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ABSTRACT BOOK

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Dimorphic traits in the dwarf elephant "*Palaeoloxodon falconeri*" from Spinagallo Cave (Siracusa, south-eastern Sicily)

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The Sicilian dwarf elephant belonging to the Middle Pleistocene deposits of Spinagallo Cave (Hyblean Plateau, south-eastern Sicily) (Fig. 1) is the smallest insular elephant known to have existed, and the most extreme example of insular dwarfism in large mammals (Ambrosetti, 1968; Palombo, 2003; 2007). The dwarf elephant, generally considered as con-specific with *Palaeoloxodon falconeri* from Malta, had a shoulder height of 0.9 - 1.20 m, and an average body mass of ca. 150 kg (Roth, 1990; Palombo and Giovino, 2005). *P. 'falconeri'* was reduced by approximately 85% in height and 88% in mass with respect to its Italian mainland ancestor *Palaeoloxodon antiquus*, which had a body mass of ca. 10 tons and a shoulder height of 3.5-4 m in fully-adult males. In addition to its dramatically reduced size, *P. 'falconeri'* from Spinagallo Cave is characterized by extremely high morphological and dimensional variation, as well as paedomorphic features and the absence of tusks in females (Fig. 2).

Deformed tusks, supernumerary tusklets, and the unilateral failure of tusk eruption, occasionally due to a trauma at an early stage of tusk development, are features, which are also common in both males and females of extant Asian and African elephants (e.g. Raubenheimer, 2000). Conversely, the bilateral tusklessness - which is generally congenital and commonly evidenced in females of *Elephas maximus*, but also occasionally reported in females of *Loxodonta africana* - has been regarded by some researches as an inherited, non-dominant morphological trait with some dimorphic significance. In isolated populations, e.g. that of *Loxodonta africana* from Addo Elephant National Park (South Africa), the high percentage of bilateral tusklessness has also been



Fig. 2. A complete skull of an adult female of *P. 'falconeri'* from Spinagallo cave in lateral/frontal view.

Museum of Palaeontology, Sapienza University of Rome, Italy.

attributed to non-selective genetic drift resulting from a high frequency of inbreeding, or due to an augmented resource allocation to reproductive efforts (see e.g. Seydack et al., 2000; Whithouse, 2002 and Steenkamp et al., 2007 for discussion). The hypothesis that bilateral tusklessness in females from Spinagallo Cave (with poorly developed fan and ossified alveoli) might therefore relate to an increase in reproductive rate in order to reproduce more rapidly and decrease the likelihood of extinction cannot be rejected (Raia et al., 2003; Palombo, 2007). Whatever the actual significance of this morphological trait, it is undoubtedly the most evident dimorphic feature displayed in the dwarf elephant from Spinagallo Cave.

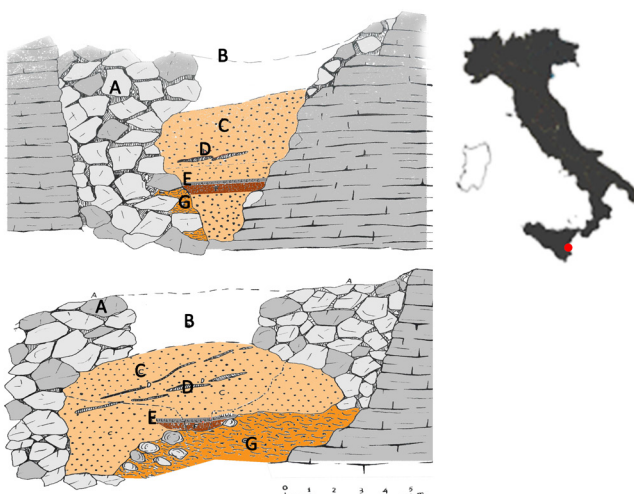


Fig. 1. Localization of Spinagallo Cave (Hyblean Plateau) east-southern Sicily. Transversal (above) and longitudinal (below) section of the cave.

A, collapsed and cemented block; B, Floor of the main cave; C, reddish heart containing fossil bones; D, Discontinuous flow stones; E, Black clayed level; G, marine fossiliferous calcarenite. Modified after Accordi and Colacicchi (1962).

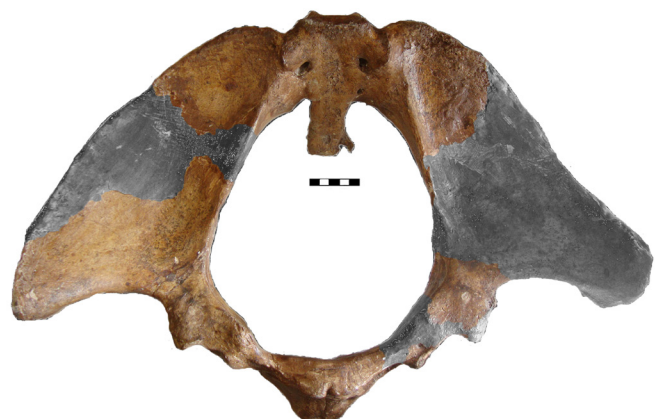


Fig. 3. A pelvis of *P. 'falconeri'* from Spinagallo cave belonging to an adult individual.

