Diversity and Resilience—Planning Ahead

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In this era of increasing environmental variability, it is increasingly important to understand the resilience and stability of populations to these changes. Here I discuss collaborative projects that are related to the diversity and resilience of steelhead. We examined life-history diversity and its importance to stability for steelhead in the Skeena and Nass watersheds in northwestern British Columbia, Canada. We synthesized life-history information derived from scales collected from adult steelhead (N = 7227) in these watersheds across a decade. These migratory fishes expressed 36 different manifestations of the anadromous life-history strategy, with diversity in years spent in freshwater, the ocean, and the number of spawning events. Furthermore, different life-histories were differently prevalent through time and no life-history ever represented more than 45% of the population. These asynchronous dynamics among life-histories decreased the variability of the aggregated population so that it was >20% more stable than the stability of the weighted average of specific life-histories, evidence of a substantial portfolio effect. Year of ocean entry was a key driver of dynamics; the median correlation coefficient of abundance of life-histories that entered the ocean the same year was 3.6 times higher than the median pairwise coefficient of life-histories that entered the ocean at different times. Thus, steelhead life-history diversity can dampen fluctuations in population abundances. In addition, collaborations and modeling exercises also reveal the potential for rapid shifts in the expression of anadromy/residency, which may also influence the persistence of populations. Conserving genetic integrity and habitat diversity can enable a diversity of life-histories that increases stability to environmental variability. However, key challenges include unknown limits and trade-offs associated with this diversity and resilience, and how to manage and conserve for this resilience.