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ORIGINAL ARTICLE

Growth and life history of freshwater chelydrid turtles (Testudines: Cryptodira): A bone histological approach

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Abstract

The current study examines the growth pattern and lifestyle habits of the freshwater snapping turtles *Chelydra* and *Macrochelys* based on limb bone histology. Femora, humeri, and tibiae of 25 individuals selected from a range of ontogenetic stages were assessed to determine inter-element and intraskeletal histological variation. Osteohistological assessment of multiple elements is consistent with overall moderate growth rates as revealed by the dominance of parallel-fibered bone. However, the growth was cyclical as shown by deposition of multiple lines of arrested growths in the compacta. It appears that the bone tissue of *C. serpentina* is more variable through ontogeny with intermittent higher growth rates. *M. temminckii* appears to grow more slowly than *C. serpentina* possessing compact and thick cortices in accordance with their larger size. Overall, vascularization decreases through ontogeny with humeri and femora being well-vascularized in both species. Contrarily, epipodials are poorly vascularized, though simple longitudinal and radial canals are present, suggesting differences in growth patterns when compared with associated diaphyseal sections. The tibiae were found to be the least remodeled of the limb bones and therefore better suited for skeletochronology for snapping turtles. Intra-elementally, femora and humeri preserved higher cortical vascularity ventrally, suggestive of faster relative growth. We hypothesize that the differential growth pattern in limb bones of snapping turtles may relate to differential functional constraints, where forelimbs are operational in swimming while the hindlimbs provide stability.

KEYWORDS
bone microstructures, Chelydridae, Cryptodira, limb bones

1 | INTRODUCTION

Testudinata (Joyce et al., 2004) is a highly enigmatic group of amniotes characterized by the presence of an anapsid skull, immovable dome-shaped bony carapace, and flat plastron that encloses the pectoral and pelvic girdles within the rib cage (Burke, 1989; Lyson et al., 2013, 2014; Schoch & Sues, 2020; Thomson et al., 2021; Zangerl, 1969). Testudinata is a geographically widespread clade with more than 360 species (Rhodin et al., 2021; Uetz et al., 2018) and is divided into two major lineages: Pleurodira (side-neck turtles) and Cryptodira (hidden-neck turtles). Extant pleurodires are restricted to aquatic/semi-aquatic lifestyles and are currently found only in the southern hemisphere, though they have historically occupied several niches in the northern hemisphere (Cleary et al., 2020). Conversely, cryptodires are common in both hemispheres and occupy a wider range of habitats (Pough et al., 2013). Both extant lineages range back to the Jurassic, alongside various earlier-diverging stem-group taxa (Joyce, 2017), and have a rich and widespread fossil record. The Cryptodira, including the crown-group taxa, are the most abundant and morphologically diverse group of turtles (Sterli, 2010;

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