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PATHOLOGY OF AN UNUSUAL LUMBAR CONDITION IN A YOUNG BLACK BEAR (*URSUS AMERCANUS*) FROM THE BIG BEND REGION OF TRANS-PECOS TEXAS

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ABSTRACT.—The skeleton of a young American black bear (*Ursus americanus*) possessing asymmetrical distortions of the 5 caudalmost lumbar neural spines was recovered from west Texas. We attribute this abnormality, presumed to be congenital, to the absence or atrophy of the right multifidus muscle straddling L3 and to the series of compensatory muscle adjustments required to maintain spinal alignment. This finding may have important management implications for black bears in Texas, given the possibility that our specimen originates from a partially isolated population.

Key words: skeletal pathology, lumbar abnormality, Ursus americanus, *black bear, Trans-Pecos Texas.*

RESUMEN.—El esqueleto de un oso negro juvenil (*Ursus americanus*) con distorsiones asimétricas de las cinco espinas neurales lumbares inferiores fue descubierto en el oeste de Texas. Atribuimos esta anormalidad, suponiendo que es de origen congénito, a la ausencia o atrofia del músculo multifidus derecho que se extiende a ambos lados de la vértebra L3 y la serie de ajustes musculares compensatorios necesarios para conservar el alineamiento espinal. Este hallazgo podría tener implicaciones importantes para esta especie en Texas, dada la posibilidad de que nuestro espécimen provenga de una población parcialmente aislada.

The nearly complete skeleton of a young black bear (*Ursus americanus*) was recovered on 17 March 2008 from approximately 5 km south of the headquarters of Black Gap Wildlife Management Area (WMA), southern Brewster County, Texas. The site (29°31′N, 102°55′W; elevation 837 m) was a densely vegetated wash that fed from the west into Frog Canyon of the Sierra del Carmen range. The carcass represented an animal that would have weighed an estimated 70–75 kg in life and appeared to have been in place for less than a week. Scavengers had gnawed at the tips of ribs, some vertebral processes, and the margins of ischial crests. The tip of the tail and the right scapula with the associated limb were missing, but the articulated skeleton was otherwise intact. We found no sign of skeletal trauma indicative of predation or a fatal accident, although Pelton (2003) lists human activities (e.g., hunting, poaching, and predator control) and accidents (e.g., snakebite and lightning) as possible common causes of black bear mortality that may leave no such sign. The cleaned skeleton was cataloged as MWSU 23020 in the Midwestern State University Collection of Mammals.

Among the lumbar vertebrae ($n = 6$) was a minor bone spur or osteophyte (approximately 5 mm^3) observed on the right neural arch of L5. It was presumed to be of little consequence. However, the neural spines of L2–L6 deviated from the normal blade-like processes that are typically in alignment along the vertebral axis. The neural spine of L3 is normal except for the deflection to the left, and the distal tips of the neural spines of L2, L4, L5, and L6 are expanded caudally in asymmetrical fashion (Fig. 1). Ursidae are noted for an exceptionally high incidence (>25%) of arthritic or degenerative bone disorders of the postcranial skeleton (Greer et al. 1977, Rothschild 2005, Nunn et al. 2006) that extends into the archaeological record (e.g., Lyman 2008 and references therein). For all the detailed attention received by the ursid skeleton in these previous studies, we find no reference to any condition comparable to the series of asymmetrical lumbar elements observed in the recently salvaged skeleton of this young American black bear from Texas.

Selected dimensions (mm) of the skull were greatest (condylobasal) length, 271; least interorbital breadth, 61; and zygomatic breadth, 165.

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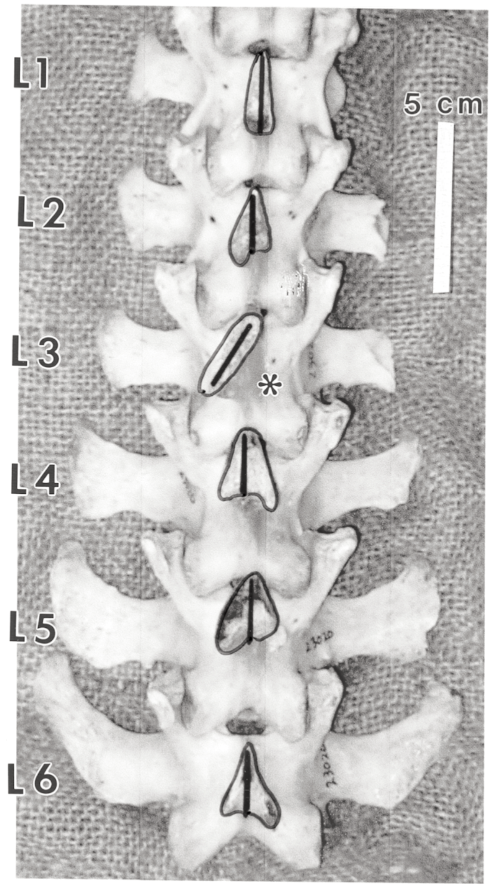

Fig. 1. Dorsal view of articulated lumbar vertebrae of a young *Ursus americanus* (MWSU 23020). Lines indicate the midlines of lumbar neural arches, outlined by contours of neural crest tuberosities. An asterisk (*) indicates the site of presumptive multifidus muscle loss. Distal portions of transverse processes show postmortem damage by scavengers.

