

PALEONTOLOGICAL DISCOVERIES AT CURECANTI NATIONAL RECREATION AREA AND BLACK CANYON OF THE GUNNISON NATIONAL PARK, UPPER JURASSIC MORRISON FORMATION, COLORADO

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Abstract—A paleontological survey conducted by the National Park Service during the 2005 summer field season, and relocation of previously discovered sites, produced nearly 40 documented fossil localities within the boundaries of Black Canyon of the Gunnison National Park and Curecanti National Recreation Area in southwestern Colorado. The majority of fossil material was found in the Upper Jurassic Morrison Formation, and includes wood, turtle fragments, goniopholidid crocodylian teeth and bone, six types of dinosaur, a possible mammal bone, large reptile or mammal burrows, termite nests, and other invertebrate traces. Most notably, one of the sites discovered during the 2005 field season at Curecanti National Recreation Area expanded the dinosaur faunal list from *Apatosaurus* and *Allosaurus* to include *Camarasaurus*, *Ceratosaurus*, *Stegosaurus*, and either *Diplodocus* or *Barosaurus*.

INTRODUCTION

Black Canyon of the Gunnison National Park (BLCA) and Curecanti National Recreation Area (CURE), both units of the National Park Service, are located in southwestern Colorado (Fig. 1). Previous paleontological investigations within the boundaries of the parks began in the 1990s by paleontologists Dr. Anthony Fiorillo (of the Dallas Museum of Natural History) and Dr. Cathleen May (Fiorillo, 1996, 1999; Fiorillo and Harris, 2000; Fiorillo et al., 1996; Fiorillo and May, 1995, 1996; and Fiorillo and McCarty, 1996). These explorations revealed a wealth of paleontological finds, including crayfish burrows, termite nests, unionid clam burrows, root casts, and a sauropod dinosaur. During the summer of 1995, Dr. Fiorillo, along with Fred Olson of Paleontological Investigations, Inc., began an excavation at the Dino Cove site in CURE that produced remains of the sauropod *Apatosaurus* sp., a single tooth of the theropod *Allosaurus* sp., conchostracans, isolated crocodylian teeth, and a probable mammalian long bone (Trujillo, 2000). Over the next three summers, field crews continued to excavate the sauropod from the Brushy Basin Member of the Morrison Formation. The *Apatosaurus* specimen (MWC 5140) consists of a partial skeleton. Recent review of this Dino Cove material by Dr. John Foster of the Museum of Western Colorado revealed that *Stegosaurus* fossils also exist among the collection. The material from Dino Cove is currently being prepared by volunteers at both the Museum of Western Colorado in Fruita, Colorado, and the Dinosaur Depot in Cañon City, Colorado.

One of us (KCT) participated in the excavation during the summers of 1995-1998, and she produced a report for the National Park Service in 2000 on the dig (Trujillo, 2000). She also conducted new paleontological surveys in 2001 and 2002 that identified additional invertebrate trace fossils, plant material, and vertebrate fragments (Trujillo, 2001).

BLCA and CURE are included in the Morrison Formation Extinct Ecosystems Project, a cooperative effort to survey the Morrison Formation across its depositional area, focusing on National Park System units. Multiple federal agencies, museums, and universities combined forces to produce this touchstone report that investigates the paleontologic, geologic, climatologic, geomorphic, and environmental history of this Jurassic rock unit (Turner and Peterson, 1998, 2004). Several National Park Service summary reports have been published to acknowledge the variety of fossil material in BLCA and CURE (Santucci et al., 1998; Scott et al., 2001; and Koch and Santucci, 2002).

The National Park Service conducted a field paleontological survey within BLCA and CURE in 2005 to reassess previous fossil sites and survey for new localities. As a result, a total of 15 sites in BLCA and 22 sites in CURE were reported. Within the Morrison Formation, fossils found in

