



# An Overview of Paleontological Mitigation

by Georgia E. Knauss

**SWCA**<sup>®</sup>

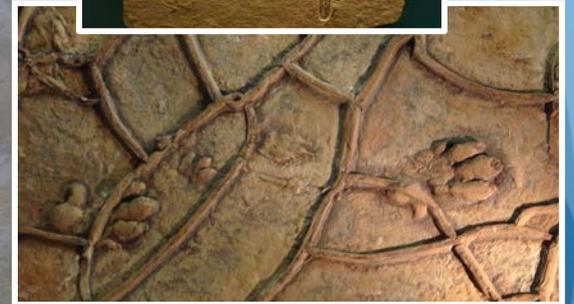
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# WHAT ARE PALEONTOLOGICAL RESOURCES?

The remains, imprints, or traces of once-living organisms preserved in rocks, sediments, tar, amber, and other settings

- ◆ Skeletal (i.e., bones and teeth) remains of reptiles, fish, amphibians, birds, and mammals
- ◆ Shells of mollusks
- ◆ Full-body fossils or impressions of insects
- ◆ Wood, leaves, and flowers
- ◆ Trace fossils including footprints and burrows
- ◆ Soft tissue or other organic matter (i.e., skin impressions, coprolites)
- ◆ The physical characteristics of the associated sedimentary matrix



*NOTE: Fossils are considered non-renewable resources because the organisms they represent no longer exist.*

# PALEONTOLOGICAL RESOURCES ARE DISTINCT FROM CULTURAL/ARCHEOLOGICAL RESOURCES

- ◆ Fossils are typically older – tens of thousands to millions and billions of years old.
- ◆ Fossils consist of biological remains and traces of animal activities rather than evidence of past cultures.
- ◆ Overlap occurs in “human paleontology,” which is the study of early evolution of humans in Africa, Europe, and Asia and of fossils or sub-fossils that show evidence of humans.



Commonality = “old stuff that sometimes has to be dug up”

# WHAT FOSSILS ARE IMPORTANT/SIGNIFICANT?



## ◆ Vertebrate fossils:

- Identifiable to the level of taxon and/or element



## ◆ Particularly noteworthy Invertebrate and plant fossils:

- Well-preserved
- Uncommon taxa
- Unusual depositional setting
- Paleoenvironment

