

GROWTH, ALLOMETRY, AND AGE/SIZE DISTRIBUTION OF THE LATE TRIASSIC THEROPOD DINOSAUR *COELOPHYSIS BAURI*: PRELIMINARY RESULTS

Larry F. Rinehart¹, Andrew B. Heckert², Spencer G. Lucas¹, Matthew D. Cellesky¹

¹ New Mexico Museum of Natural History and Science, Albuquerque, NM

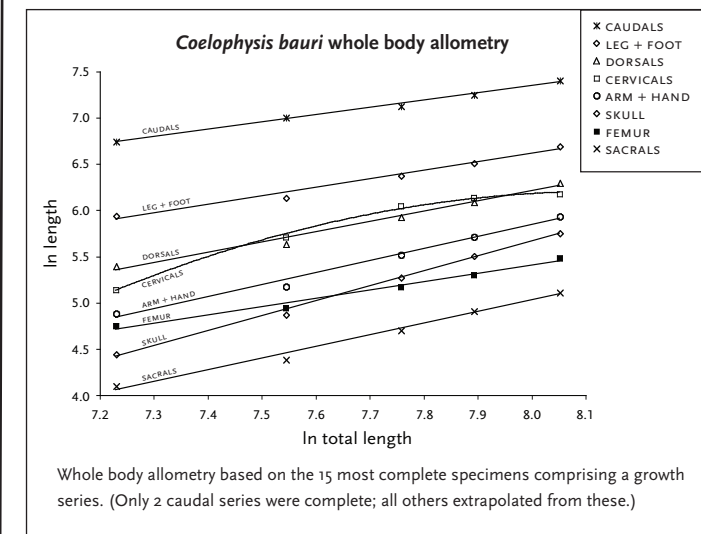
² Appalachian State University, Boone, NC

ABSTRACT

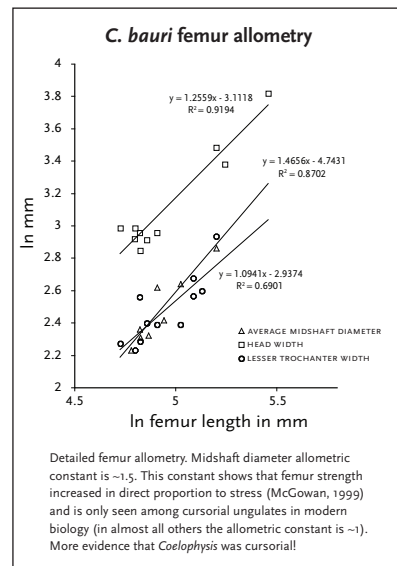
We statistically extracted size (= age) classes from *Coelophysis bauri* metrics. Using these size classes, we generated a hypothetical growth curve for *C. bauri* based on femur lengths (N=56). This curve is similar in shape to that of some birds (e.g. *Gallus gallus*) with the differences largely in time scale, and also to previously reported histologically derived growth data for *C. kayentakatae*. Age and mass distributions were then calculated based on the number of individuals in each age class and on femur dimensions. Hypothetically, *Coelophysis'* growth rate was very high for the first year. Sexual dimorphism apparently onset between years one and two. After one year growth slowed in the gracile morph while the robust morph is first apparent and grew aggressively for another year; slow growth then continued in both morphs. Robust and gracile morphs probably represent males and females respectively based on their sexual dimorphism index (SDI = robust size / gracile size = 1.34). Both age and mass distributions are of hyperbolic form. Very small ~ one-year-olds weighing ~2 kg and ~1.4 m long comprise 40 % of the population, ~11 % are adults weighing ~14 kg and ~2.7 m long, ~2 % reach 25 kg and 3.1 m length.

Our allometry study, based on the 15 suitably complete specimens, agrees with previous studies showing that orbits and hind limbs show negative allometry while skull and neck lengths are positive. Allometric growth constants (this study) relative to total length are: skull length, 1.62; cervical series, 1.31; sacrum, 1.26; caudal series, 0.78; forelimb inc. hand, 1.3; hand, 1.52; hindlimb inc. foot, 0.92; foot, 0.91. Relative to skull length: orbit diameter, 0.28; height at quadrate, 0.22; height at prefrontal, 0.32. The cervical series shows complex allometry (log-transformed data are better fit by a polynomial than linear regression); growth rate being high in juveniles and progressively lower in adults. Thus, relative to adult proportions, juveniles had very short, high faces with large orbits, very short necks, short torsos, long tails, short arms, very small hands, long legs and large feet.

