Plasticity as Thermal Breadth

Introduction

In the previous document, I showed how outcrossed lines of Paramecium varied in their morphology and movement with temperature, how their growth rates changed with temperature, and how morphology and movement were associated with changes in growth rates within outcrossed lines. One hypothesis that we had that we did not find evidence for, however, was that the overall flexibility or magnitude of plasticity in morphology and movement among outcrossed lines would be related to their degree of plasticity in growth rate. In particular, we hypothesized that outcrossed lines with greater plasticity in morphology/movement across temperature would show less variable growth rates across temperature as, presumably, the morphological/behavioral changes could buffer their growth rate responses to temperature.

In these first analyses of plasticity in morphology/movement and growth, we used the overall magnitude of change in phenotypes as our measure of phenotypic plasticity across the temperature range (the maximum mean value across the temperatures minus the minimum mean value across the temperatures). There were some concerns, however, particularly for the growth rate tpc's, that this metric wasn't really capturing plasticity in the growth rates. In particular, one suggestion was that a better metric might be the thermal breadth – the range of temperatures over which at least some proportion of the maximum in performance is achieved (e.g. in our case, the range of temperatures over which an outcrossed line acheives a growth rate that is at least some proportion of its maximum growth rate). Furthermore, John had also mentioned looking at whether the area under the total curve was related to morphology/movement plasticity. Last, there were also some ideas about measuring plasticity of the morphology and movement variables differently. Specifically, one idea was to use the total amount of change in the phenotype and another was to use the amount of morphological/movement change that occurred between an anchor point (e.g. the thermal optimum (t_{opt} or the temperature at which the maximum of the tpc occurs)) and calculate the total amount of change between the say the edges of the temperature limits of the thermal breadth and the thermal optimum.

In this document, I will try to address these comments and perform analyses to look at whether any of these different definitions of plasticity provide us with a different answer than we arrived at previously.