# PALEONTOLOGICAL RESOURCES: VISIBLE VS. NOT VISIBLE

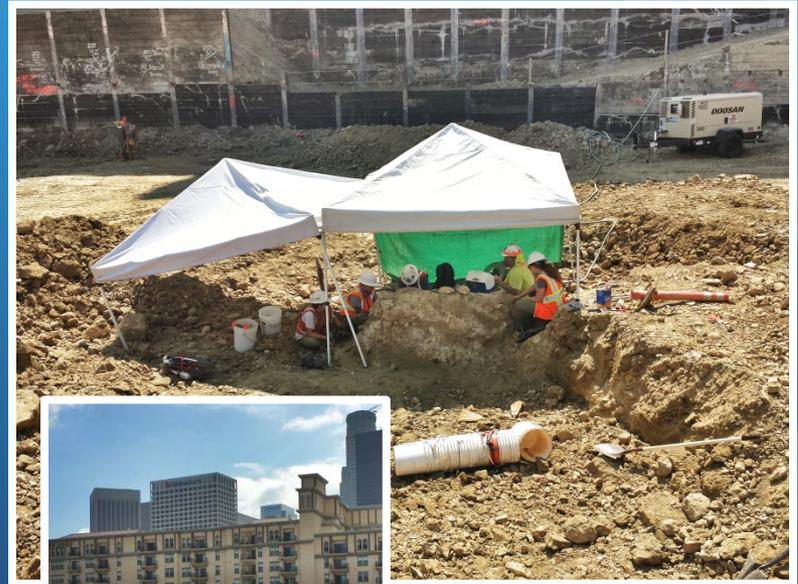
Surface:  
eroded out of ground

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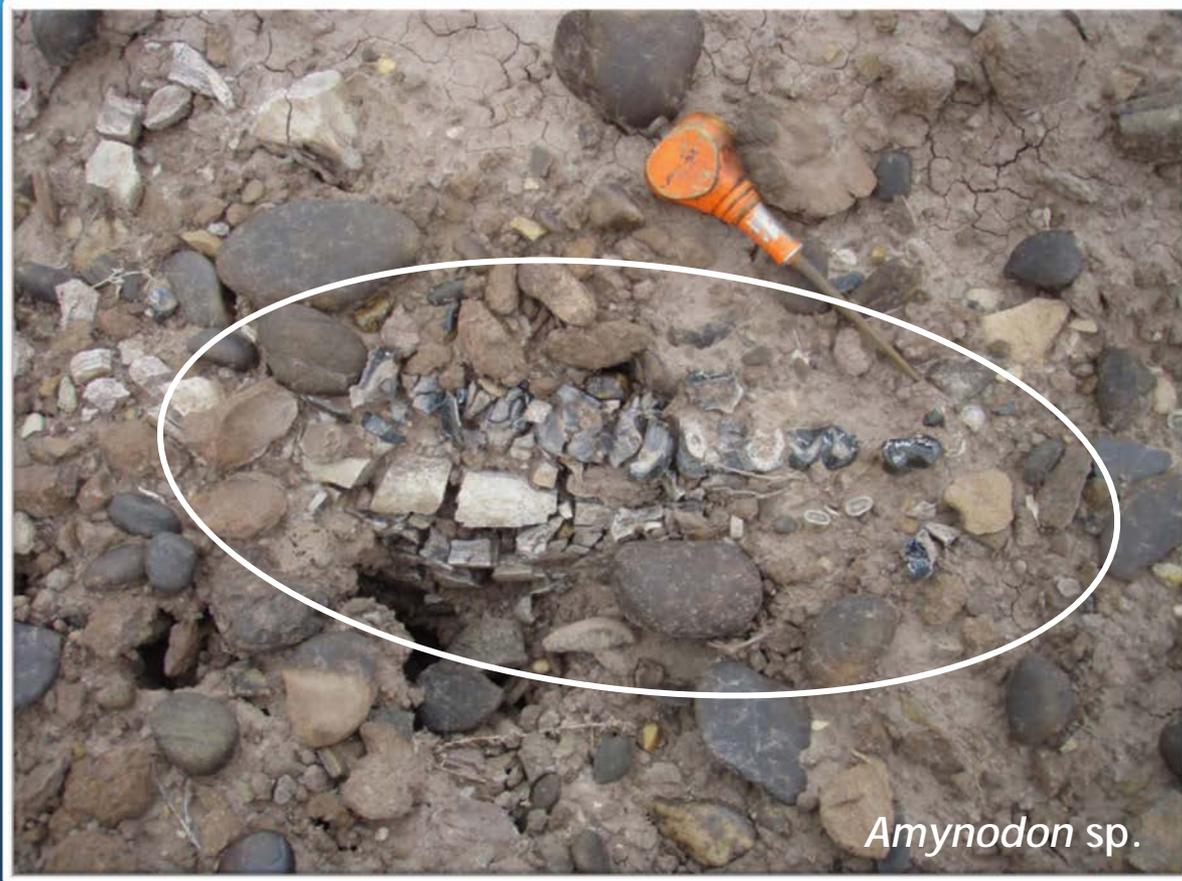


Subsurface:  
buried in sediment

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# EXAMPLES OF FOSSILS: LARGE FOSSIL

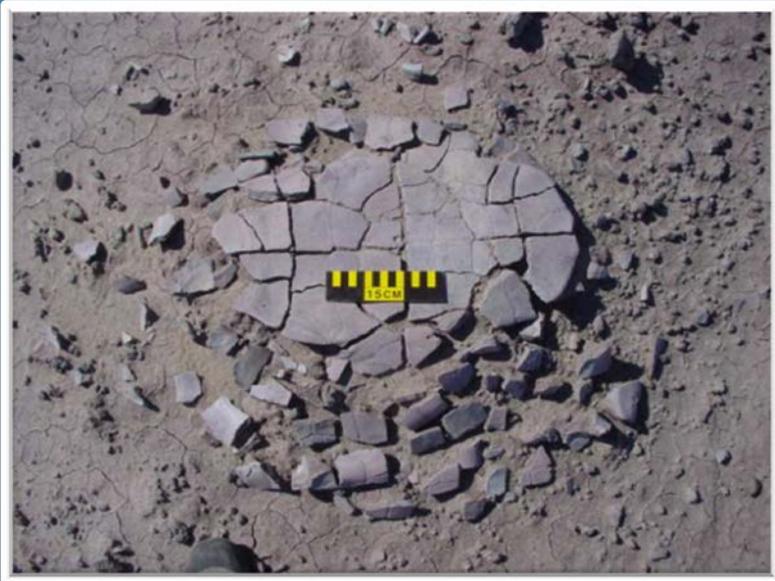


*Amynodon* sp.

