RATES OF EVOLUTION IN THE CARNIVORA (MAMMALIA): THE IMPORTANCE OF PHYLOGENY AND FOSSILS

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Calculations of "rates of evolution" have been applied to a variety of indicators of change within populations, species, or higher taxa. This has led to confusion about taxonomic and temporal scaling, particularly when rates are calculated for supposedly "equivalent" taxonomic ranks, or "higher-level" taxa that are not monophyletic groups. All calculations of rates of evolutionary change require accurate temporal calibration. Even in studies of molecular evolution that assume a "molecular clock", the rate at which any clock ticks must be calibrated empirically by fossil data on the age of divergence of some taxa.

Molecular clock rates for all Mammalia generally have been calculated from the primate fossil record and phylogeny. However, rates of molecular evolution have been shown to vary both within and among different clades. Given a preference for a more rigorous system in which molecular divergence is not assumed to occur at a constant rate, the time of divergence should be determined directly for all clades in studies of molecular "rates of evolution".

The mammalian order Carnivora is a monophyletic group widely cited in studies of evolutionary tempo, and mode. However, few of those rate studies have considered explicitly the roles of fossil taxa and rigorously tested phylogenies. For example, phylogenetic placement of early Cenozoic Carnivora (generally placed in the paraphyletic "stem-group" "Miacoidea"), relative to the two major clades of living Carnivora (Caniformia and Feliformia), profoundly influences estimates of the age of cladogenetic divergence for clades of living carnivorans. If all the taxa placed within the "Miacoidea" lie outside a restricted clade of Carnivora (defined as the most recent common ancestor of extant Carnivora, and all of its descendants), then the oldest Carnivora ("neocarnivorans") are late Eocene (about 35-40 Ma). However, if miacid "miacoids" are caniforms and viverravid "miacoids" are feliforms, then the Caniformia/Feliformia (=Carnivora) clade is at least as old as the oldest "miacoid" (middle Paleocene, or >60 Ma). The implications for calculations of rates of evolution within Carnivora are obvious. Similarly, many fossil Carnivora taxa have been assigned to living families, although the phylogenetic relationships of both fossil and living taxa within most of these families has been poorly understood. This presentation will consider: 1) minimum estimates of clade divergence time, based on current hypotheses of carnivoran phylogeny (emphasizing placement of fossil taxa) and oldest occurrence of fossils within a clade or its sister group- traditional taxonomies both underestimate (e.g. Caniformia/Feliformia) and overestimate (e.g. some living families, such as Viverridae) clade divergence times; and 2) calculation of rates of evolution within Carnivora, focusing on taxonomic diversification and molecular divergence, comparison of rates calculated using traditional taxonomies and artificial "higher-taxa" categories versus those using phylogenetic clades ("unranked"), and the effects of fossil taxa.