

Universal rules of life: metabolic rates, biological times and the equal fitness paradigm

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Abstract

Here we review and extend the equal fitness paradigm (EFP) as an important step in developing and testing a synthetic theory of ecology and evolution based on energy and metabolism. The EFP states that all organisms are equally fit at steady state, because they allocate the same quantity of energy, ~22.4 kJ/g/generation to production of offspring. On the one hand, the EFP may seem tautological, because equal fitness is necessary for the origin and persistence of biodiversity. On the other hand, the EFP reflects universal laws of life: how biological metabolism – the uptake, transformation and allocation of energy – links ecological and evolutionary patterns and processes across levels of organization from: i) structure and function of individual organisms, ii) life history and dynamics of populations, iii) interactions and coevolution of species in ecosystems. The physics and biology of metabolism have facilitated the evolution of millions of species with idiosyncratic anatomy, physiology, behavior and ecology but also with many shared traits and tradeoffs that reflect the single origin and universal rules of life.

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