# EXAMPLES OF FOSSILS : TURTLES

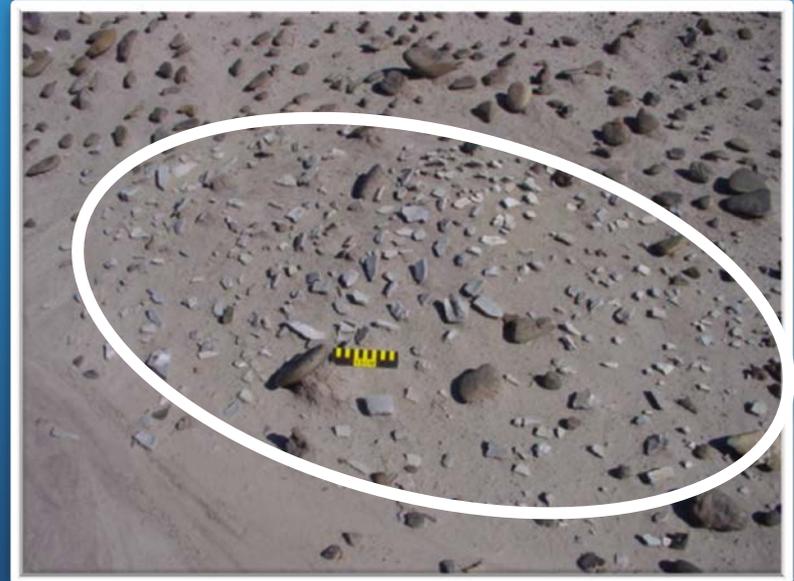
## Complete Turtle

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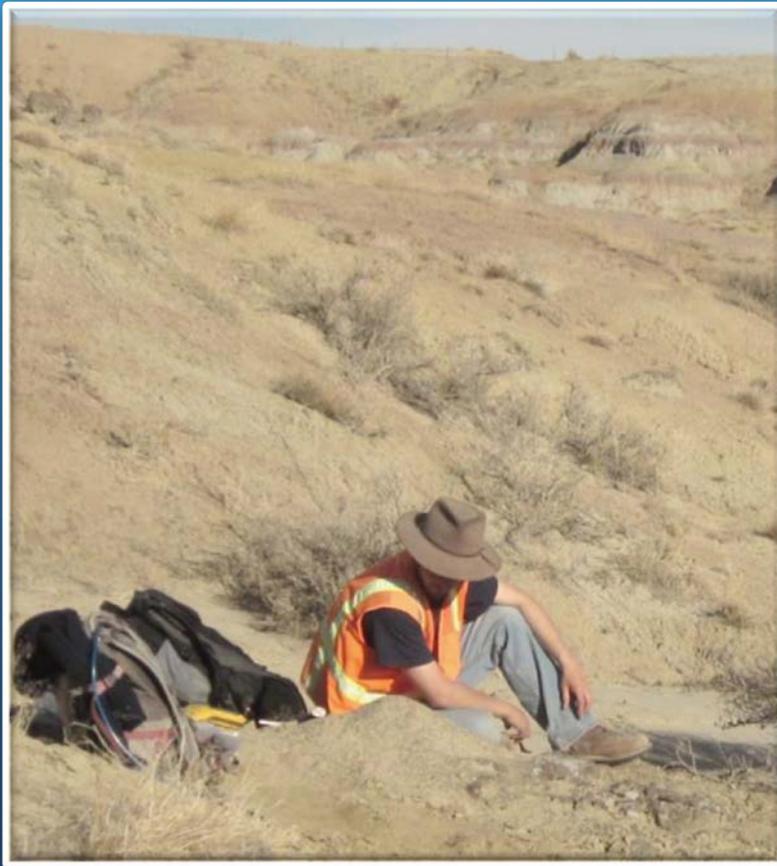


## Turtle Shell Scatter

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# EXAMPLES OF FOSSILS: SMALL FOSSILS



# REGULATORY DRIVERS: FEDERAL

## National Environmental Policy Act of 1969 (NEPA)

- Recognizes continuing responsibility of Federal Government to “preserve important historic, cultural and natural aspects of our national heritage ...”