Occlusal surfaces of cheek teeth were lightly worn, and the dimensions of M2 were 26.5 × 14.7. General dimensions of the skull, presence of adult dentition, absence of epiphyseal sutures on long bones, and near closure of the basioccipital–basisphenoid and maxillary–premaxillary sutures (see Hoffmeister 1986 for latter criterion) indicate early adulthood (approximately 3–5 years of age). Based on the comparatively slender lower canine (*in situ* measurements of 10.6 × 15.8 at crown base; see Gordon and Morejohn 1975) and lack of pelvic suspensory tuberosities, the bear was probably female. The skull and available parts of the appendicular skeleton of this young bear are unremarkable and suggest normal development, as do other elements of the vertebral column (cervical, n = 7; thoracic, n = 14; sacral, n = 4; and caudal, n = 3 proximal-most vertebrae).

Bone remodeling via ongoing constructive (osteoblastic) and destructive (osteoclastic) processes typically permit a gradual sculpting or molding of bone in orientations directionally aligned with applied stresses (Wolff's Law of 1892; see Pearson and Lieberman 2004). The observed distortion of the neural spines in our specimen is attributed to uneven opposing stresses by the paired multifidus muscles, which originate on the dorsum of each anterior zygapophysis and bypass the adjoining vertebra to insert along the superior margin of the next neural spine. This muscle complex contributes to maintenance of lumbar alignment and lordosis while minimizing excessive torsion or flexion. Despite the observed asymmetry, the fit of the articulated vertebrae indicates that the lumbar spine of the specimen was correctly aligned in life.

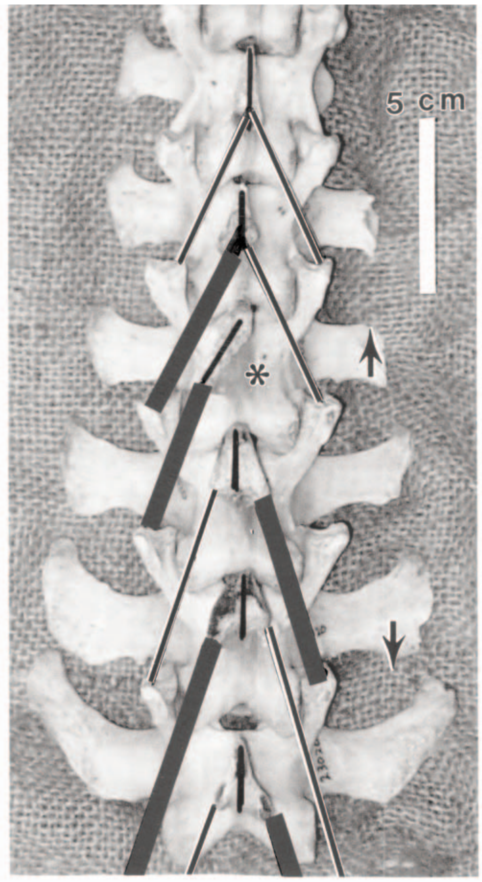

Fig. 2. Dorsal view of articulated lumbar vertebrae of a young *Ursus americanus* (MWSU 23020), demonstrating placement of individual multifidus muscles. Widths of lines illustrate relative degrees of muscle stress. An asterisk (*) indicates the site of presumptive multifidus muscle loss. Arrows indicate direction of stress on transverse processes of L3 and L5 caused by absence of the right multifidus on L3.

Lacking any evidence for spinal degenerative disease or trauma, we hypothesize that the congenital absence or atrophy of the right multifidus on L3 of the young bear was the causative destabilizing factor that initiated what we envision as a cascade of muscle adjustments in neighboring vertebrate which served to maintain a straightened spine. The unopposed multifidus effect at L3 would have caused stress that opened the distance between right transverse processes of L3 and L5 (arrows, Fig. 2). Correction by long-term tension of alternate multifidus musculature and resulting neural-spine deformation obviously stabilized the spine in correct position, but would have limited lumbar flexion to some degree. To what extent this handicap contributed to the animal's demise or influenced its fitness relative to agility, speed, or ability to perform critical actions (e.g., climbing, assuming a bipedal stance, or self-defense) is unknown.

If our interpretations of this observed skeletal deformity (i.e., of congenital origin, causative multifidus muscle imbalance, and restrictive lumbar flexibility) are correct, then our findings have important management implications for *U. americanus*—a taxon only recently becoming reestablished in Texas. Bailey (1905) reported the species in west Texas as largely extirpated by hunting pressure from all but the higher regions of the Guadalupe, Davis, and Chisos ranges. The species persisted in these remote enclaves through at least the 1930s–40s (Chisos Mountains—Borell and Bryant 1942;

Davis Mountains—Blair 1940; Guadalupe Mountains—Davis and Robertson 1944), when unrestricted hunting eliminated these resident populations. For the next 4 decades, Trans-Pecos records were attributed to vagrant individuals from the Sierra Madre range of Mexico or the Guadalupe Mountains of New Mexico (Schmidly 1977, Davis and Schmidly 1994, Stangl et al. 1994).