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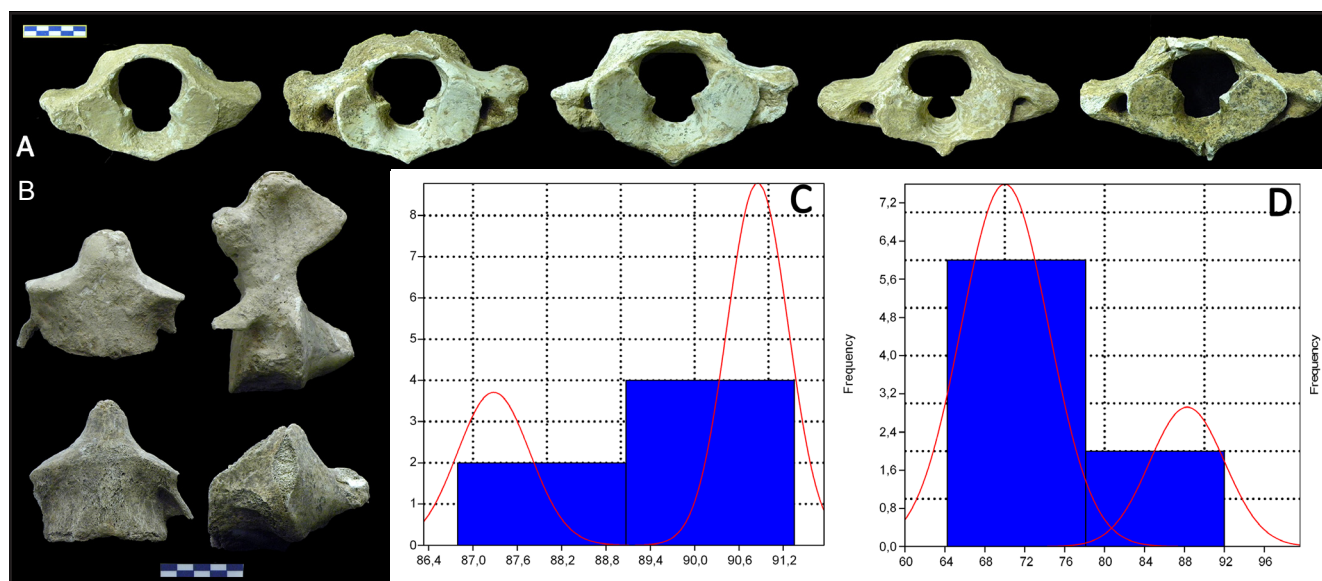


Fig. 4. **A**, Atlases of *P. "falconeri"* from Spinagallo cave belonging to individuals of the same age in cranial view. **B**, Epistropheus of *P. "falconeri"* from Spinagallo cave at the same ontogenetic stage in lateral (on the right) and ventral (on the left) view. Museum of Earth Sciences, University of Catania, Italy. The "best solution" obtained by mixture analysis of the maximum height of the atlas (**C**) and the maximum ventral width of the epistropheus (**D**) of *P. "falconeri"* from Spinagallo cave.

Pelvises are known to be particularly useful for determining the gender of elephants, but pelvises of *P. "falconeri"* from Spinagallo are either incomplete or belong to young individuals. The shape of the pelvic aperture (commonly used to differentiate between males and females in fossil and extant Elephantini) and the ratio between the maximum diameter of the pelvic aperture and the minimum width of the shaft of the ilium in (PAMD/ISmW) (particularly useful with regard to *Mammuthus* and *Palaeoloxodon*, Lister 1996; Palombo and Villa, 2003; Marano and Palombo, 2013), can only be examined fully in two nearly complete pelvises belonging to adult individuals. In the specimen MPRV-P15 (Museum of Palaeontology, Sapienza University of Rome) the PAMD/ISmW value falls within the range of variation in males of European *Palaeoloxodon antiquus* (Fig. 3), in spite of its large pelvic aperture. In the specimen MCA-P17 (Museum of Earth Sciences, Catania University), which displays a more rounded pelvic aperture, the same ratio falls within the range of *P. antiquus* females.

Among the numerous specimens of atlas and epistropheus vertebrae found in Spinagallo Cave, most belong to very young and young individuals, while a few belong to young-adults and adults. Comparing specimens belonging to the same ontogenetic stage, two morphotypes may be detected in both atlas and epistropheus vertebrae, which may be attributed to females and males as is the case in some continental straight-tusked elephants (Marano and Palombo, 2013) (Fig. 4 A, B). In males the arcus dorsalis of the atlas is more robust and the odontoid process of the epistropheus stout and prominent, while in females the dorsal tubercle is less developed and the odontoid process protrudes less.

In conclusion, some dimorphic traits of *P. "falconeri"* from Spinagallo Cave roughly match those displayed in its continental ancestor. Nonetheless, whether or not the peculiar large pelvic aperture which characterizes the pelvis of MPRV-P15 may relate to allometric growth of the iliac wing in male Spinagallo elephants or not requires further investigation.

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