## Federal Land Policy and Management Act of 1976 (FLPMA)

- Two mandates - preserve natural and cultural values, public use (benefit) of resources
- “Significant fossils” are understood and recognized in policy as scientific resources.

## Code of Federal Regulations (CFR), Title 43

- Numerous parts and subparts

# REGULATORY DRIVERS: FEDERAL

In 1998, Congress recognized that:

“Under current public laws, including the Federal Land Management Policy Act of 1976, Federal land management agencies are given the authority and the mandate to protect public resources, including those of scientific value. These resources include fossilized paleontological specimens, which provide valuable clues to the Earth's history.”  
(SENATE REPORT 105-227, p. 60, June 26, 1998)

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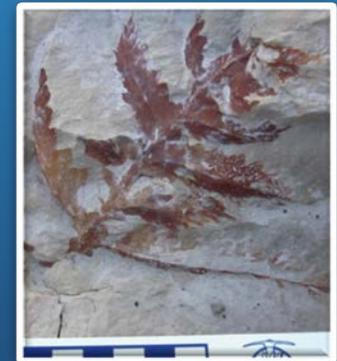
In 2005, the Interior Board of Land Appeals (IBLA) acknowledged that paleontological resources on public lands are owned by the United States, and that they are (generally) managed and protected under FLPMA of 1976 (BOARD OF REGENTS OF THE UNIVERSITY OF OKLAHOMA, 165 IBLA 231, April 13, 2005)



# REGULATORY DRIVERS: PRPA

(Paleontological Resources Preservation), Title VI, Subtitle D, Omnibus Public Lands Act (2009)

- ◆ Applies to all DOI lands (except Tribal) and USFS lands (DOA)
- ◆ Charges government to “manage and protect paleontological resources . . . using scientific principles and expertise”
- ◆ Defines fossils as paleontological resources and reaffirms that fossils from federal lands are federal property, meaning impacts to paleontological resources must be considered under NEPA
- ◆ Also defines casual collecting, minimum requirements for paleontological use permits and fossil curation, uniform criminal and civil penalties



*NOTE: New implementing regulations are being developed/undergoing review*

# BLM OBJECTIVES FOR PALEONTOLOGICAL RESOURCES

- ◆ Locate, evaluate, manage and protect
- ◆ Facilitate appropriate scientific, educational, and recreational Uses
- ◆ Ensure that proposed land uses do not inadvertently damage or destroy
- ◆ Foster public awareness



# REGULATORY DRIVERS: SPLIT ESTATE

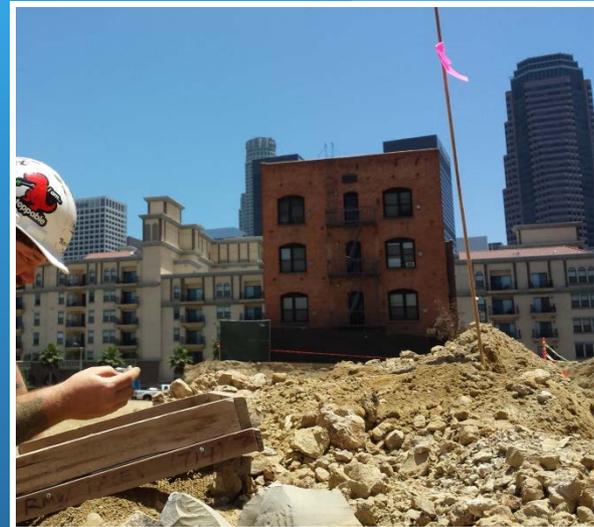
- ◆ Lands where title to the surface and mineral estate have been severed.
- ◆ In many instances where the surface estate is not owned by the Federal Government, the mineral estate is, and is administered by the BLM.
- ◆ Paleontological resources are considered to be part of the surface estate.
- ◆ If BLM is going to approve an action involving the mineral estate that may affect the paleontological resources, the action should be conditioned with appropriate paleontological mitigation recommendations to protect the interests of the surface owner.

For split estate lands, BLM places necessary lease stipulations and conditions of approval on permitted activities and works in cooperation with the surface owner.