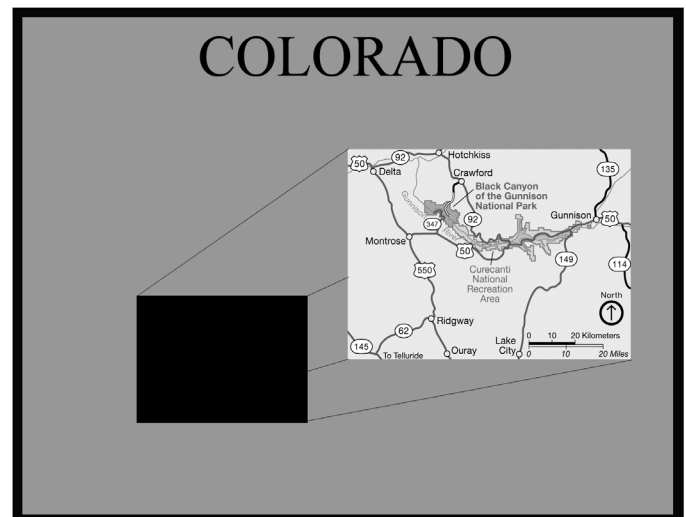


FIGURE 1. Location map of Black Canyon of the Gunnison National Park and Curecanti National Recreation Area.

the parks' exposures include: unionid clam burrows, termites nests, various additional invertebrate burrows, vertebrate burrows, reptile bone fragments, dinosaur bones, crocodile bone, turtle bone, root traces, and wood.

Abbreviations: BLCA, Black Canyon of the Gunnison National Park; CURE, Curecanti National Recreation Area (numbers listed are field numbers, not yet cataloged); MWC, Museum of Western Colorado.

NEW LOCALITIES OF INTEREST

Northern Dinosaur Beach (CURE)

Fossils at this site are primarily found in a conglomeratic sandstone that is poorly-sorted, containing very coarse sand- to pebble-sized red and green semi-angular chert and mud clasts in a fine sand matrix. The site is stratigraphically slightly lower than the Dino Cove site and the section matches Hansen's 1971 description of the Brushy Basin Member in the area. This stratigraphic unit has been, and continues to be, undercut by fluctuating lake levels eroding a softer underlying mudstone. As a result, large float material disguises *in situ* bedding. Fossil specimens are mostly fragments found in basal lags within the conglomeratic sandstone. However, teeth, vertebrae, and a few large, near-complete limb bones have been recovered. Collection was necessary due to potential looting threats and

