Poster Session B

SPEED IN GIANT TYRANNOSAURS: ANATOMICAL AND SCALING COMPARISON OF RUNNING POTENTIAL WITH LIVING ANIMALS

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It is widely assumed that top speeds inevitably decrease in gigantic animals because muscle force scales to the 2/3s power. It follows that elephants should have exceptionally large leg muscles generating high levels of power just to move slowly. But available measurements indicate that elephant locomotion requires very low power production, and leg muscles are only 10% or less the total mass of large bulls, a ratio also observed in small slow animals. Mice to elephant data shows that the power leg muscles need to produce to run at a given speed also scales to the 2/3s power, so leg muscle/total mass ratios remain uniform as size increases if top speed remains constant. In most tetrapods doubling locomotary muscle power production doubles speed, so top speed rises as leg muscle/total mass ratios rise, and both fast running quadrupeds and bipeds are up to 20 to 30% locomotary muscles.

All giant tyrannosaurs were speed adapted, small bellied predators with weight reducing pneumatics, shortened distal tails, and hypotrophic arms, propelled by long, bird like legs powered by muscles anchored on expansive pelvic plates, prominent cnemial crests, and stout tail bases. Leg muscles would have been 20-30% of total mass. No comparable giants live today. Multi-tonne, heavy bellied herbivorous rhinos achieve full gallops of up to ~13 m/s with short, moderately muscled legs with minimal running adaptations. Similar sized, longer striding, better muscled albertosaurs and daspletosaurs should have been able to achieve higher speeds of 14-18 m/s. Even massive bellied elephants with weakly muscled legs entirely lacking speed adaptations exceed 6 m/s. Because *Tyrannosaurus* had flexed jointed, running legs operated by muscles two to three times larger and more powerful it must have been much swifter, probably as fast as its smaller relations. This conclusion is supported by new computer simulations.