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Modelling allometric variation of foreleg length in oil bees

Pollinators often have exaggerated traits that are thought to have co-evolved with traits of the flowers they visit. One spectacular example is the elongated forelegs that Rediviva bees use to collect oil from flowers with long spurs. We examined the ecological basis of variation in foreleg length among 26 Rediviva species in South Africa and to what extent underlying developmental constraints might have played a role in their evolution. We adapted linear mixed effects models for estimating the allometric scaling relationships between foreleg length and body size within species (static allometry) and between species (evolutionary allometry), while accounting for phylogenetic relatedness among species. We found low variation in static allometric slopes suggesting that body size constrained the evolution in leg length in similar ways across species. However, the static allometric intercept varied among species and part of this variance was explained by the spur length of the species-specific host flowers. Our analysis indicates that spur length was a selective force shaping the foreleg length in these bees but that variation in leg length was constrained by variation in body size within species. We found no evidence for phylogenetic constraints on the variation of leg length. Overall, our study provides new insights on how phenotypic evolution in the forelegs of oil-collecting bees is related to the variability of the allometric intercept and adaptation to host plants.