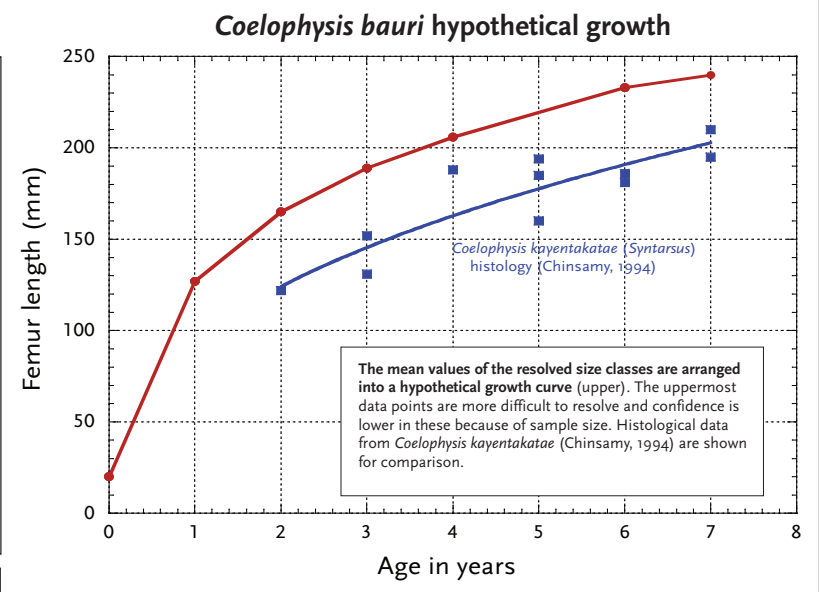
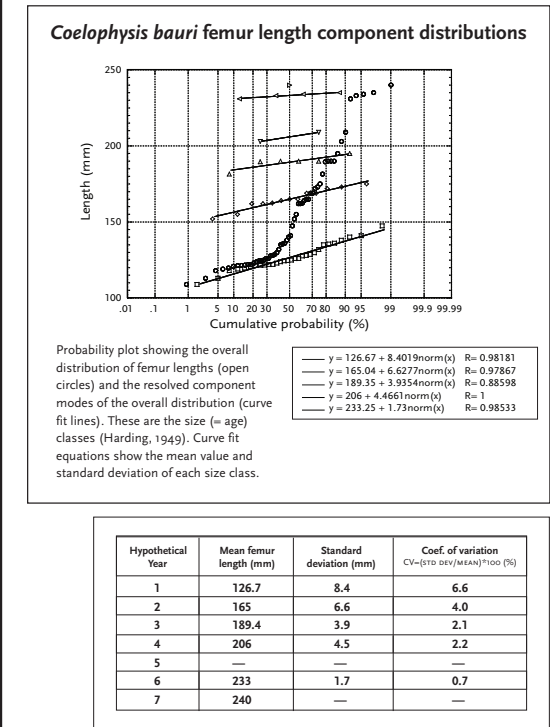
ALLOMETRY (RELATIVE GROWTH)



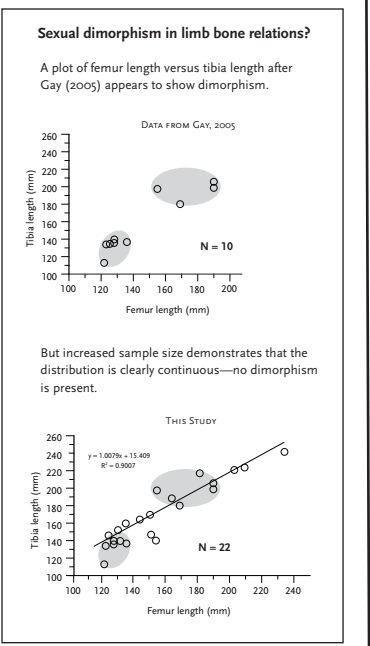
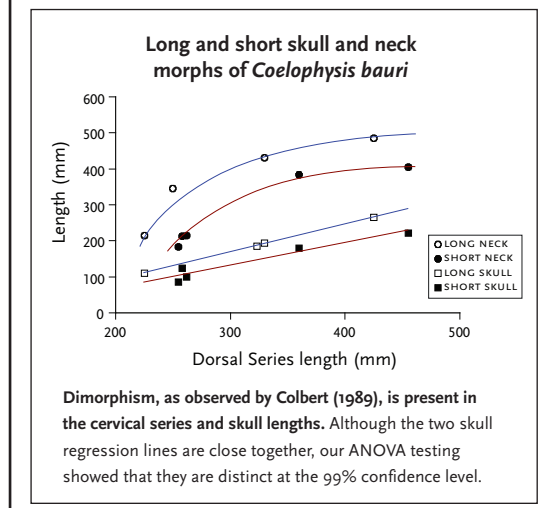
Element lengths	Allometric Constant
ON DORSAL SERIES LENGTH	
skull	1.45
cervical series	1.34
sacrum	1.06
caudal series	0.75
forelimb inc hand	1.18
humerus	1.2
radius	1.05
hand (dig 3)	1.26
hindlimb inc foot	0.88
femur	0.8
tibia inc ast-cal	0.89
foot (dig 3)	0.54
ON SKULL LENGTH	
skull shape factors:	
orbit diameter	0.28
skull height at:	
quadrate	0.22
prefrontal	0.32
ON TOTAL LENGTH	
skull	1.62
cervicals	1.31
dorsals	1.11
sacrum	1.26
caudals	0.78
arm+hand	1.3
humerus	1.27
radius	1.09
hand dig3	1.52
leg-foot	0.92
femur	0.9
tibia+a-c	0.95
foot dig3	0.91