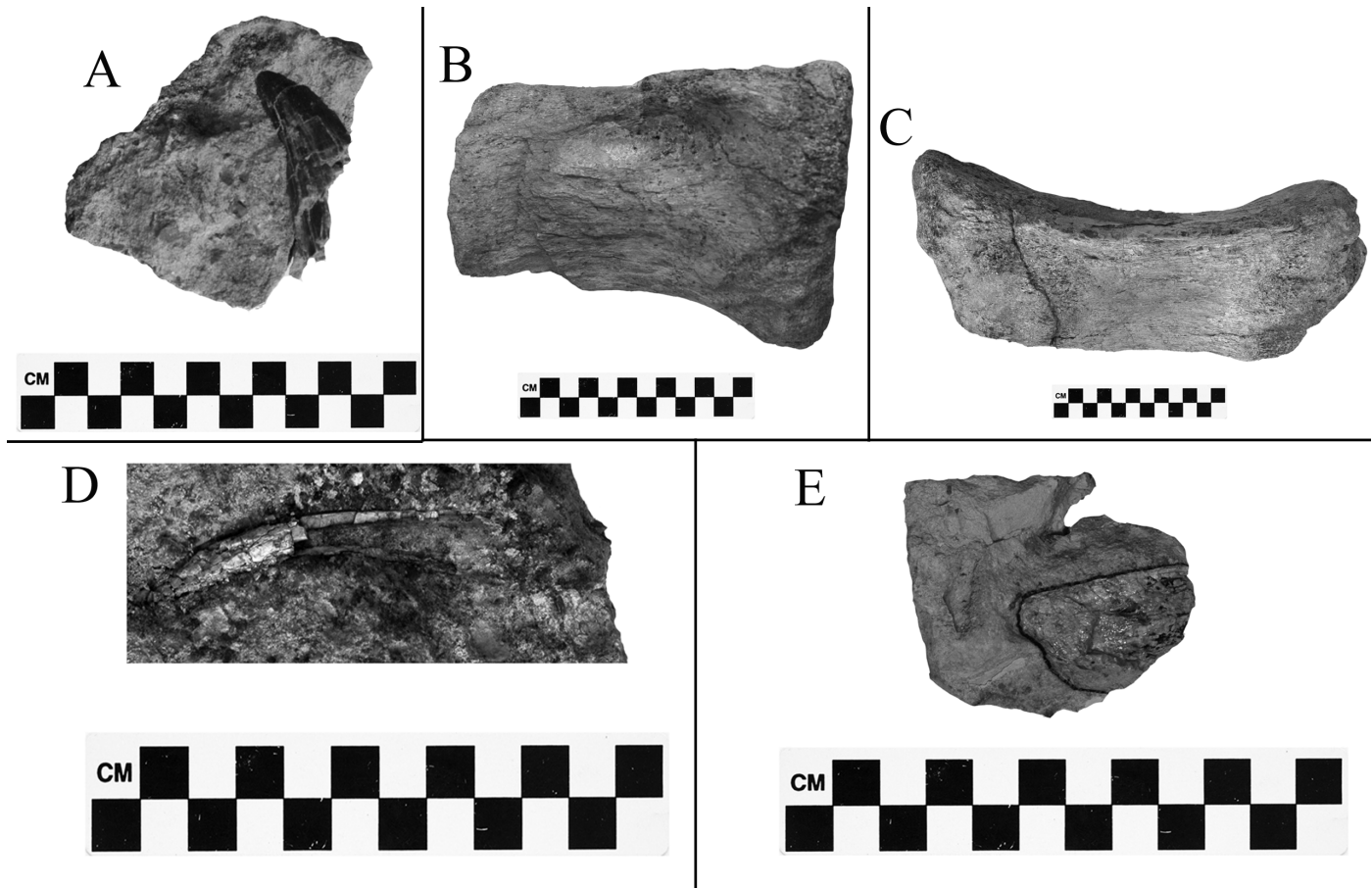


FIGURE 2. **A)** *Ceratosaurus* tooth, lingual view (CURE 004); **B)** *Diplodocus* or *Barosaurus* caudal centrum, lateral view (CURE 001); **C)** *Diplodocus* or *Barosaurus* mid-caudal centrum, ventral view (CURE 002); **D)** Diplodocidae tooth, cross-section (CURE 005); and **E)** *Camarasaurus* tooth, cross-section, dark line is enamel (CURE 003).

damage caused by high rates of natural erosion. Taxa found at the site include *Allosaurus*, *Apatosaurus*, *Camarasaurus*, *Ceratosaurus*, either *Diplodocus* or *Barosaurus*, and possibly *Stegosaurus* (Fig. 2). Termite burrows and other invertebrate burrows are also found throughout the locality.

Dinosaur Beach (CURE)

The geologic setting of Dinosaur Beach is very similar to that of Northern Dinosaur Beach. Consistent with Northern Dinosaur Beach, the site is stratigraphically slightly lower than the Dino Cove site and the section matches Hansen's 1971 description of the Brushy Basin Member in the area. Undercutting has tumbled a conglomeratic sandstone that contains mostly fragmentary vertebrate fossil material. Sauropod (*Camarasaurus*), theropod (*Allosaurus*), and turtle material has been discovered at the site. Additionally, a complete crocodylian ulna was found in the sandstone. Preparation of the specimen revealed that it is from a large goniopholidid (cf. *Goniopholis* or *Eutretauranosuchus*) (Fig. 3). Dinosaur Beach fossils are darker in color than Northern Dinosaur Beach bones and have been exposed for a shorter period of time. There may be greater chance of uncovering complete and well-preserved fossils at this locality. This locality is frequently inundated and limited collections were made.

Ichnofossils (BLCA and CURE)

Abundant invertebrate traces exist within the Morrison Formation in both parks. Unionid clam burrows and termite nests are present, and many other burrows require further identification. One site near the Dinosaur Beach locality contains numerous large vertebrate burrows, either mammal or reptile (Dr. S. Hasiotis, personal communication, 2005) (Fig. 4).

SYSTEMATIC PALEONTOLOGY

REPTILIA

CROCODYLIA

NEOSUCHIA

GONIOPHOLIDAE INDET.

Fig. 3

Referred Specimen.—CURE 006, complete ulna, from Dinosaur Beach locality, Curecanti National Recreation Area, Gunnison County, Colorado.

