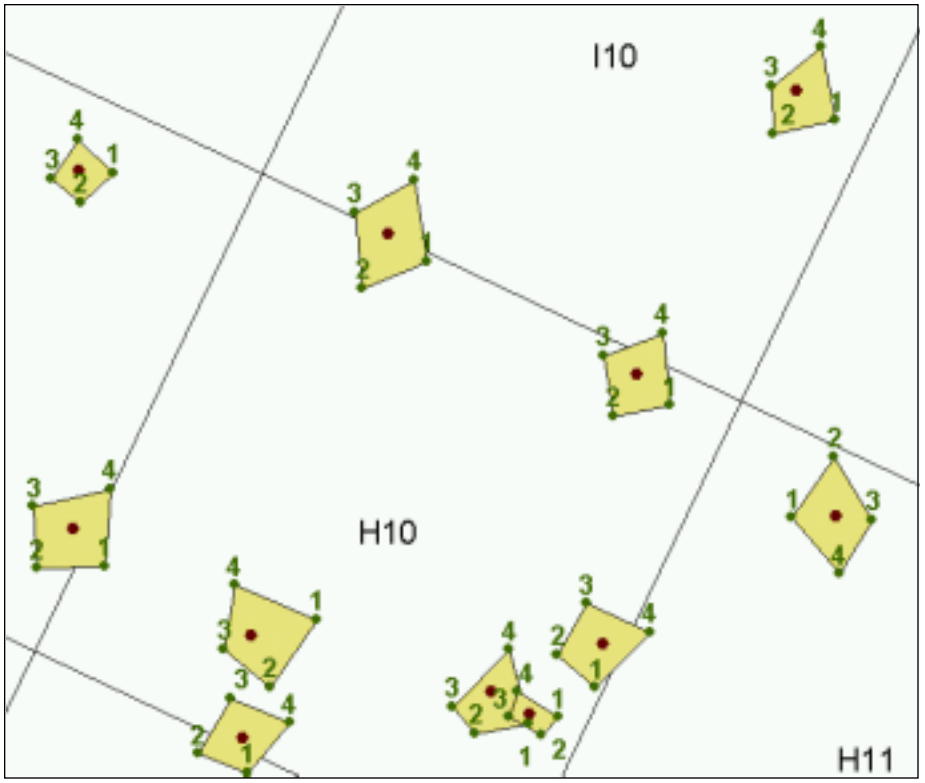
Ty Naus,
South Dakota School of Mines and Technology

INSTRUMENTATION

The Geodimeter® System 4000 is a robotic surveying instrument accurate to +/- 6mm in 100 meters. One person can take care of the entire measurement procedure. All surveying operations, such as aiming, changing of modes, data registration, calculations, keying of coordinates, etc., can be done using the collector or Remote Positioning Unit at the reflector station. The most qualified work, (i.e., coding, recording, calculating etc.), is done at the point to be measured.

GRID ESTABLISHMENT

A series of points was computer generated at 1-meter spacing in the northing and easting directions, then transformed to NAD83 UTM Zone 13 coordinates at an orientation suitable for the track-bearing horizon. Each grid corner point is assigned a unique identification. By keying in the corner identification number on the Remote Positioning Unit, the coordinates are retrieved and the operator is instructed to move in or out and left or right from the position of the instrument base until the ground coordinates match the coordinates of the point in the Remote Positioning Unit.



TRACK COORDINATES

The Geodimeter® is preprogrammed prior to field data collection with a user-defined table describing what the instrument is to measure at each point. For each point collected, the track number identifier is keyed in, followed by a number that corresponds to the track feature location (2 - toe tip, 4 - heel, etc).

Photographic Documentation

SCALES OF PHOTOGRAPHIC DOCUMENTATION

In order to preserve the value of the unique paleontological resource at the Red Gulch Dinosaur Tracksite and to facilitate intensive study of the dinosaur tracks, extensive photographic documentation of the site has taken place over the past 2 years. Imagery of the tracksite ranges from 30-meter resolution satellite data to close-range photogrammetric images of a single track. Large format (9- x 9-inch) natural color aerial photography was obtained in the fall of 1998 at scales of 1:12,000, 1:3,000, and 1:1,800, with an endlap of 60 percent to ensure stereoscopic coverage.

