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Carnassiform notches improve the functional efficiency of bat molar shearing crests

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We surveyed molar surface morphology of bats of 281 extant and extinct species in 5 archaic and 19 extant families using scanning microscopy. We note the occurrence of structural features on talonid crests, the cristid obliqua, postcristid, and entocristid, and their absence in upper molars, even of the same species having them on lowers. We term the structures “carnassiform notches” (CN) for their resemblance to similar features on the carnassial teeth of carnivorans. A CN consists of a small cleft in the edge of a talonid shearing crest accompanied by an adjacent “accessory trough” on the basinward side of the notch. The CN occur in bats with tribosphenic molar morphology and insectivorous or insectivorous–omnivorous dietary habits. Of 19 extant families examined, eight include members that possess lower molars with a CN in at least the cristid obliqua: Megadermatidae, Nycteridae, Mystacinidae, Furipteridae, Thyropteridae, Phyllostomidae, Natalidae, and Vespertilionidae (Murininae and Kerivoulinae only). An extinct genus of Hipposideridae, *Vaylatsia*, shows CN although extant hipposiderids do not. In extinct families for which lower molar fossils are available, notches were not recognized on the talonids, indicating the condition is not plesiomorphic for bats and probably evolved convergently in different lineages. Where present, the CN or troughs are morphologically consistent within a family, and might serve in some cases as characters supporting phylogenetic analyses and clade diagnoses. CN and accessory troughs probably increase the functional efficiency at sectioning chitin by increasing the effective length of a crest while maintaining the same cusp-to-cusp distance and precise occlusal relationships, and by improving the food-capture area of the shearing blade during occlusion. The accessory troughs provide an immediately adjacent fragment-clearance area. The increased sophistication of this food-processing system might be particularly important in species that must quickly acquire, chew, and swallow their food and resume echolocating in flight. The common ancestor of bats probably did not have CN in its molars, and the presence of CN does not signal carnivory in bats.

Key words: Mammalia, Chiroptera, molars, talonid crests, dental morphology, shearing blades, bio-engineering, functional morphology, functional design.

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