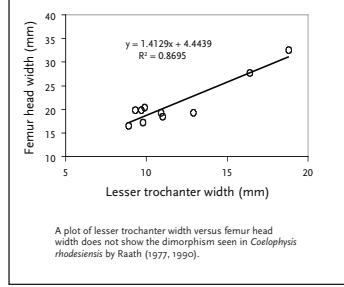
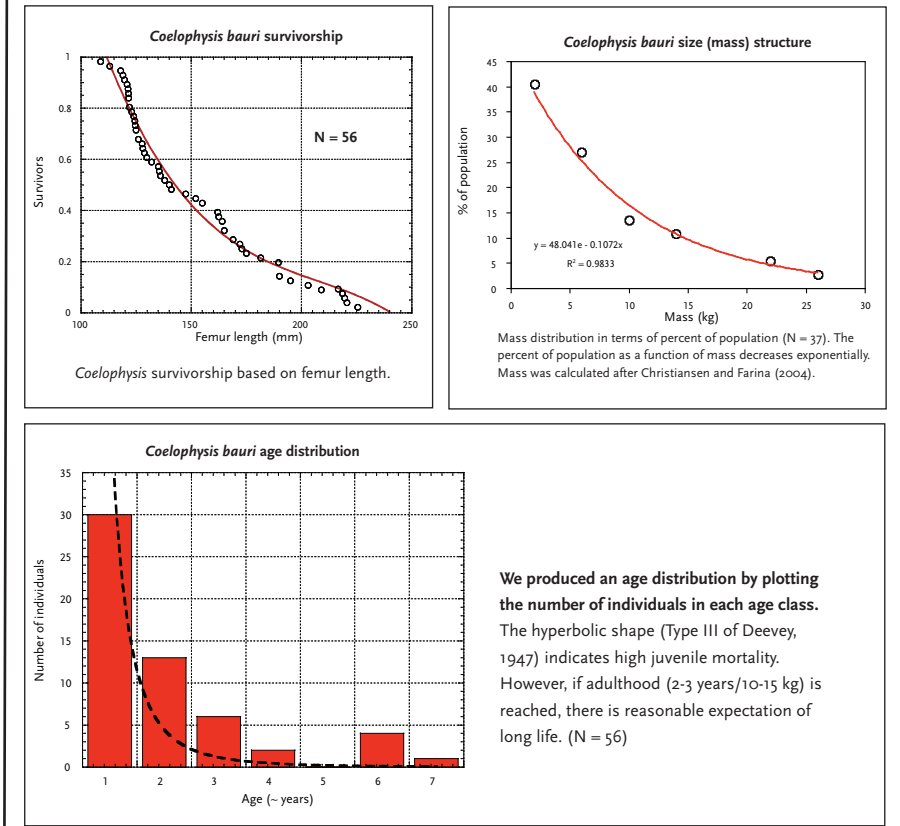
ABSOLUTE GROWTH



SEXUAL DIMORPHISM



POPULATION STRUCTURE



REFERENCES

Carpenter, K. 2002. Forelimb biomechanics of nonavian theropod dinosaurs in predation: Senckenbergiana Lethaea, v. 82, p. 59-76.

Chinsamy, A. 1994. Dinosaur bone histology: implications and inferences, in Rosenberg, G. D., and Wolberg, D. L., eds., Dino Fest: The Paleontological Society Special Publication: Knoxville, The Paleontological Society, p. 213-227.

Christiansen, P., and Farina, R. A., 2004. Mass prediction in theropod dinosaurs: Historical Biology, v. 16, p. 85-92.

Colbert, E. H., 1989. The Triassic dinosaur *Coelophysis*: Museum of Northern Arizona Bulletin 57, p. 1-160.

