

Appendix B

Paleontological Resources

GEOLOGIC FORMATIONS CONTAINING PALEONTOLOGICAL RESOURCES IN THE PLANNING AREA

The Bureau of Land Management (BLM) manages paleontological resources, including mitigation and sensitivity rankings per BLM Handbook H-8270-1, General Procedural Guidance for Paleontological Resources Management, BLM WO Instruction Memorandum (IM) 2008-09 on the Potential Fossil Yield Classification (PFYC) system, BLM WO IM 2009-11 on Assessment and Mitigation, and the Paleontological Resources Protection Act of 2009.

Major Geologic Units	Probable Fossil Yield Classification (PFYC)	Known Fossil Resources
Quaternary ¹ Alluvium	–	Shrub ox
San Jose Formation ^{1,2}	–	Diverse early Eocene vertebrate fossils along the eastern margin of the San Juan Basin
Nacimiento Formation ¹	–	Brachiopods; fish, crocodiles, turtles, various mammals, and temperate flora in central San Juan Basin, outside the planning area
Animas Formation ^{1,2,3}	3	59 species of fossil plants, consisting of 3 ferns, 1 palm, 55 dicots; various vertebrates including Triceratops, Discoscaphites, and Sphenodiscus; abundant petrified wood; typical late-Paleocene mammalian fossils
Kirtland Shale ^{1,3}	5	Baculites; various vertebrates, invertebrates, and plants in the western San Juan Basin
Fruitland Formation ^{1,3}	5	Baculites, vertebrates including dinosaurs; various vertebrates, invertebrates, and plants in the western San Juan Basin
Pictured Cliffs Sandstone ^{1,3}	5	Ammonites, cephalopods, baculites, ophiomorpha burrows, palm fronds, leaf impressions, petrified and carbonized palm wood
Navajo Sandstone ³	3	Vertebrate and invertebrate tracks and traces
Chinle ^{2,3}	5	Vertebrates (fish) and plants
Cutler ²	–	Vertebrates
Lewis Shale ¹	–	Ammonites, baculites, partial skeleton of a mosasaur, Exiteloceras
Dolores Formation ^{2,3}	3	Flowering plants
Mancos Shale ^{2,3}	2–3	Invertebrates (ammonites, oysters, brachiopods, clams, crayfish burrows), sharks, large marine reptiles, fish, dinosaurs, pollen, plants
Mesaverde Group, undivided ^{1,2,3}	3	Theropod dinosaur tracks, baculites, scaphites, plants, dinosaurs, mammals, crocodylians, turtles, snails, oysters
Burro Canyon ^{1,3}	3	Plants and invertebrates
Dakota Sandstone ^{1,3}	5	Plants, dinosaur bones and tracks
Morrison Formation Brushy Basin Member Salt Wash Member ^{1,2,3}	5	Dinosaurs, lizards, other reptiles, birds, mammals, amphibians, fish, invertebrates, plants
Cliff House Sandstone ^{1,3}	5	Ammonites, crustaceans, clams, oysters, snails, starfish, sea urchins, shark teeth, amphibians, turtles, mosasaur, plesiosaur

Major Geologic Units	Probable Fossil Yield Classification (PFYC)	Known Fossil Resources
Menefee Formation ^{1,3}	5	Leaf impressions, palm fronds, conifers, reptile bones, fossil tree trunk
Point Lookout Sandstone ^{1,3}	5	Worms, crustaceans, clams, ammonites, various animal tracks, driftwood

¹ Adapted from: Carroll et al. 1999; Kues and Lucas 1987.
² BLM Colorado Oil and Gas Leasing Draft Environmental Impact Statement. April, 1990.
³ Final Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States, Appendix D: Potential Fossil Yield Classifications for Geologic Formations Intersecting Proposed Corridors Under the Proposed Action by State

Description of Major Fossil-bearing Geology Formations in the Planning Area

Dakota Sandstone (Upper Cretaceous)

The Dakota Sandstone consists of dominantly yellowish brown to gray, quartzitic sandstone and conglomerate with subordinate thin, lenticular beds of gray claystone, impure coal, carbonaceous papery shale, and gray, friable, carbonaceous sandstone. Depositional environments are marine near the top and fluvial near the base. The Dakota Sandstone and its fossils characterize the beach and nearshore sands associated with the initial stage of the encroaching Cretaceous epicontinental seaway.

Dinosaur tracks, Tempskya wood, wood impressions, coals, and invertebrate traces are the types of fossils known to be present in the Dakota Sandstone.

Burro Canyon Formation (Lower Cretaceous)

The Burro Canyon Formation is composed of light gray and light brown, fluvial, quartzose sandstone and conglomerate in thick beds with lenticular, greenish gray, locally purplish, siltstone, shale, and mudstone. The Burro Canyon Formation is a continuation of the basin fill atop the Morrison Formation, but with sediments derived from Sevier highlands in central Utah (Aubrey 1992).

Dinosaur bones and tracks, limonitic wood, seed pod, and leaf impressions are known in areas of the Four Corners region.

Morrison Formation (Upper Jurassic)

Dominantly fluvial, subordinately lacustrine, sandstone and mudstone alluvial deposits make up the Morrison Formation. The Morrison Formation is a vast shallow-basin deposit that extends across nine western states. In the Four Corners region, the Morrison records the deposition of detritus derived from Jurassic Mogollan highlands of central Arizona. The coarser-grained lower members of the Morrison preserve remains of large river deposits with associated floodplain and shallow ponds and lakes. The Morrison Formation of the western United States is famous for its dinosaur fossils. Gymnosperm fossils are also known to occur. All of the four members of the Morrison Formation are fossiliferous. The Brushy Basin member has been studied by Brigham Young University at a location on Horse Range Mesa site, which contains dinosaur fossils.

The Brushy Basin member consists of variegated bentonitic lacustrine mudstone with a few lenses of chert-pebble conglomeratic sandstone, some of which contain uranium-vanadium deposits. Significant fossils include carnivorous dinosaurs like *Allosaurus*, sauropod dinosaurs including *Camarasaurus*, gastroliths (stomach stones), and petrified wood including *Hermanophyton* and *Xenoxylon*.

The Brushy Basin member and remaining members of the Morrison Formation generally contain dinosaur bones, petrified wood, and plant fossils in the Four Corners region.

Junction Creek Sandstone (Upper Jurassic)

Pink or reddish orange, fine- to coarse-grained, poorly sorted eolian cross-bedded sandstones make up the Junction Creek Sandstone. The Junction Creek Sandstone, and the fossils it bears, records the sand dune deposits derived from winds off of the retreating Curtis Sea.

References

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