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Megacicadas show a temperature-mediated converse Bergmann cline in body size (larger in the warmer south) but no body size difference between 13- and 17-year species pairs

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Koyama T, Ito H, Kakishima S, Yoshimura J, Cooley JR, Simon C, Sota T (2016) Geographic body size variation in the periodical cicadas Magicicada: implications for life cycle divergence and local adaptation. bioRxiv, ver. 1, peer-reviewed and recommended by Peer Community in Evolutionary Biology. https://doi.org/10.1111/jeb.12653

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Periodical cicadas are a very prominent insect group in North America that are known for their large size, good looks, and loud sounds. However, they are probably known best to evolutionary ecologists because of their long juvenile periods of 13 or 17 years (prime numbers!), which they spend in the ground. Multiple related species living in the same area are often coordinated in emerging as adults during the same year, thereby presumably swamping any predators specialized on eating them. Life history differences between the 13yr and 17yr cicadas are a particular focus of interest. For example, as it takes time to grow large, one would expect 17yr cicadas to be larger than 13yr cicadas on average. Koyama *et al.* [1] investigate geographic body size clines for 7 species of periodical cicadas in eastern North America, whose phylogenetic relationships are resolved, in a life history context, using an impressively large number of populations (Fig. 1 of [1]). The authors report generally female-biased sexual body size dimorphism (SSD), and (however not for all species) a positive relationship of body size with habitat annual mean temperature taken from weather data and a negative correlation with latitude (Fig. 3 of [1]). The latter is consistent with a converse Bergmann cline. Crucially, body size of two at least partly sympatric 13y & 17y sister species pairs did not differ (by much), contrary to expectation because the 17y species have more time to grow larger. 13y cicadas must therefore generally grow

faster (or 17y cicadas slower) to in the end acquire the same (optimal?) body size. The phylogenetically oldest 13y cicada species, however, is larger, suggesting that selection for large (optimal?) body size has relaxed over evolutionary time, for unknown reasons (about which the authors speculate). A mechanistic explanation for this phenomenon is suggested based on the hypothesis that 17y cicadas simply arrest or slow down growth early during their juvenile stage to delay emergence for 4 further years (Fig. 2 of [1]). We think this is an impressive data set, and the life history question addressed in this prominent insect taxon should appeal to readers generally interested in whole-organism evolution despite being largely descriptive.

References:

[1] Koyama T, Ito H, Kakishima S, Yoshimura J, Cooley JR, Simon C, Sota T. 2015. Geographic body size variation in the periodical cicadas *Magicicada*: implications for life cycle divergence and local adaptation. Journal of Evolutionary Biology 28:1270-1277. doi: [10.1111/jeb.12653](https://doi.org/10.1111/jeb.12653)

Reviews

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