**SURFACE MANAGEMENT OF SPLIT ESTATE LANDS:** The BLM has the statutory authority to require lease stipulations and conditions of approval for activities of its lessees to minimize adverse impacts that may result from Federally-authorized mineral lease activities. These stipulations and conditions of approval are intended to comply with the BLM's responsibilities under the Endangered Species Act, the National Historic Preservation Act, and the National Environmental Policy Act and to protect or preserve the privately-owned resources while preventing adverse impacts to adjoining lands, not to dictate management to the surface owner.

# REGULATORY DRIVERS: STATE AND LOCAL

- ◆ Scope and intensity of regulations vary widely between states and municipalities.
- ◆ Strong state protections are present in CA, CO, MT, UT; many western states have lesser protections.
- ◆ The most stringent local regulations (city and county) are in place in Southern California.

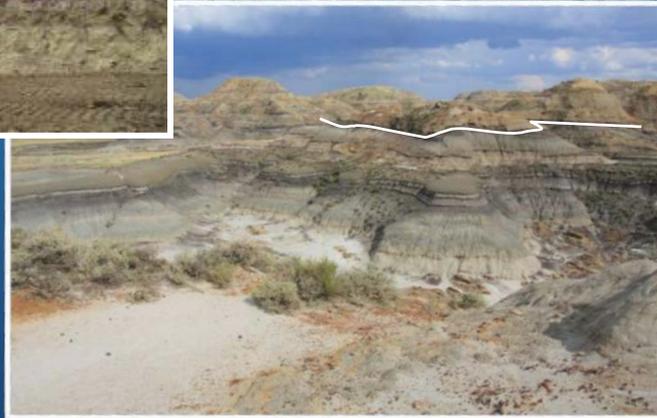


# ESTIMATING ADVERSE EFFECTS TO PALEONTOLOGICAL RESOURCES

- ◆ Estimated by evaluating paleontological potential of geologic units
- ◆ Directly proportional to amount (acres) of ground disturbance of paleontologically sensitive geologic units



