Upper limits on the mass of land animals estimated through the articular area of limb-bone cartilage.

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Unlike mammals, dinosaurs did not have shaped articular surfaces to their limb bones, but flat, rugose surfaces that bore thick cartilage caps in life. Many workers have felt that this cartilage would not have been strong enough to support the masses of large sauropods on land, and that sauropods must therefore have been aquatic. I test this assumption by measuring the areas of the articular surfaces of sauropod limb bones and using life-mass estimates from the literature to calculate the compressive stress operating on the cartilage. For *Brachiosaurus altihorax*, assuming a mass of 35000 kg, this method yields an estimated compressive stress of 706 KPa at rest if the whole surface areas of the proximal humerus and femur were in articulation with the glenoid and acetabulum. Assuming that only about half of the area was in contact at any time, and that locomotory stress was about twice static stress, the stress would be 2.8 Gpa. The compressive strength of hyaline cartilage is variously reported, but it seems to sustain about 5 Gpa before the onset of plastic deformation. The safety factor of 1.8 is close to the limit of safety factors exhibited during vigorous locomotion by extant animals, suggesting that cartilage stress may have limited the athletic performance of *B. altithorax*.