INNOVATIVE APPROACHES

The large-format aerial photography, while suitable for developing management and recreation plans for the Red Gulch Dinosaur Tracksite, did not provide the level of detail needed to illustrate track and trackway relationships. To fill the gap, a 35-mm camera was mounted on a remote controlled airplane and used to photograph the main track-bearing surface. The resulting photographs were scanned, moasicked, and registered to the digital orthophoto. This detailed digital mosaic integrates into GIS applications.

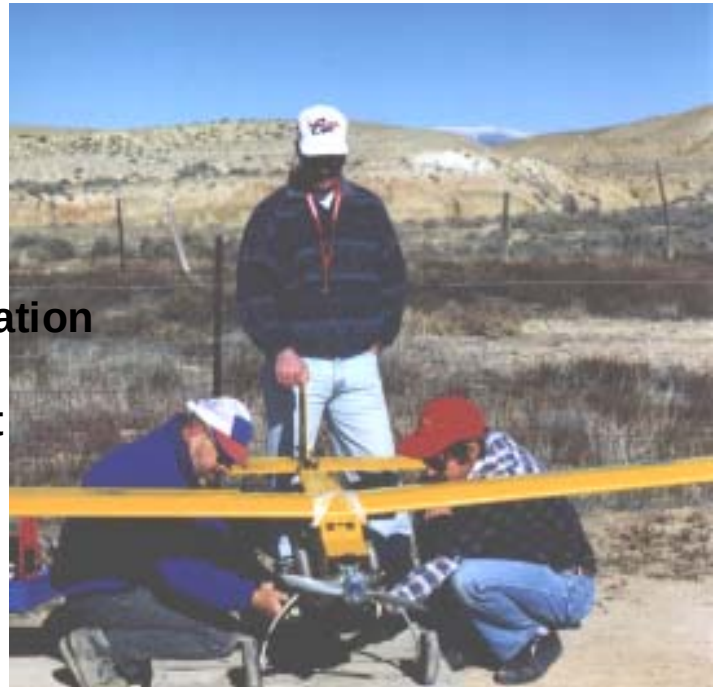
Low Altitude High Resolution (LAHR) Plane Flyover

Airplane:

- **Senior Telemaster**
- **Wingspan- 2.44 meters**
- **Weight- 8.2 kilograms**
- **Engine- MVVS 1.44, 2 cylinder**
- **Radio- Futaba 9Z AWS with Piezoelectric gyros on roll and pitch axis**
- **Mission duration- 80 minutes**

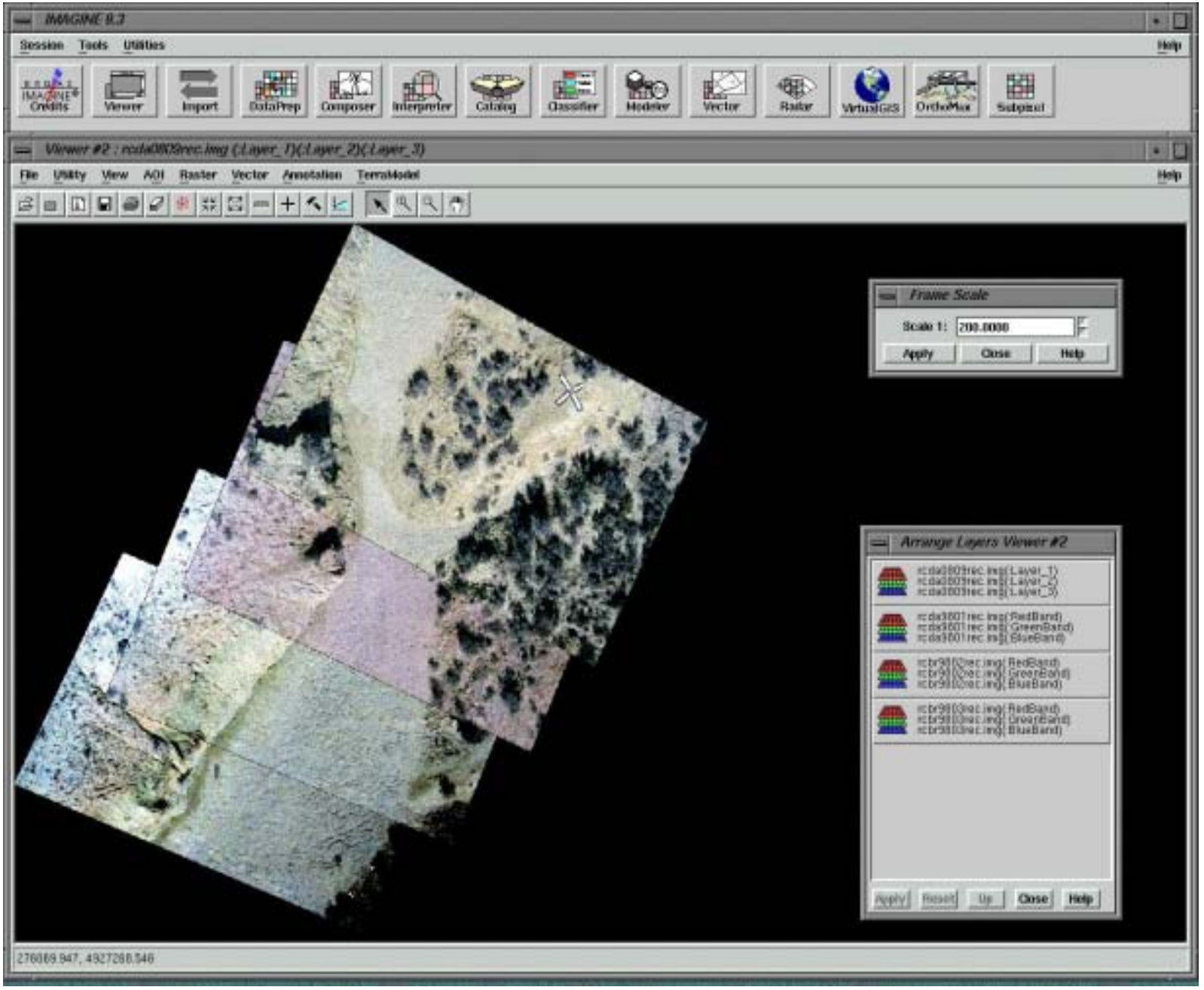
Camera:

- **Olympus OM-2, 35 mm SLR**
- **Lens- 50 mm Zuiko**
- **Shutter release- remote activation**
- **Frames speed- 2 per second**
- **Capacity- 36 frames per flight**



Jerry, Randy, and Larry Cunningham, NARSC Cartographer, attaching the camera housing to the bottom of the plane.

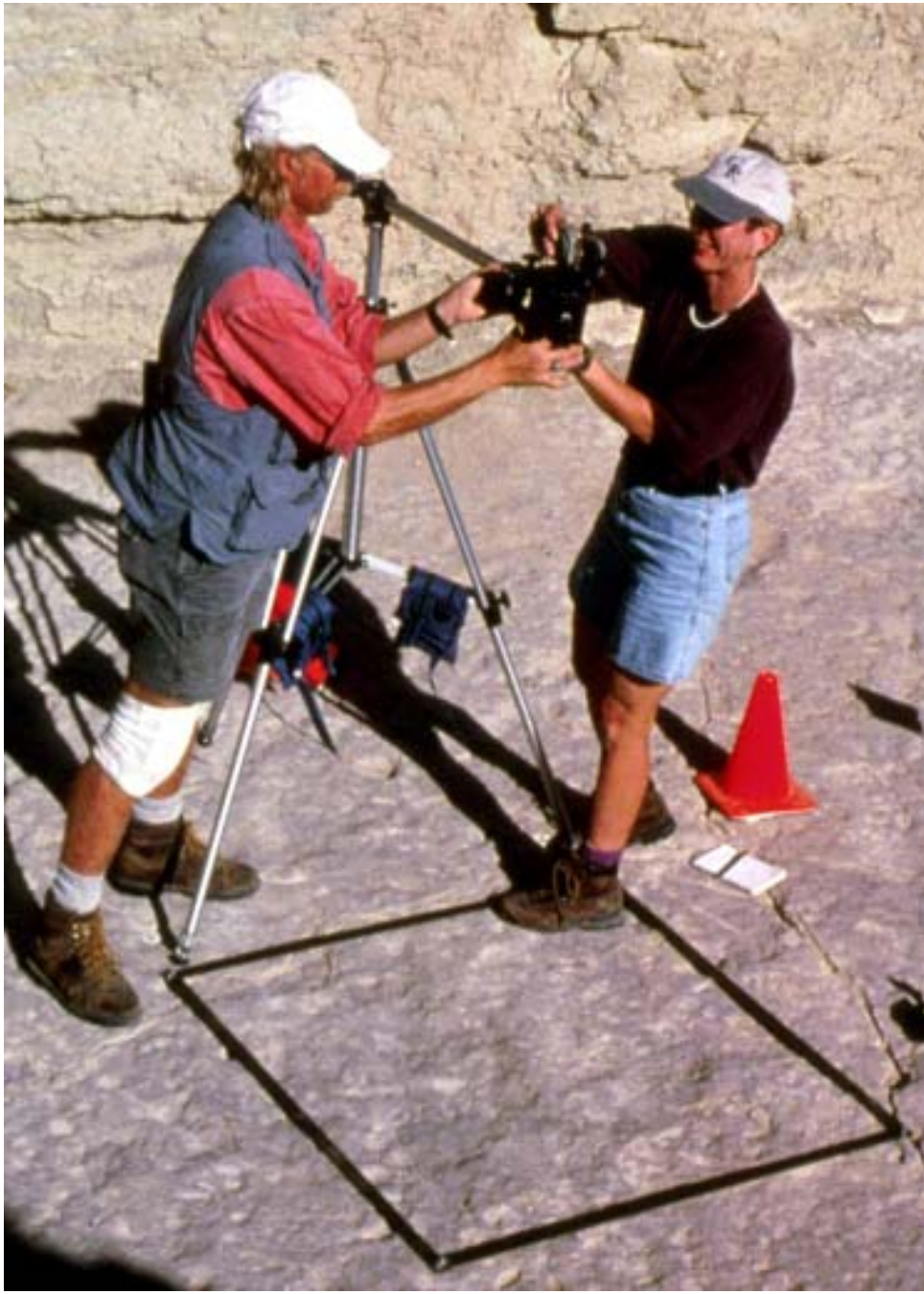
LAHR Photo Mosaic



Close Range Photogrammetry

Close-range photogrammetry has an object-to-camera distance of less than 300 meters and applies the same principles as traditional large-format aerial photogrammetry. Reliable measurements can be taken from photographic images if the following conditions are met: stereoscopic images (two or more overlapping photographs) cover the object to be analyzed, and accurate horizontal (x and y) and vertical (z) coordinates are known for at least three defined object points in the overlapping photographs.

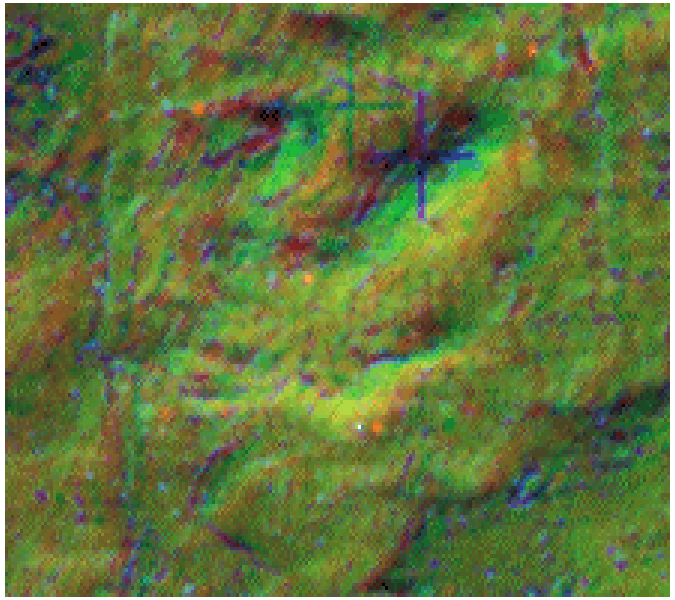
A Rollieflex 3003 metric 35-mm surveying camera was used at the Red Gulch Dinosaur Tracksite to photograph selected 1-meter grids, as well as individual footprints on the Ballroom. To further preserve and record the paleontological resource on the main track-bearing surface, each 1-meter grid on the Ballroom, which contains a Dinosaur track, was photographed using the Rollieflex 3003 and a 1.05-meter-square grid, which provided internal horizontal and vertical control. These photographs will be scanned, rectified, moasicked, and georeferenced using the Geodimeter® coordinates.