# POTENTIAL FOSSIL YIELD CLASSIFICATION (PFYC)

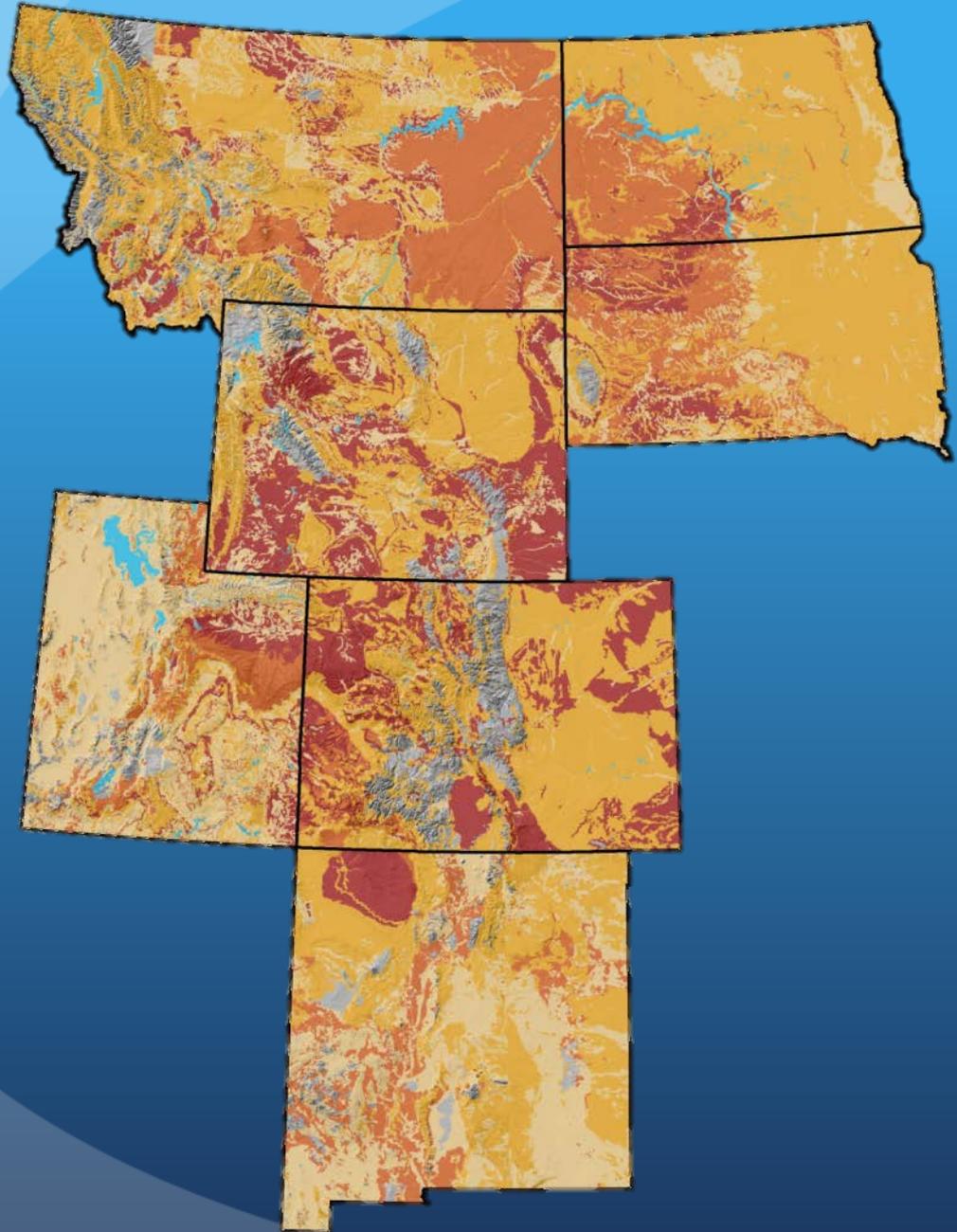


- ◆ Class 1: Very Low
- ◆ Class 2: Low
- ◆ Class 3:
  - 3a: Moderate
  - 3b: Unknown
- ◆ Class 4: High
- ◆ Class 5: Very High

# PFYC MAP

## PFYC Classes

-  Class 2
-  Class 3a
-  Class 4
-  Class 5
-  Water



# WHAT ARE PALEONTOLOGICAL RESOURCE IMPACT MITIGATION TRIGGERS?

If land is managed by or the project is associated with an action overseen by an agency with regulations, policies, or laws that require evaluations of paleontological resource (and mitigation)

Disturbance to rock with the potential to contain paleontological resources

Locations where previously recorded fossil localities have been documented

# TYPES OF PROJECTS THAT REQUIRE PALEONTOLOGICAL RESOURCE EVALUATIONS



# STEPS FOR MINIMIZING IMPACTS TO PALEONTOLOGICAL RESOURCES AND OBTAINING PALEONTOLOGICAL RESOURCE CLEARANCE/PROJECT AUTHORIZATION

## Analysis of Existing Data



**PERFORMED BY:**  
Agency or Consultant and Agency

**DELIVERABLE:**  
Reporting (including NEPA)

**PREFERRED RESULT:**  
Project Approval

## Field Survey



**PERFORMED BY:**  
Typically a Professional Paleontologist/Consultant

**ADDITIONAL TASK(S):**  
Collection or Avoidance

**ADDITIONAL TASKS:**  
Laboratory Work & Reporting

**PREFERRED RESULT:**  
Project Approval

## Formal Monitoring



**PERFORMED BY:**  
Typically a Professional Paleontologist/Consultant

**ADDITIONAL TASK:**  
Collection

**ADDITIONAL TASKS:**  
Laboratory Work & Reporting

# PRELIMINARY RESOURCE ASSESSMENT OF PROJECT AREA AND BUFFER (or ANALYSIS OF EXISTING Data)



- ◆ Potential Tasks:
  - Review of geologic maps at smallest available scale
  - Review of agency PFYC determinations, if available
  - Review of published scientific papers and unpublished technical reports
  - Search of museum and agency records
  - Consultation with local experts and agencies
  - Data synthesis
- ◆ Potential Deliverables:
  - Impact report: summary of analysis and recommendations
  - NEPA section/s
  - Monitoring Plan and/or Unanticipated Discovery Plan
  - Training material for project personnel
  - Project paleontological potential maps

# TYPES OF RECOMMENDATIONS



Clearance

Survey

Collection

Avoidance

Worker  
Training

Monitoring

# FIELD SURVEY OF PROJECT AREA AND BUFFER



- ◆ Potential Tasks:
  - Focus on exposures of fossiliferous bedrock or surficial sediments
  - Documentation and significance determination of surface fossils
  - Mitigation of fossils via surface collection/excavation or avoidance
  - Preparation and identification of fossils
  - Transfer of fossils to federally approved curation facility (usually a public museum)
- ◆ Potential Deliverables:
  - Survey report: summary of survey details including a description of fossils and mitigation recommendations;
  - NEPA section/s
  - Monitoring Plan and/or Unanticipated Discovery Plan
  - Training material for project personnel