—, 1990. Variation in *Coelophysis bauri*, in Carpenter, K., and Currie, P. J., eds., Dinosaur Systematics, Approaches and Perspectives, Cambridge Press, p. 81-90.

Deevey Jr., E. S., 1947. Life tables for natural populations of animals: Quarterly Review of Biology, v. 22, no. 4, p. 283-314.

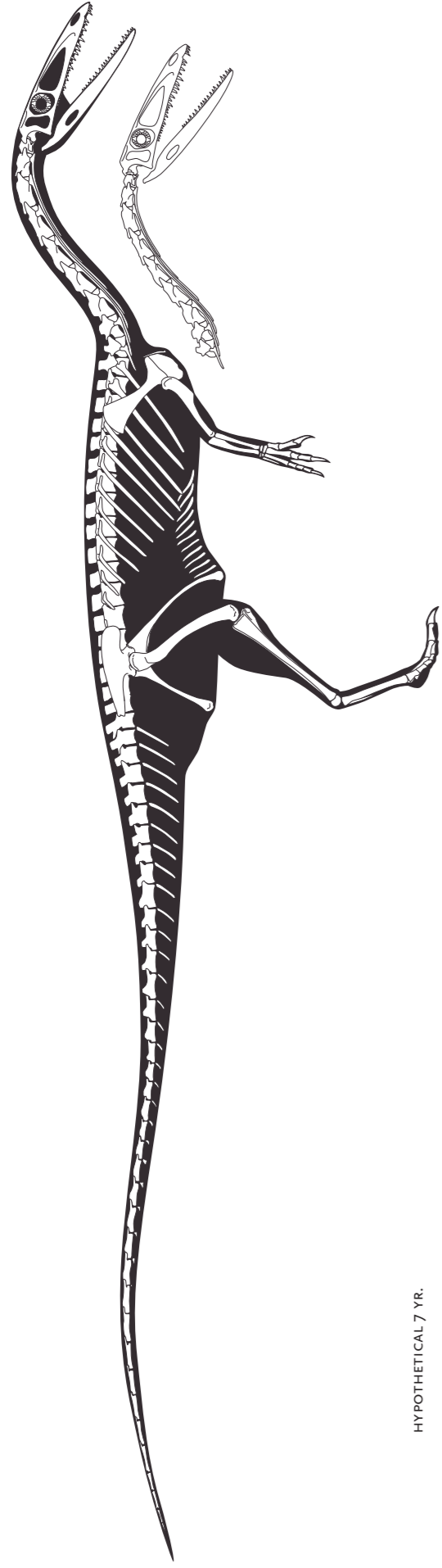
Gay, R., 2005. Sexual dimorphism in the Early Jurassic theropod dinosaur *Dilophosaurus* and a comparison with other related forms, in Carpenter, K., ed., The Carnivorous Dinosaurs: Bloomington, ID, Indiana University Press, p. 277-283.

Harding, J. P., 1949. The use of probability paper for the graphical analysis of polymodal frequency distributions: Journal of the Marine Biological Association of the United Kingdom, v. 28, p. 141-153.

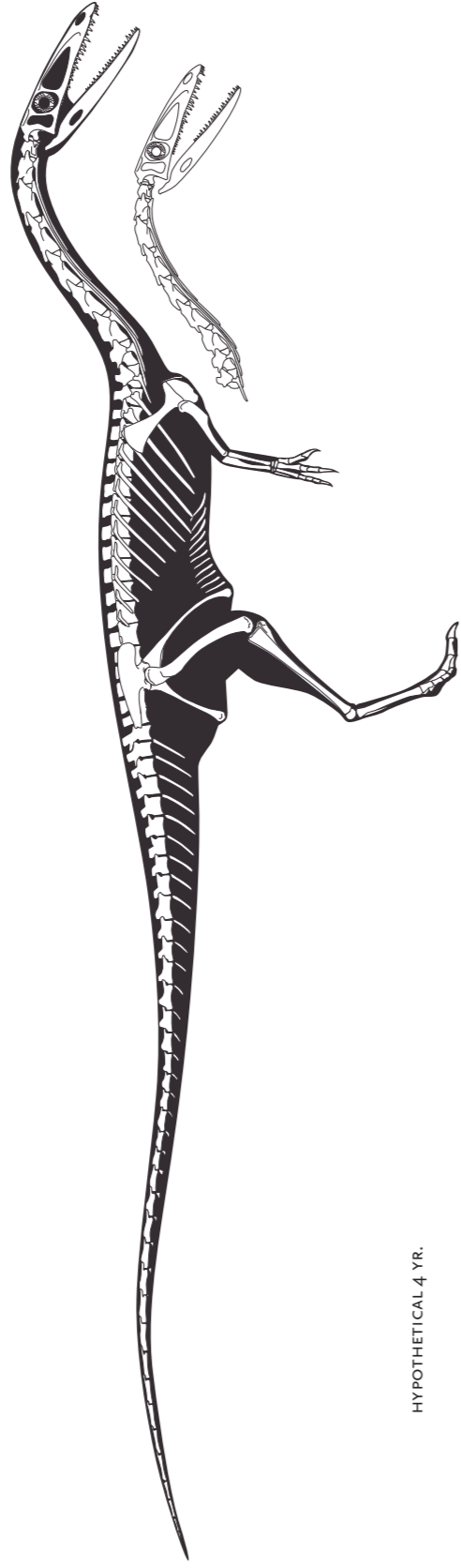
McGowan, C., 1999. A Practical Guide to Vertebrate Mechanics: New York, NY, Cambridge University Press, 301 p.

