

What is the status of metabolic theory one century after Pütter invented the von Bertalanffy growth curve?

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Abstract

Growth models are a fundamental aspect of metabolic theory but remain controversial. It is a century since the first theoretical model of growth was put forward by Pütter. His insights were deep, but his model ended up being attributed to von Bertalanffy and his ideas largely forgotten. Here I review Pütter's ideas and trace their influence on existing theoretical models for growth and other aspects of metabolism, including those of von Bertalanffy, the Dynamic Energy Budget (DEB) theory, the Gill-Oxygen Limitation Theory and the Ontogenetic Growth Model (OGM). I then synthesise, compare and critique the ideas of the two most comprehensive theories, DEB and the OGM, in relation to Pütter's original ideas, and discuss how these theories have been used to explain 'macrometabolic' patterns including the scaling of respiration, the temperature size rule (first modelled by Pütter), and the connection to life history. Although theoretical work on growth and metabolism has generally proceeded in an un-coordinated and disconnected fashion, significant progress has been made and it has been built upon the original and fundamental insights of Pütter. What we need now is a coordinated empirical research program to test the existing ideas and motivate new theoretical directions.

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