Developing a Framework for Assessing Adaptive Capacity Using Agent-Based Models

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Introduction

- Adaptive capacity of species can be understood by developing models to track local adaptation and phenotypic plasticity the across the landscape (Kremer et al. 2012).

- GxE's role in the creation of adaptive phenotypes needs to be understood for conservation and management (Naish and Hard 2008).
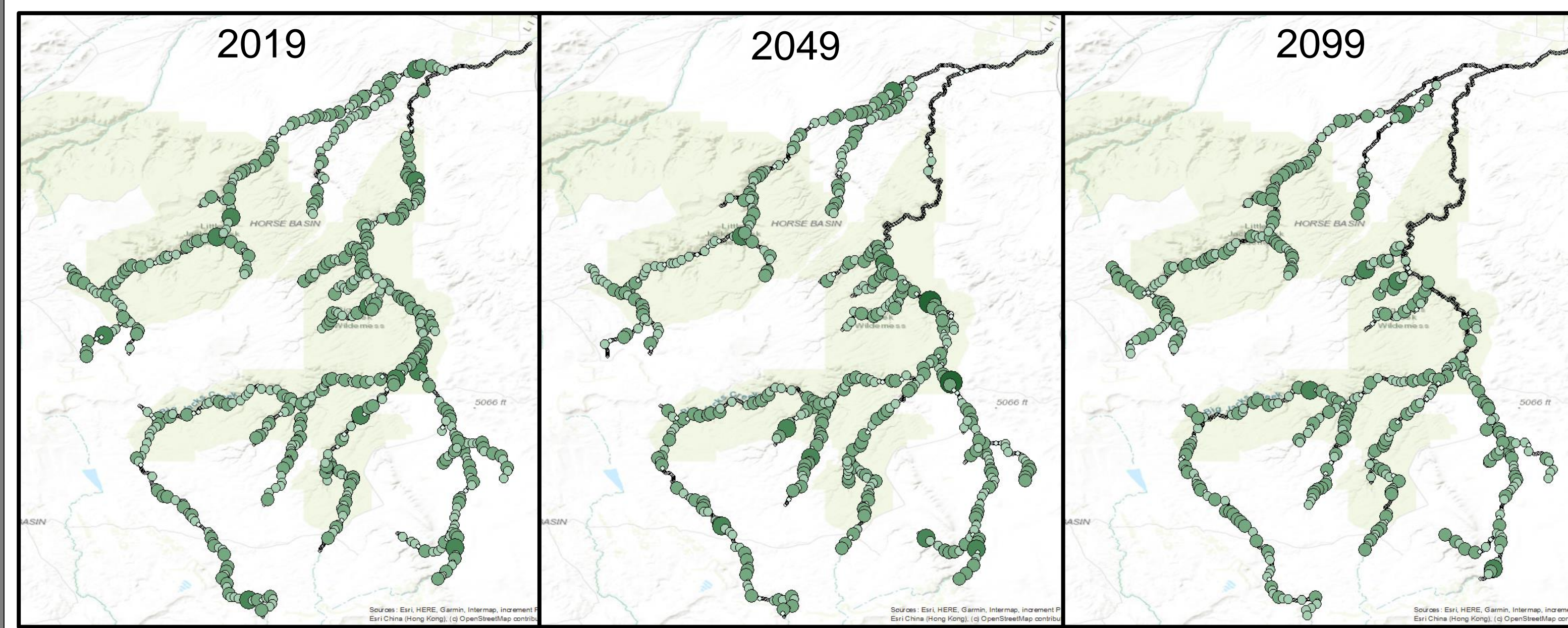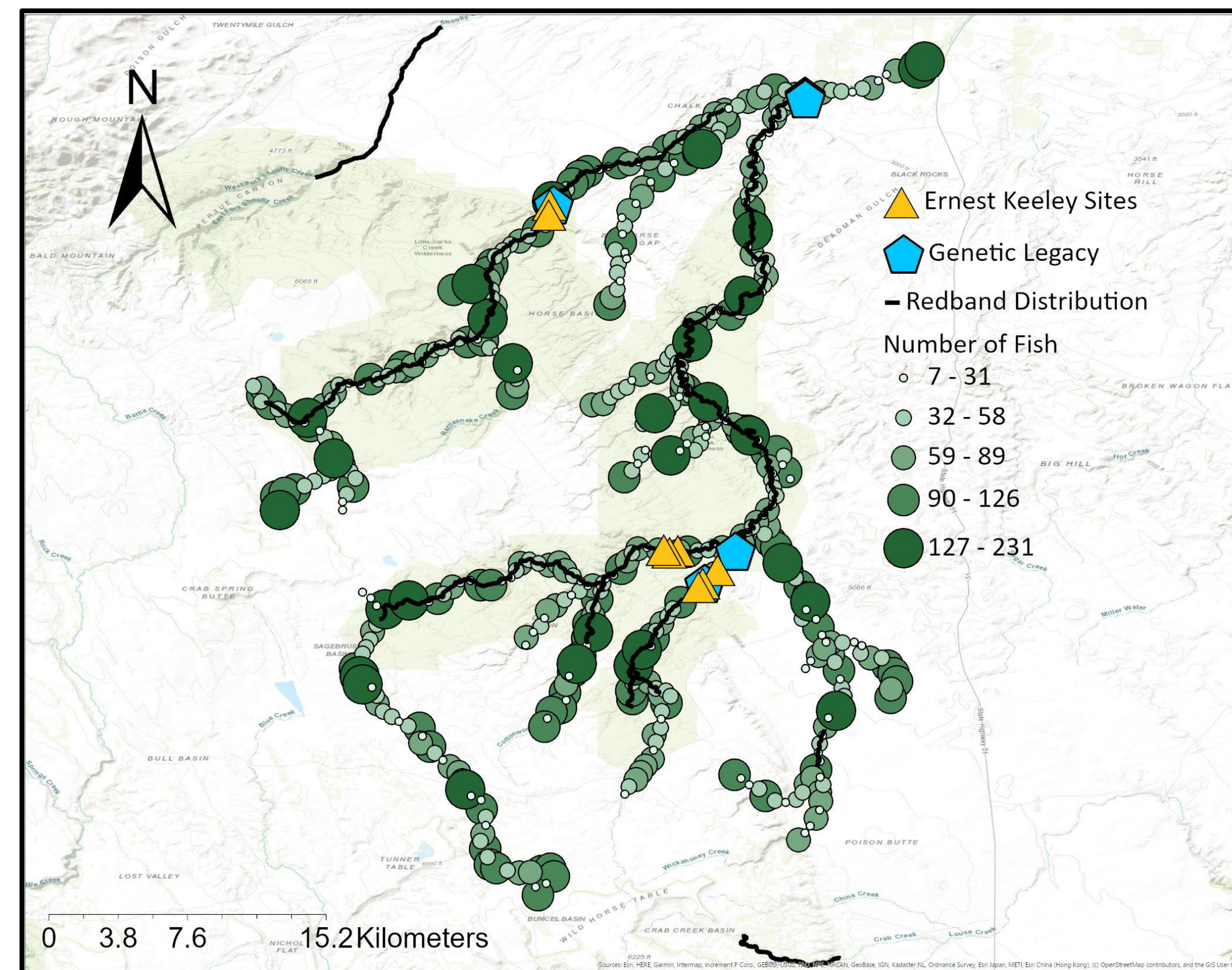
Research Goal