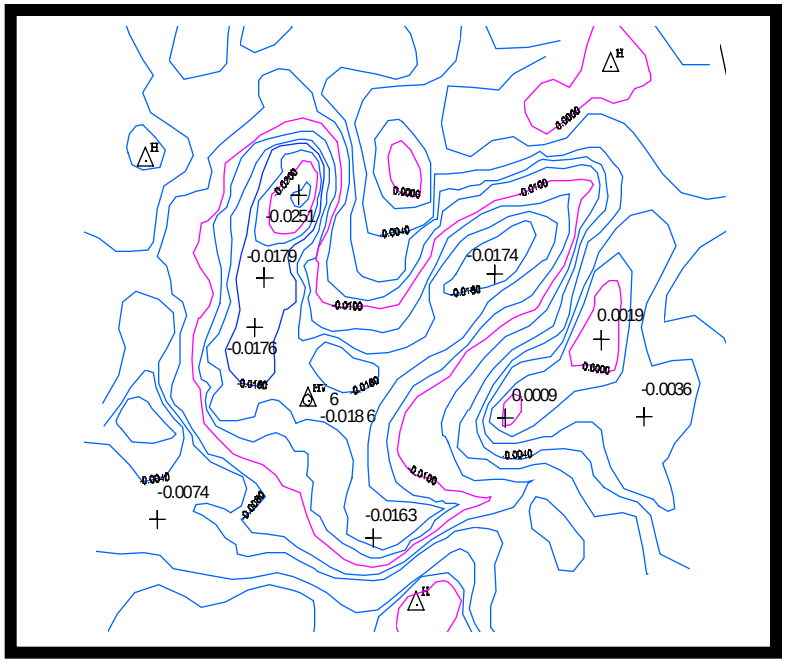
Analytical Stereoplotter

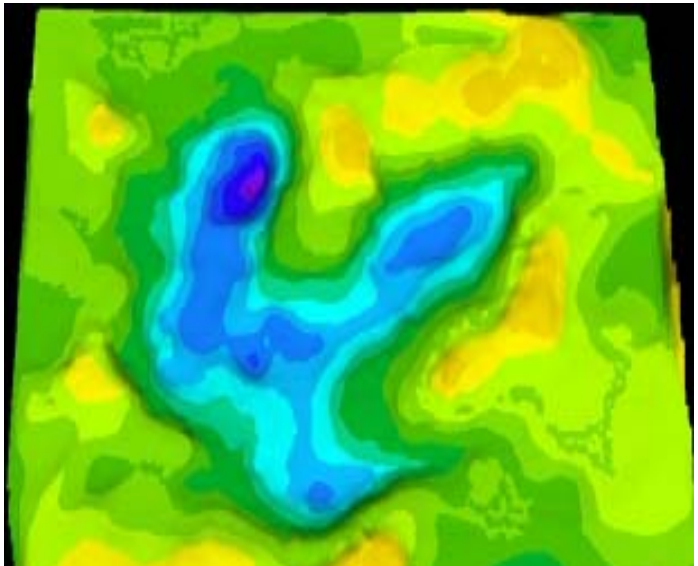
Detailed measurements, such as digital terrain models and topographic contours, can be produced for the individual tracks using the Zeiss P3 Analytical Stereoplotter.

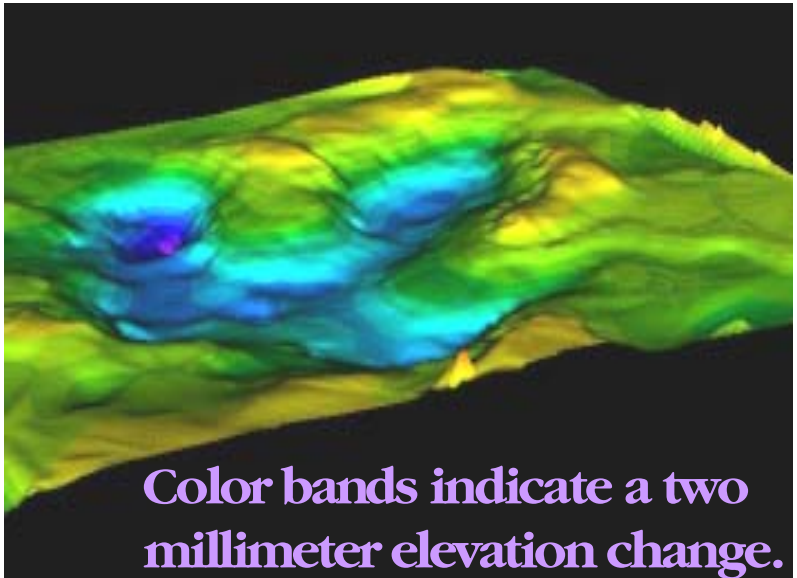
3-Dimensional views of dinosaur tracks.



Best when viewed with red and blue stereo glasses.





