

RESEARCH ARTICLE

Long bone histology of *Chersina angulata* : Interelement variation and life history data

Mohd Shafi Bhat¹  | Anusuya Chinsamy¹  | John Parkington²

¹Department of Biological Sciences, University of Cape Town, Cape Town, South Africa

²Department of Archaeology, University of Cape Town, Cape Town, South Africa

Correspondence

Mohd Shafi Bhat, Department of Biological Sciences, University of Cape Town, Private Bag X3, Rhodes Gift 7701, Cape Town, South Africa.
Email: shafialig@gmail.com

Funding information

Department of Science and Technology-National Research Foundation; Centre of Excellence in Palaeosciences (CoE in Palaeosciences), Grant/Award Number: COE2018-12POST; National Research Foundation, African Origins Platform, Grant/Award Number: 117716

Abstract

The current study deduced the growth pattern and lifestyle habits of *Chersina angulata* based on bone histology and cross-sectional geometry of limb bones. Femora, humeri, and tibiae of seven different-sized individuals representing different ontogenetic stages were assessed to determine the interelement and intraskeletal histological variation within and among the tortoises. The bone histology of adult propodials consists of a highly vascularized, uninterrupted fibrolamellar bone tissue with a woven texture in the perimedullary and midcortical regions suggesting overall fast early growth. However, later in ontogeny, growth was slow and even ceased periodically as suggested by slowly formed parallel-fibered bone tissue and several growth marks in the pericortical region. In juvenile individuals, fibrolamellar bone tissue is restricted to the perimedullary regions of propodials as remnants of bone formed during the earliest stages of ontogeny. The epipodials are characterized by having parallel-fibered bone tissue present in their cortices; however, periodic arrests in growth are recorded at various times. Remnants of fibrolamellar bone tissue formed during early ontogeny occur in the epipodials of only a few individuals. Interelement variation is evident, in terms of variation in the orientation of vascular canals between individuals and within the same diaphyseal cross-sections. Different elements show varying cross-sectional geometry, which appear to be correlated with the fossorial behavior of the species. Our results show that of all the long bones, the tibia is least remodeled during ontogeny and it is therefore the best element for skeletochronology.

KEYWORDS

bone histology, bone microstructures, Testudinidae, tortoise

1 | INTRODUCTION

Tortoises are crepuscular reptiles of the monophyletic family Testudinidae (Batsch, 1788; Crumly, 1985), which mostly comprises terrestrial forms (Greig & Burdett, 1976). Testudines are known from all subpolar continents except Antarctica and Australia and inhabit a wide array of territories varying from rain forests in Southeast Asia and South America, to the deserts of North America and Africa (Le, Raxworthy, McCord, & Mertz, 2006).

Chersina angulata (Schweigger, 1812), also known as bowsprit (Flower, 1929) or angulate tortoise (Hewitt, 1937), is extremely

common in the Western Cape coastal regions of South Africa (Avery, Kandel, Klein, Conard, & Cruz-Urbe, 2004). The monotypic genus *Chersina* is distinguished from other genera by the presence of an undivided gular, moderate to large palatine foramina, and a greatly thickened anteroposteriorly extended gular process (Loveridge & Williams, 1957; Meylan & Auffenberg, 1986). Angulate tortoises are mostly terrestrial, endemic to Namibia and South Africa (van den Berg & Baard, 1994), and are capable of inhabiting wide range of habitats and climatic zones (Greig & Burdett, 1976; Ramsay, Hofmeyr, & Joshua, 2002). Their fossil record ranges from early Miocene (Arrisdrift, Orange River, SW Africa; Meylan & Auffenberg, 1986) to