# MONITORING FOR PALEONTOLOGICAL RESOURCES DURING GROUND DISTURBANCE



## ◆ Potential Tasks:

- Examining exposed rock for presence of fossils (in compliance with all safety requirements)
- Documentation and rapid salvage via a variety of techniques, including immediate removal of fossil and matrix samples from project area for processing
- Preparation and identification of fossils
- Transfer of fossils to federally approved curation facility (usually a public museum)

## ◆ Potential Deliverables:

- Monitoring report documenting the results of all mitigation actions including monitoring locations and dates, fossils observed/collected, and lithologic descriptions

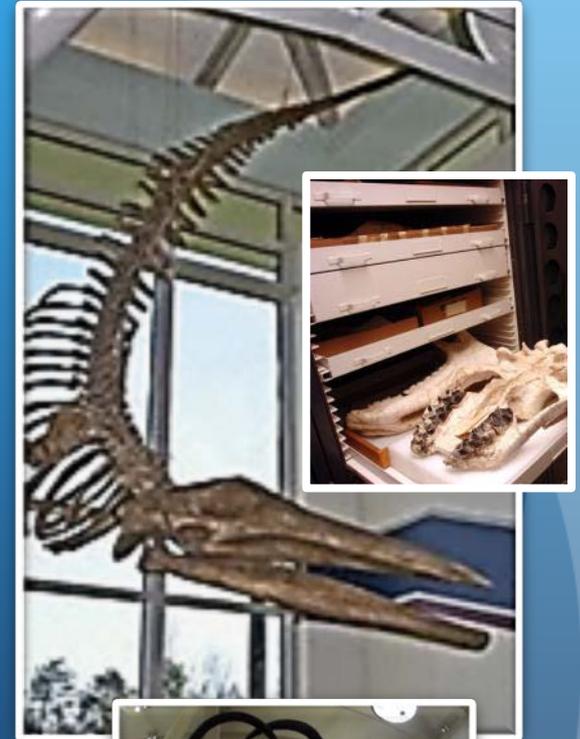
# CONTRIBUTIONS OF MITIGATION PALEONTOLOGY

- ◆ From beach cliffs to badlands and cornfields, mitigation projects have resulted in the collection of skeletons of dinosaurs; mammals including whales, sea hippos, mastodons, ground sloths, and primitive primates; leaves from fossil forests; shells of marine and fresh water invertebrates, and much more.
- ◆ These fossils come from areas with no natural rock exposures and where the fossils would never have been discovered without mitigation.



# CONTRIBUTIONS OF MITIGATION PALEONTOLOGY

- ◆ Once in museums, many of the fossils become the subject of scientific research, leading to the description of new species and a greater understanding of the history of biotic and environmental change in North America.
- ◆ Fossils collected from mitigation activities have been extensively exhibited and used for educational programs.



# PALEONTOLOGICAL MITIGATION MYTHS

- ◆ Myth: Paleontological discoveries need to be avoided.
  - Reality: Collecting significant fossils is less costly than moving or rerouting the project.
- ◆ Myth: Nothing was found on the surface, so there are no fossils underground.
  - Reality: The presence of surface fossils does increase likelihood of subsurface fossils, but the lack of surface fossils does not mean they are not present subsurface.



# PALEONTOLOGICAL MITIGATION MYTHS

- ◆ Myth: Monitors can perform their work from behind construction equipment out of view of excavations.
  - Reality: Monitoring cannot be successful without visual proximity to construction excavations.
- ◆ Myth: Construction personnel can spot the fossils without monitors present.
  - Reality: Discovery of fossils by paleontologists (surveyors/monitors) is less costly and disruptive than the destruction of fossils by construction equipment.



# PALEONTOLOGICAL MITIGATION MYTHS

- ◆ Myth: Paleontological discoveries result in construction delays or shut down projects.
  - Reality: Construction schedules are rarely delayed by a paleontological discovery with implementation of rapid removal and documentation procedures. Paleontological discoveries never stop a project; construction can be re-directed away from the discovery site and can continue.