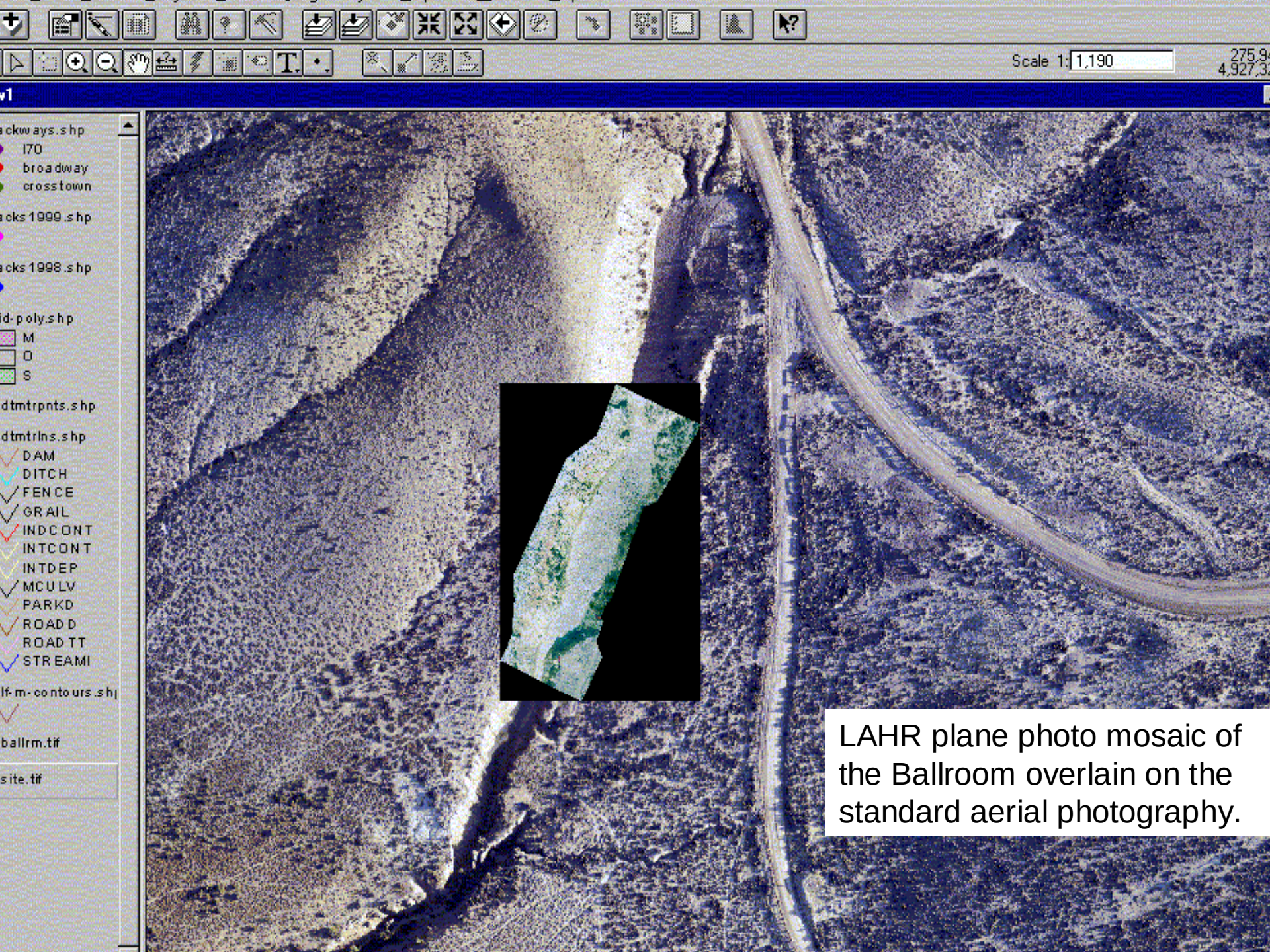


USE OF GIS

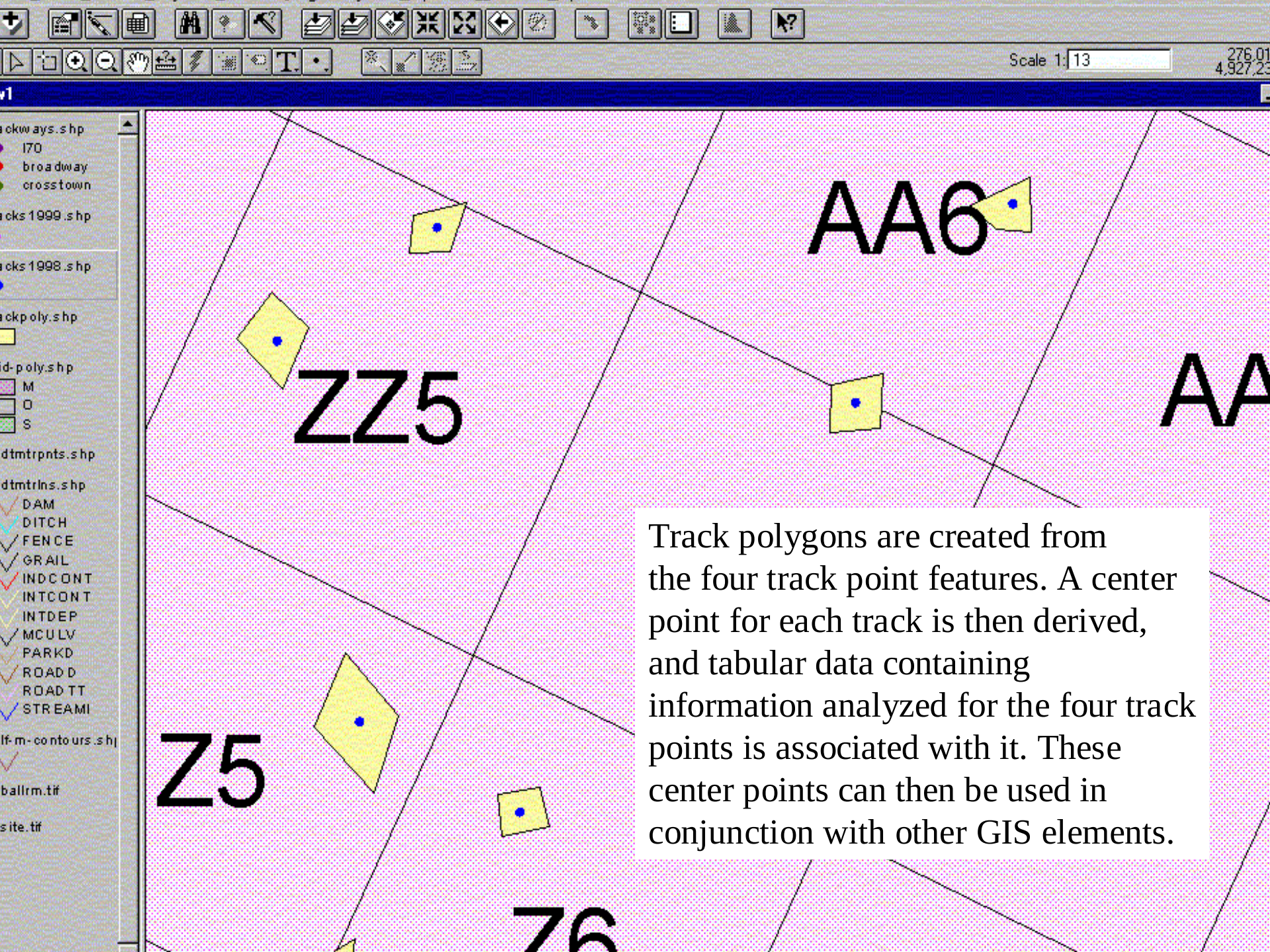
- Integration and display of the various scales of imagery.