Increased sightings in the early 1990s from the Chisos Mountains of Big Bend National Park (BBNP) suggested the first evidence of a resident breeding population originating in Mexico (Davis and Schmidly 1994, Schmidly 2004). The black bear is now well established in the national park, and mitochondrial data suggest the smaller population of adjoining Black Gap WMA is partially isolated as postulated by Onorato et al. (2004) and Van Den Bussche et al. (2009).

Continued monitoring of this recent immigrant population in west Texas is warranted to determine both the dynamics of gene flow with Mexican populations and the degree of inbreeding within resident populations. Any such monitoring program should also include the opportunistic salvage of skeletal voucher materials whenever available. The accumulation of such data in systematic collections will ultimately provide an invaluable data set for future workers to assess the spatial and temporal incidence of any potentially deleterious morphological manifestations of inbreeding. This would be especially critical for the American black bear in west Texas, where past founder effects and the possibility of future population bottlenecks would increase the species' vulnerability to the threat of fixation of any such conditions.

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LITERATURE CITED

BAILEY, V. 1905. Biological survey of Texas. North American Fauna 25:1–222.

BLAIR, W.F. 1940. A contribution to the ecology and faunal relationships of the mammals of the Davis Mountain region, southwestern Texas. Miscellaneous Publications, Museum of Zoology, University of Michigan 46:1–39.

BORELL, A.E., AND M.D. BRYANT. 1942. Mammals of the Big Bend area of Texas. University of California Publications in Zoology 48:1–61.

DAVIS, W.B., AND J.L. ROBERTSON JR. 1944. The mammals of Culberson County, Texas. Journal of Mammalogy 25:254–273.

DAVIS, W.B., AND D.J. SCHMIDLY. 1994. The mammals of Texas. Texas Parks and Wildlife Press, Austin, TX.

GORDON, K.R., AND G.V. MOREJOHN. 1975. Sexing black bear skulls using lower canine and lower molar measurements. Journal of Wildlife Management 39:40–44.

GREER, M., J.K. GREER, AND J. GILLINGHAM. 1977. Osteoarthritis in selected wild mammals. Proceedings of the Oklahoma Academy of Science 57:39–44.

HOFFMEISTER, D.F. 1986. Mammals of Arizona. University of Arizona Press, Tucson, AZ.

LYMAN, R.L. 2008. Spondyloarthropathy in cervical vertebrae of late prehistoric black bear from northwestern Oregon, USA. Ursus 19:194–197.

NUNN, C.L., B. ROTHSCHILD, AND J.L. GITTLEMAN. 2006. Why are some species more commonly afflicted by arthritis than others? A comparative study of spondyloarthropathy in primates and carnivores. Journal of Evolutionary Biology 20:460–470.

ONORATO, D.P., E.C. HELLGREN, R.A. VAN DEN BUSSCHE, AND D.L. DOAN-CRIDER. 2004. Phylogeographic patterns within a metapopulation of black bears (*Ursus americanus*) in the American Southwest. Journal of Mammalogy 85:140–147.

PEARSON, O.M., AND D.E. LIEBERMAN. 2004. The aging of Wolff's "Law": ontogeny and responses to mechanical loading in cortical bone. Yearbook of Physical Anthropology 47:63–99.

PELTON, M.R. 2003. Black bear, *Ursus americanus.* Pages 547–555 *in* G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, editors, Wild mammals of North America: biology, management, and conservation. 2nd edition. Johns Hopkins University Press, Baltimore, MD.

ROTHSCHILD, B.M. 2005. Osseotypes and spondyloarthropathy exposed. Current Rheumatology Reviews 1:57–63.

SCHMIDLY, D.J. 1977. The mammals of Trans-Pecos Texas. Texas A&M University Press, Austin, TX.

______. 2004. The mammals of Texas. University of Texas Press, Austin, TX.

STANGL, F.B., JR., W.W. DALQUEST, AND R.R. HOLLANDER. 1994. Evolution of a desert mammalian fauna: a 10,000-year history of mammals in Culberson and Jeff Davis counties, Trans-Pecos Texas. Midwestern State University Press, Wichita Falls, TX.

VAN DEN BUSSCHE, R.A., J.B. LACK, D.P. ONORATO, L.C. GARDNER-SANTANA, B.R. MCKINNEY, J.D. VILLALOBOS, M.J. CHAMBERLAIN, D. WHITE JR., AND E.C. HELLGREN. 2009. Mitochondrial DNA phylogeography of black bears (*Ursus americanus*) in central and southern North America: conservation implications. Journal of Mammalogy 90:1075–1082.

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