Remarks.—This specimen is 131 mm long and is complete except for a small part of the external surface of the proximal end. It was found isolated in a medium-grained, slightly pebbly sandstone block. The ulna indicates an animal approximately 2–2.5 meters long, and its overall size and morphology is comparable with the ulna of modern *Alligator mississippiensis* and a goniopholidid from the Morrison Formation at Bone Cabin Quarry collected by Western Paleontological Laboratories. The ulna probably represents one of the known Morrison goniopholidids, *Goniopholis* or *Eutretauranosuchus* (Owen, 1878; Mook, 1967).

DINOSAURIA

THEROPODA

ALLOSAURUS SP.

Fig. 3

Referred Specimens.—CURE 007, partial phalanx; CURE 008, partial manual claw; both from Dinosaur Beach locality; CURE 009, partial dorsal vertebra centrum; CURE 010, nearly complete dorsal vertebra centrum; both from Northern Dinosaur Beach locality, Curecanti National



FIGURE 3. **A)** Goniopholididae, ulna (CURE 006); **B)** *Allosaurus*, phalanx, oblique proximal view (CURE 007); and **C)** *Allosaurus*, claw, proximal end fragment, lateral view (CURE 008).

Recreation Area, Gunnison County, Colorado.

Remarks.—The phalanx and manual claw specimens are fragmentary but are consistent with the morphology of *Allosaurus*. The dorsal vertebrae consist of centra with very constricted mid-sections of a size and shape consistent with *Allosaurus* (Madsen, 1976).

CERATOSAURUS SP.

Fig. 2

Referred Specimen.—CURE 004, partial anterior tooth, from Northern Dinosaur Beach locality.

Remarks.—This specimen is 40 mm long and consists of most of the tooth crown preserved in lingual view. The lingual surface of the tooth crown has several longitudinal ridges characteristic of the anterior teeth of other *Ceratosauros* specimens; these ridges distinguish the teeth from those of other Morrison theropods (Madsen, 1976; Madsen and Welles, 2000).

SAUROPODA

DIPLODOCIDAE

DIPLODOCUS OR BAROSAURUS SP.

Fig. 2

Referred Specimens.—CURE 001, centrum of caudal vertebra; CURE 002, centrum of mid-caudal vertebra, both from Northern Dinosaur Beach locality.

Remarks.—Both specimens are elongate centra typical of the diplocids *Diplodocus* and *Barosaurus* (Hatcher, 1901; Lull, 1919; McIntosh, 2005) and are clearly different from those of *Apatosaurus*, *Camarasaurus*, or *Brachiosaurus*. CURE 001 is elongate, has a shallow longitudinal ventral excavation, and a shallow pleurocoel on the well-preserved side of the centrum, indicating it was probably in some caudal position from 15 to 19. CURE 002 is more posterior and is relatively elongate, with a shallow ventral excavation, but no pleurocoels, demonstrating it was probably just posterior to position 19. The ventral excavations and pleurocoel of these two specimens, along with their great elongation, clearly distinguish them from the other Morrison sauropods *Apatosaurus*, *Brachiosaurus*, *Camarasaurus*, and *Haplocanthosaurus* (McIntosh, 1990a).

APATOSAURUS SP.

Referred Specimen.—MWC 5140, partial skeleton consisting of two nearly complete cervical vertebrae, parts of at least three other cervical vertebrae, four dorsal vertebrae, four sacral vertebrae, four caudal vertebrae, several chevrons, left femur, a partial ilium, a partial ischium, several partial ribs, and many fragments; from Dino Cove locality.

Remarks.—Described by Fiorillo and May (1996).

DIPLODOCIDAE INDET.

Fig. 2

Referred Specimen.—CURE 005, tooth with root in cross-section, from Northern Dinosaur Beach locality.

Remarks.—This specimen is a long, slender and cylindrical tooth typical of the Diplodocidae (McIntosh, 1990b). It is 63 mm long as preserved.

