Disproportionate Dwarfism in a Wild Asian Elephant

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Introduction

Dwarfism is unusual in wild animals. Individuals with disproportionate dwarfism are especially unlikely to survive in the wild as shorter limbs would impose severe fitness costs in predators or prey. As social mega-herbivores without predators, Asian elephants are one of the very few species in whom a dwarf phenotype may not be lethal. Here we report the first record of a free ranging adult wild animal - an Asian elephant (*Elephas maximus*), with disproportionate dwarfism (Fig. 1).

Observation of dwarf elephant

On July 7, 2013, at approximately 6:30 am, two elephants were observed 'sparring' on the main road of the Udawalawe National Park in southern Sri Lanka (Fig. 2). While this is not an unusual sight in itself, with around 1000 elephants in the 308 km^2 area of Udawalawe (de Silva *et al*. 2011), one of the protagonists was a mature male of just over five feet (1.5 m) in height. It had a normal sized upper body, with well developed male secondary sexual characteristics such as a large head, broad trunk-base, pronounced nasal bump and prominent temporal protuberances (Varma *et al*. 2012), but had very short, stubby legs. The other elephant was of normal stature. Both displayed temporal gland secretions (Fig. 3), indicative of 'musth' - an annual physiological state in male elephants with heightened aggression and increased ranging behaviour (Fernando *et al*. 2008). The 'dwarf' was by far the main aggressor in the altercation and appeared to be older than the other, a young-adult. Other than for the disproportionately short legs, morphologically and behaviourally the dwarf elephant appeared normal. Absence of previous records and body lumps from gunshot injuries indicative of crop raiding outside the park, suggest that he was not a resident but wandered into the park during musth ranging.

Forms of dwarfism

Two main phenotypic forms of dwarfism occur, proportionate and disproportionate. In proportionate dwarfism 'normal' allometric ratios of the body and limbs are preserved, whereas in disproportionate dwarfism the limbs are comparatively short. Both types of dwarfism are observed in humans. In domestic animals dwarf phenotypes have been selectively bred, creating a number of distinct breeds in dogs, cattle, horses, rabbits and other livestock. Selective breeding for proportionate dwarfism has produced a number of 'miniature' breeds of dogs and cats. Selection for disproportionate dwarfism has produced dog breeds such as the dachshund, basset hound and

Figure 1. Dwarf elephant in Udawalawe National Park, Sri Lanka.

bulldog; cat breeds such as the munchkin; cattle breeds such as the Japanese brown and Dexter; goat breeds such as the Ethiopian dwarf goat and pig breeds such as the Vietnamese pot bellied pig.

Disproportionate dwarfism occurs due to genetic defects involving cartilage and/or bone growth of long bones. Achondroplasia is the commonest cause of disproportionate dwarfism in humans. Inherited as an autosomal dominant disorder it originates from a single point mutation in the transmembrane domain of the Fibroblast Growth Factor receptor 3 (FGFR-3) gene (Shiang & Thompson 1994). The genetic mutation in osteochondrodysplastic dog breeds is not the same as in humans (Martinez *et al*. 2000) and is inherited as a polygenic trait (Minor & Farnum 1988). The Dexter phenotype of disproportionate dwarfism in cattle is shown by heterozygotes of an allele caused by a mutation in the Aggrecan gene that is lethal in homozygotes (Cavanagh *et al*. 2007). Chondroplastic dwarfism in Japanese brown cattle shows autosomal recessive inheritance and is due to a mutation in the Limbin gene (Takeda *et al*. 2002). Given the diversity of genetic mutations and inheritance patterns causing disproportionate dwarfism in different taxa, it is not possible to speculate on the provenance or likely inheritance of the character in elephants.

Dwarf and pygmy elephants

Anecdotal accounts of 'pygmy' or 'dwarf' elephants are common in elephant-lore of many countries (Groves & Grubb 2000; Das 2005; Saparamdu 2006). However such accounts are likely to have originated from cursory observations of juvenile groups. In contrast, Mediterranean dwarf elephants were a classic example of insular dwarfism. Proportionate dwarfism with 1.5-2 m adult height occurred in Mediterranean island elephantids in the Pleistocene (Orlando *et al*. 2007). Insular isolation of *Elephas antiquus* or *Mammuthus* and allopatric speciation is thought to have given rise to these dwarf taxa including *Elephas falconeri* and *Elephas creticus*. The last of these Mediterranean dwarf elephants may have survived till about 10,000 YBP (Orlando *et al*. 2007). Asian elephants in Borneo, isolated since the Pleistocene (Fernando *et al*. 2003) are also called pygmy-elephants. However, they are not significantly smaller than their Sundaic conspecifics (Othman *et al*. 2008). Although the occurrence of an African dwarf elephant (*Elephas pumilio*) has been suggested in the past, such references probably allude to the smaller size of *Loxodonta cyclotis*, in comparison with *L. africana* rather than actual dwarfism (Groves & Grubb 2000).

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Figure 2. Dwarf elephant interacting with 'normal' adult male. Video clips of the encounter can be watched online at <http://www.flickr.com/photos/54907779@N03/sets/72157634655101151>.

Figure 3. Dwarf elephant being in musth, as seen from the temporal gland secretions.

maximus) at Uda Walawe National Park, Sri Lanka based on identified individuals. *Biological Conservation* **144:** 1742-1752.

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