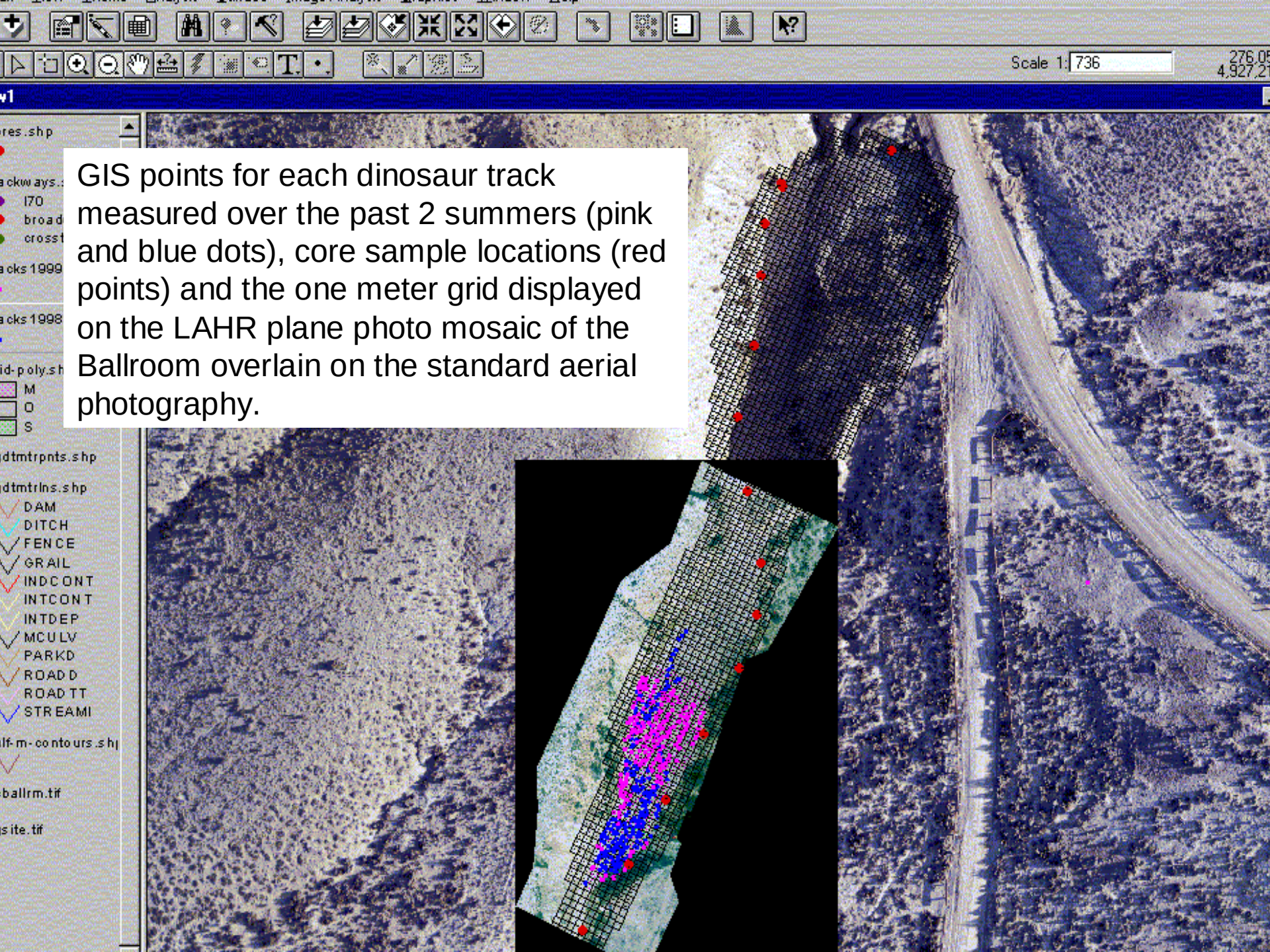
- Integration and display of scientific data.

- Analysis of data.



LAHR plane photo mosaic of the Ballroom overlain on the standard aerial photography.


Scale 1: 13
ckways.shp
I70
broadway
crosstown
cks1999.shp
cks1998.shp
ckpoly.shp
d-poly.shp
M
O
S
dtmtrpnts.shp
dtmtrlns.shp
DAM
DITCH
FENCE
GRAIL
INDCONT
INTCONT
INTDEP
MCULV
PARKD
ROADD
ROADTT
STREAMI
lf-m-contours.shp
ballrm.tif
site.tif
AA6
ZZ5
AA
Z5
Z6
Track polygons are created from the four track point features. A center point for each track is then derived, and tabular data containing information analyzed for the four track points is associated with it. These center points can then be used in conjunction with other GIS elements.



GIS points for each dinosaur track measured over the past 2 summers (pink and blue dots), core sample locations (red points) and the one meter grid displayed on the LAHR plane photo mosaic of the Ballroom overlain on the standard aerial photography.

RESOURCE MANAGEMENT

- Public access to site
- Limited development
- Monitoring
- Preserve the value of the site

Scientific Interaction

While visitors look on, Beth Southwell, University of Wyoming, (lower right) is making detailed measurements of the dinosaur tracks. Neffra Matthews, NARSC, (center right) photodocuments the footprints, Brent Breithaupt, University of Wyoming, Al Pierson, Wyoming BLM, and Pat Shea, DOI (center of photo) discuss the important implications of the research.

Walk like a Dinosaur