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Allometric scaling and functional morphology of large female size in flying squirrels

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Female-biased size dimorphism (FBSD) is uncommon in mammals, and unlike male-biased size dimorphism (MBSD), which is typically explained by sexual selection, FBSD is often explained by functional or reproductive advantages to females. FBSD provides functional advantages to offset increased costs of maternal locomotion, this should result in selective pressure on female body proportions that enhance gliding performance. Additionally, gliders with different body sizes and patagial shapes will experience different performance losses, and consequently should offset these costs of increased wing loading by different compensatory mechanisms.

Methods:
We examined patterns of scaling (Rensch's rule) of FBSD across 27 flying squirrel species based on morphometric measurements from over 1500 museum specimens. Ten measures were used to investigate Rensch's rule. The ratio of tail to head and body length was used as the measure of compensatory structures that enhance gliding

performance. The analysis was performed within a phylogenetic framework.

Results:
Flying squirrels were seen to scale in accordance with Rensch’s rule, which predicts that FBSD decreases with increasing body size across related species. Females had relatively longer tails and larger heads than males, indicating that selection for enhanced gliding ability may have resulted in FBSD. We found that within flying squirrels, small body sized gliders with reduced patagia had more compensatory morphological adaptations than large body sized gliders with extended patagia. Sexes of species within each of these two groups also scaled differently, and the slopes taken together explain the pattern of allometric scaling in accordance with Rensch’s rule.

Discussion:
Flying squirrels are one of the few groups where FBSD scales across related species in accordance with Rensch’s rule, and this pattern can be directly explained by adaptations of females to the interaction of differing airfoil structure, body size and potential weight gain. Patterns of gliding morphostructure, and consequently dimorphism are deeply rooted within the phylogenetic history of this subfamily.