Insights into the ecology and evolutionary success of crocodilians revealed through bite force and tooth pressure experimentation

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Abstract: Crocodilians have dominated predatory niches at the water-land interface for over 85 million years. Like their ancestors, living species show substantial variation in their jaw proportions, dental form and body size. These differences are assumed to reflect specialization related to feeding and niche occupation, but how they relate to biomechanical performance during feeding and their relevance to evolutionary success are not well understood. During the course of the last two decades we measured adult bite forces and tooth pressures in 23 extant crocodilian species and analyzed the results in ecological and phylogenetic contexts. We demonstrate that these animals generate the highest bite forces and tooth pressures known for any living animals. Body size changes are the dominant mechanism of feeding evolution in this group with jaw shape demonstrating surprisingly little correlation with bite forces and pressures. Critical to crocodilian long-term success was the evolution of a high bite force generating musculo-skeletal architecture. Once achieved, the relative force capacities of this system went essentially unmodified throughout subsequent diversification. Rampant changes in body size and concurrent changes in bite force served as mechanisms to allow access to differing prey types and sizes. Further access to the diversity of near-shore prey was gained primarily through changes in tooth pressures via the evolution of dental form and distributions of the teeth within the jaws. Bite forces can now be predicted in fossil crocodilians using the regression equations generated in this research and for other fossil archosaurians (e.g. dinosaurs) using models developed during the course of our work.

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