CAMARASAURIDAE

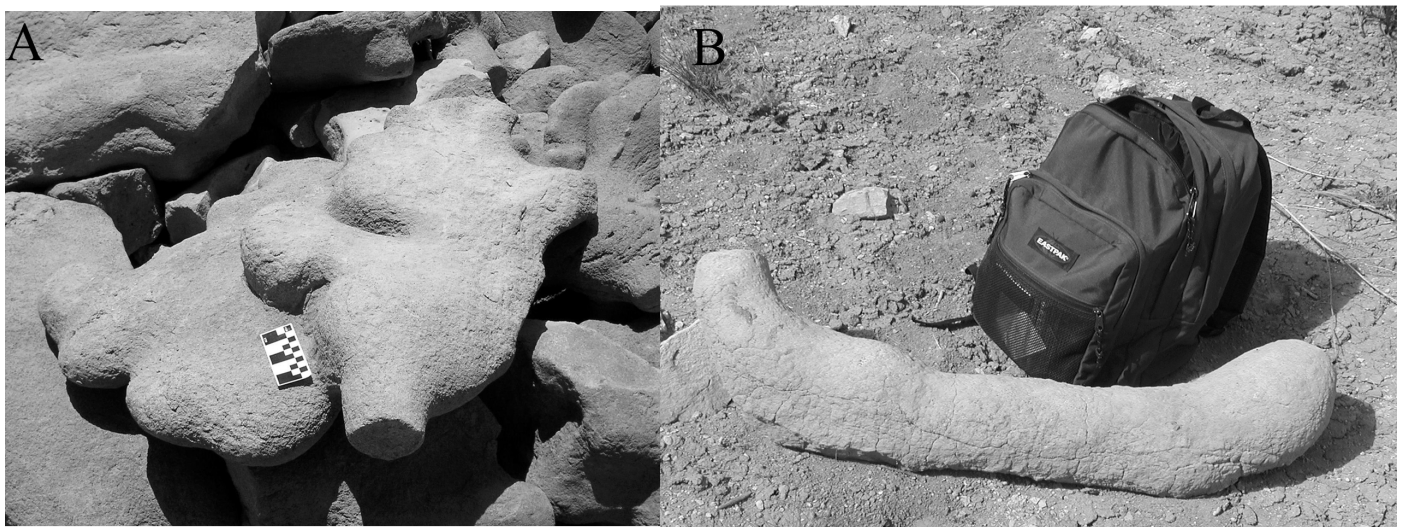
CAMARASAURUS SP.

Fig. 2

Referred Specimens.—CURE 003 (Fig. 2), CURE 011, and CURE 012, tooth crowns preserved in cross-section, all from Northern Dinosaur Beach locality.

Remarks.—These specimens are preserved in cross-section in matrix and expose dentine and enamel of the tooth crowns. Each is robust and spoon-shaped in the morphology characteristic of *Camarasaurus* teeth (Osborn and Mook, 1921).

FIGURE 4. Large vertebrate burrows found approximately 0.25 miles west of Dinosaur Beach locality.



STEGOSAURIA
STEGOSAURIDAE
STEGOSAURUS SP.

Referred Specimen.—MWC 5525, one anterior caudal centrum and one mid-caudal centrum, from the Dinosaur Cove locality.

Remarks.—These two centra were found among the prepared material collected from Dinosaur Cove and are clearly different from the *Apatosaurus* material found there. The anterior caudal centrum is anteroposteriorly short compared to its diameter and contains dorsoventrally elongate caudal rib bases typical of *Stegosaurus* (Gilmore, 1914). The mid-caudal centrum is nearly as long as it is in diameter and contains a mid-centrum ridge on each lateral surface. Both centra are of sizes consistent with adult *Stegosaurus* as well and are distinctly different from the *Apatosaurus* material. Comparisons of the vertebrae with those of a partial skeleton of *Stegosaurus* (MWC 81) from Rabbit Valley, Colorado, demonstrate almost no differences.

FUTURE PALEONTOLOGICAL WORK

Both Dinosaur Beach and Northern Dinosaur Beach sites require additional paleontological investigation in order to pursue the future goal

of providing interpretive opportunities for the public. Ichnofossils within the Morrison Formation warrant further identification and paleoenvironmental analysis. BLCA and CURE would like to continue fostering paleontological investigations with interested research institutions. All geological and paleontological research in the National Park Service will be conducted under the terms of a permit issued by the individual parks.

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