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Traits controlling body size in copepods: Separating general constraints from species-specific strategies

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Despite a long history of study, basic ambiguities remain in how growth rate, development rate, and adult body size are linked across copepod taxa. A new, comprehensive synthesis of laboratory measurements of food-saturated development and growth across diverse copepod taxa (n=45, 0.3–2000 μgC adult size) was conducted, within a new, simple theoretical framework that distinguishes universal allometric and metabolic constraints on copepod physiology from contingent strategies that correlate with size for other reasons. Each species was characterized by a temperature-corrected development rate u0, which indicates whether development is fast or slow relative to a presumptive general metabolic limit, and a growth rate g0 corrected not only for temperature but for the classic, three-quarters power-law scaling with body size observed in the ontogeny of several individual spp. This parameter thus indicates whether growth is fast or slow relative to metabolic and allometric limits. Over the full size spectrum (cyclopoids–large calanoids), g0 correlates with adult size better than u0, while at a finer scale of diversity (among Calanus spp., or among large calanoids in general), the reverse is true. This suggests that size diversity is generated by different mechanisms at different taxonomic scales: that relative to Calanus finmarchicus-like organism, evolution produces larger copepods by down-regulating ontogenetic development, and produces smaller copepods by down-regulating growth, ingestion, or foraging activity. Across all scales, the ratio of corrected growth and development rates g0/u0 is a better predictor of adult size than g0 or u0 alone, closely consistent with theory.

Keywords: copepods, size, development, growth, allometry, metabolism, temperature

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