Niche convergence suggests functionality of the nocturnal fovea

Abstract

The fovea is a declivity of the retinal surface associated with maximum visual acuity. Foveae are widespread across vertebrates, but among mammals they are restricted to haplorhine primates (tarsiers, monkeys, apes, and humans), which are primarily diurnal. Thus primates have long contributed to the view that foveae are functional adaptations to diurnality. The foveae of tarsiers, which are nocturnal, are widely interpreted as vestigial traits and therefore evidence of a diurnal ancestry. This enduring premise is central to adaptive hypotheses on the origins of anthropoid primates; however, the question of whether tarsier foveae are functionless anachronisms or nocturnal adaptations remains open. To explore this question, we compared the diets of tarsiers (Tarsius) and scops owls (Otus), taxa united by numerous anatomical homoplasies, including foveate vision. A functional interpretation of these homoplasies predicts dietary convergence. We tested this prediction by analyzing stable isotope ratios that integrate dietary information. In Borneo and the Philippines, the stable carbon isotope compositions of Tarsius and Otus were indistinguishable, whereas the stable nitrogen isotope composition of Otus was marginally higher than that of Tarsius. Our results indicate that species in both genera consumed mainly ground-dwelling prey. Taken together, our findings support a functional interpretation of the many homoplasies shared by tarsiers and scops owls, including a retinal fovea. We suggest that the fovea might function similarly in tarsiers and scops owls by calibrating the auditory localization pathway. The integration of auditory localization and visual fixation during prey detection and acquisition might be critical at low light levels.