New slender-snouted crocodylians from the Neogene of north and east Africa and resolution of the Gharial debate

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Abstract: Phylogenetic analyses made using molecular and morphological datasets yield conflicting results for placement of the modern Indian gharial (Gavialis gangeticus) and false gharial (Tomistoma schlegelii) among other crocodylians. Morphological analyses indicate they are distantly related, last shared a common ancestor more than 80 million years ago, and are similar because of evolutionary convergence. Molecular analyses instead support a close relationship and a divergence within the past 40 million years, with similarities resulting from common ancestry. Both arguments are well supported, with consistent, robust topologies resulting from separate morphology-, molecular-based, and combined analyses. The continued disagreement between methods limits our ability to use Crocodylia as a model clade for the integration of the earth and life sciences. Numerous undescribed Neogene slender snouted crocodylians from Libya and Kenya, along with described specimens from Uganda, reveal a substantial diversity of gharials in the region until the Pliocene. They preserve derived characters unique to both lineages; the basioccipital is anteroposteriorly broad, and there is a long, broad descending ramus of the exoccipital along the basioccipital tuber, and the orbits are broadly upturned in a manner reminiscent of true gharials, but cranial sutural patterns are more similar to those of tomistomines. Present phylogenetic analyses draw some of these close to Gavialis and others close to Tomistoma, but this may reflect incompleteness in some forms and insufficient character sampling. Ontogeny may also be a confounding factor in assessing modern relationships. Preliminary results indicate similar morphology between juvenile Tomistoma and adult Gavialis, suggesting heterochrony may be influencing our current results. Further phylogenetic work on these fossils holds great promise in reconciling modern gharial relationships using traditional morphological methods. This in turn will allow us to comment on the biogeographic histories of the lineage and the evolution of novel traits such as salt tolerance more accurately.

Keywords: Indian gharial, False gharial, Phylogenetics, Biogeography

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