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Coordination of size-control, reproduction and generational memory in freshwater planarians XINGBO YANG, Department of Physics and Astronomy, Northwestern University, KELSON KAJ, Department of Physics, University of California San Diego, DAVID SCHWAB, Department of Physics and Astronomy, Northwestern University, EVA-MARIA COLLINS, Department of Physics, University of California San Diego — Uncovering the mechanisms that control size, growth, and division rates of systems reproducing through binary division means understanding basic principles of their life cycle. Recent work has focused on how division rates are regulated in bacteria and yeast, but this question has not yet been addressed in more complex, multicellular organisms. We have acquired a unique large-scale data set on the growth and asexual reproduction of two freshwater planarian species, Dugesia japonica and Dugesia tigrina, which reproduce by transverse fission and succeeding regeneration of head and tail pieces into new worms. We developed a new additive theoretical model that mixes multiple size control strategies based on worm size, growth, and waiting time. Our model quantifies the proportions of each strategy in the mixed dynamics, revealing the ability of the two planarian species to utilize different strategies in a coordinated manner for size control. Additionally, we found that head and tail offspring of both species employ different mechanisms to monitor and trigger their reproduction cycles. Finally, we show that generation-dependent memory effects in planarians need to be taken into account to accurately capture the experimental data.

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