Explaining life history variation in a changing climate across a species' range

Timing of reproduction greatly influences offspring success and resulting population production. Explaining and predicting species' dynamics necessitates disentangling the intrinsic (genotypic) and extrinsic (climatic) factors controlling reproductive timing. Here we explore temporal and spatial changes in spawning time for 21 populations of Atlantic cod (Gadus morhua) across the species' range (40 degrees to 80 degrees N). We estimate spawning time using a physiologically relevant metric that includes information on fish thermal history (degree-days, DD). First, we estimate spawning DD among years (within populations) to show how recent changes in spawning time can be explained by local changes in temperature. Second, we employ spawning DD to identify temperature-independent trends in spawning time among populations that are consistent with parallel adaptive evolution and the evolutionary history of the species. Finally, we use our results to estimate spawning time under future climate regimes, and discuss the implications for cod ecology across the species' range.

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