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African elephants change gaits when walking downhill

Robert H. I. Dale, Robert Warren, Brock Ward, and Eric Noble

Virtually all of the published data indicate that elephants have only one form of locomotion – a lateral sequence gait (with footfalls as follows: left hind-foot → left forefoot → right hind-foot → right forefoot → left hind-foot). Only Hildebrand (1976) has reported that elephants occasionally trot, although several authors have also referred to an “amble” (e.g., Schmitt et al., 2006). Several recent publications have discussed the biomechanics of the lateral sequence gait exhibited by both African and Asian elephants. Hutchinson et al (2003) and Hutchinson et al (2006) indicated that it was unclear whether elephants run: by some measures they do run, according to other measures they don't. Ren & Hutchinson (2008) and Genin et al (2010) demonstrated that Asian elephants are unusual quadrupeds in that their front limbs and the hind limbs function differently, especially at faster speeds. On the other hand, Ren et al. (2010) provided evidence that, unlike other quadrupeds, elephants use their forelimbs and hindlimbs similarly for propulsion.

Wall et al. (2006) suggested that African elephants tend to avoid steep slopes, perhaps because of the energy cost of moving up and down hills, but all previous studies have examined elephants moving at constant speed on level ground.

Our group has collected information on the gaits exhibited by African elephants moving on level ground, uphill, and downhill. The African elephants we studied at The Indianapolis Zoo rarely walked up or down slopes. However, we were able to collect dozens of samples of the same animals walking uphill, downhill and on level ground while on exhibit. They used the standard lateral sequence gait when walking on level ground and when walking uphill, although the timing of footfalls was different depending on whether the animals were on level ground or walking uphill. The adult elephants frequently changed to a walking trot [left hindlimb and right forelimb move synchronously, right hindlimb and left forelimb move synchronously] when moving downhill, a gait they virtually never used in other circumstances. Juvenile elephants used both the lateral sequence gait and the walking trot on level ground. I will describe how gaits changed as a function of the age of the elephant and the slope of the terrain and suggest why these gait changes occur.