Raath, M. A., 1977. The anatomy of the Triassic theropod *Syntarsus rhodesiensis* (Saurischia: Podokosauridae) and a consideration of its biology [Ph.D. thesis]: Rhodes University, 233 p.

—, 1990. Morphological variation in small theropods and its meaning in systematics: evidence from *Syntarsus rhodesiensis*, in Carpenter, K., and Currie, P. J., eds., Dinosaur Systematics, Approaches and Perspectives, Cambridge University Press, p. 91-105.



HYPOTHETICAL 7 YR.



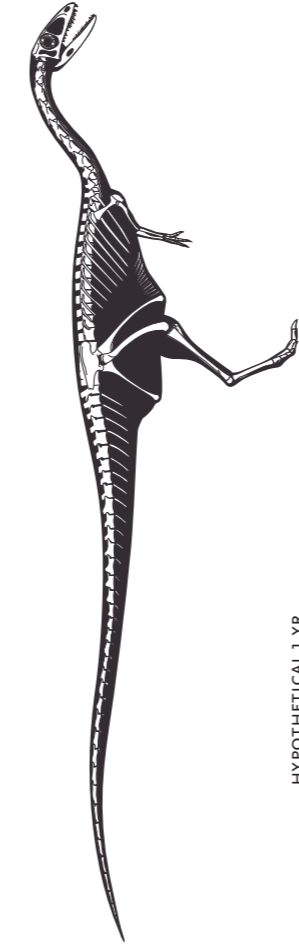
HYPOTHETICAL 4 YR.



LONG NECK/SKULL MORPH

SHORT NECK/SKULL MORPH

HYPOTHETICAL 2 YR.

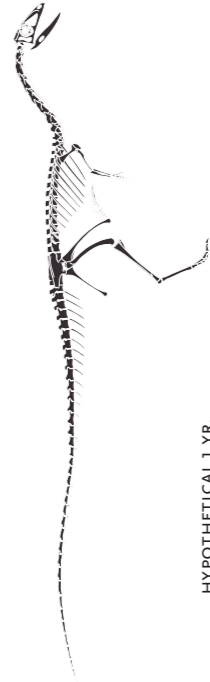


HYPOTHETICAL 1 YR.



SKELETAL RECONSTRUCTIONS MODIFIED FROM FIGURES IN COLBERT (1989) AND CARPENTER (2002).

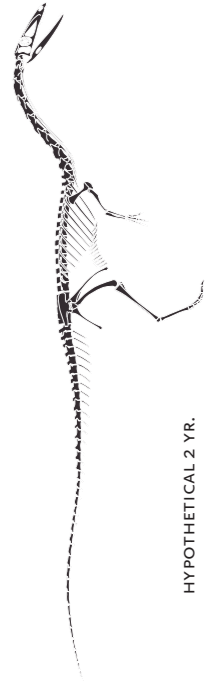
Growth series scaled to the same length:



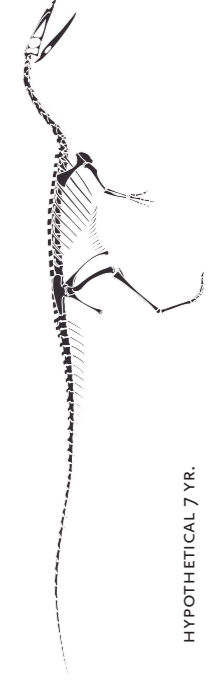
HYPOTHETICAL 1 YR.



HYPOTHETICAL 4 YR.



HYPOTHETICAL 2 YR.



HYPOTHETICAL 7 YR.