



January 15, 2017

Dear *Evolution* Editorial Office,

Please find enclosed a manuscript entitled “Grow with the flow: a latitudinal cline in physiology is associated with more variable precipitation *Erythranthe cardinalis*” for consideration at *Evolution*.

Local adaptation to the environment is common, but we still do not understand 1) why certain traits evolve rapidly in response to selection while others do not, nor 2) what climatic factor(s) is/are responsible for shaping local adaptation. We first tested whether local adaptation is driven more by intrinsic differences in physiology or genotype-by-environment interactions using a controlled growth-chamber experiment simulating realistic climatic extremes experienced by our focal species, *Erythranthe cardinalis*. Next, we applied machine learning algorithms to identify putative climatic factors shaping trait variation. In doing so, we tested whether one or multiple climatic factors are most important, and whether trait variation is better explained by local climate or climate averaged over a neighborhood of populations connected through gene flow.

Across 16 populations spanning $>10^\circ$ latitude, we found a strong latitudinal cline in growth and photosynthesis, but remarkably little genotype-by-environment interactions in drought and temperature treatments. This suggests that intrinsic variation, but not genotype-by-environment underlie local adaptation to climate. We also found that interannual variation in precipitation and temperature best explained the latitudinal cline, especially when averaged over a climatic neighborhood.

We conclude that 1) intrinsic differences are more important than genotype-by-environment interactions for local adaptation to spatially heterogeneous environments; and 2) interannual variability and gene flow among nearby populations shape latitudinal clines in physiology. This tells us that physiological drought and temperature tolerance may be less labile than growth capacity, which may determine if and how species adapt to climate change. Furthermore, this work suggests that climatic variability over space and time, as opposed to the average local climate, determines latitudinal variation in selection.

Thank you for your strong consideration of this manuscript.

Regards,

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