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Population differentiation and life history diversification: rapid and small scale?

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Abstract

Classically, ecological and evolutionary time was assumed to be orders of magnitude different, indicating that contemporary evolutionary processes were difficult to observe and study. There has, however, been a major shift in the way the time scales of these two processes are viewed, and now it is clear that they can occur at comparable timescales. Freshwater fish populations are often differentiated due to complex landscape leading to reduced connectivity and limited gene flow. This structuring can lead to significant levels of local adaptation. Here, I will present data from a long-term study on lake-living and stream-spawning grayling *Thymallus thymallus* in Norway. Grayling invaded a small sub-alpine lake in c. 1880, and has since then established numerous subpopulations in tributaries to the lake. These tributaries differ in spring water temperature, leading to large differences in spawning phenology among the sub-populations. Based on population genetic studies over several years we find significant isolation-by-distance genetic structure among sub-populations, but the sub-populations are clearly not in migration-drift equilibrium. Using common-garden experiments coupled with quantitative genetic and proteomic studies we show that several early life-history traits have become significantly differentiated among the sub-populations during the c. 25-30 generations that have elapsed since the populations were established. Using a set of climate and weather models we show that the divergence have developed during periods with very variable environmental conditions producing large temporal variation in the opportunity for gene flow among sub-populations. In order to understand how populations diverge and differentiate a range of methods and approaches are needed. Clearly, ecological and evolutionary change happens at the same time scale, and both ecological and evolutionary processes needs to be studied when trying to understand population dynamics and resilience.

Keywords: population genetics, local adaptation, rapid evolution, gene flow, climate

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