Understand how individual-level variation in genetics, plasticity, and the environment define the adaptive capacity of a species across the landscape

Approach: Spatially-explicit demographic-genetic models of individuals

Conceptual Model

CDmetaPOP (Landguth et al. 2016). Conceptual figure adapted from Day et al. 2018.

Climate Change Models

Right: Individual-based model output. Demographics only, using Jack's Creek as a template.

Below: With climate change. High mortality (0.8) during summer months if temperatures reach arrythmia-inducing levels of 20.6 average August temperature (Chen et al. 2018). Temperature data from Isaak et al. 2017.

Evolution Models

Right: Population size with adaptive allele and variation in stray rates under one strength of selection (0.1-1 mortality). Purple are climate change steps.

Below: Strength of selection and stray rates on allele counts and progress towards fixation of adaptive allele after starting at equal proportions

Next Steps And Collaboration With You

Model Construction:

o Incorporate genetically determined phenotypic plasticly

o Model with and without cost to loci

o Move away from single locus models
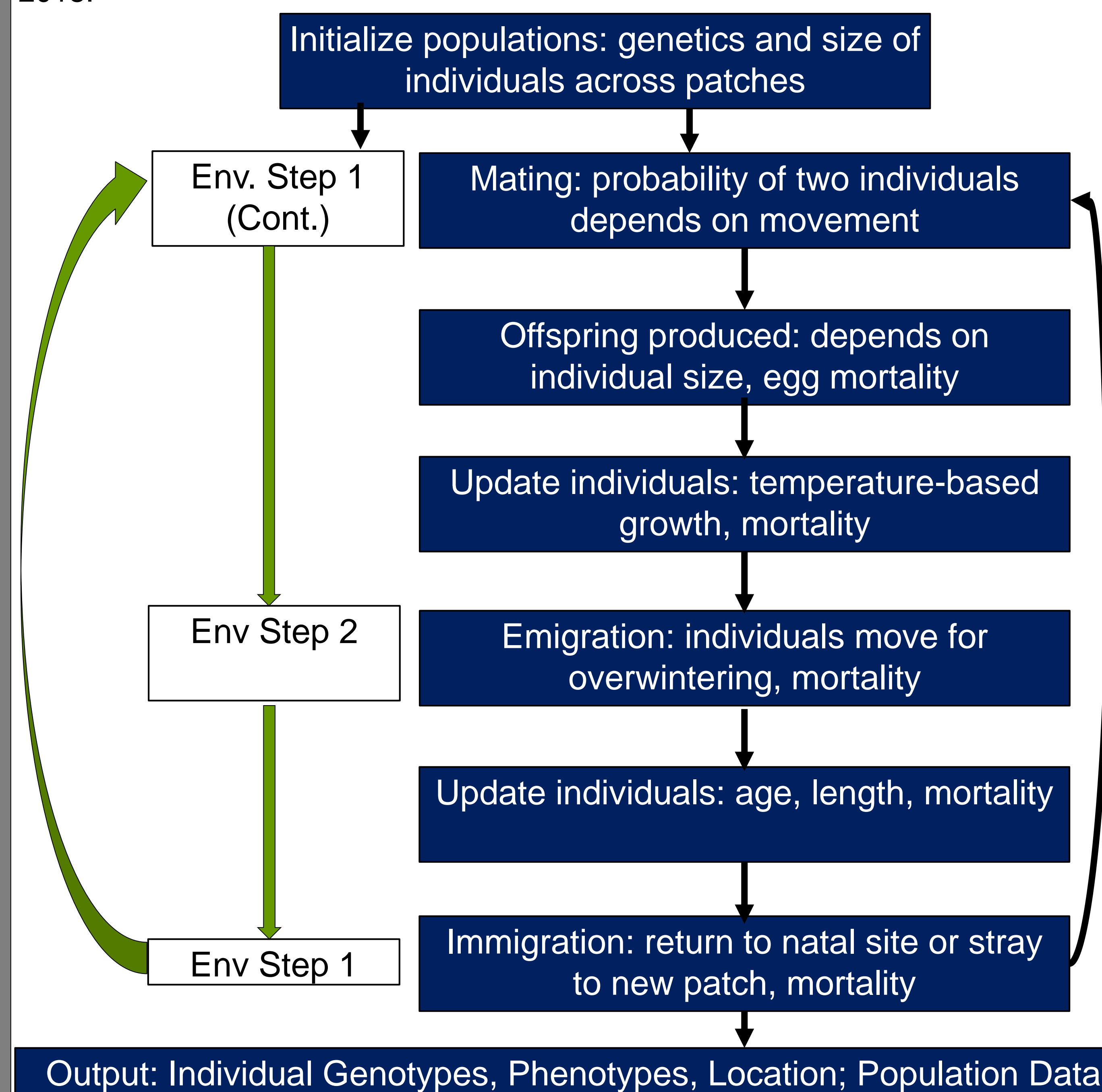
Model Refinement:

o **Landscape, traits, and demographics based on field measurements and observations**

o **Integrate growth and mortality data from common garden and field measurements**

o **Use landscape genomics and legacy samples to evaluate local adaptation and connectivity**

o **Incorporate refined climate change temperature data and models**

Model Application:

o Guide future sampling and data needs

o Expand model to new areas of redband trout and sagebrush habitat, such as Dry Creek, under different **SES Scenarios**

o Determine the sensitivity of the system to plasticity, adaptation, and environmental change.
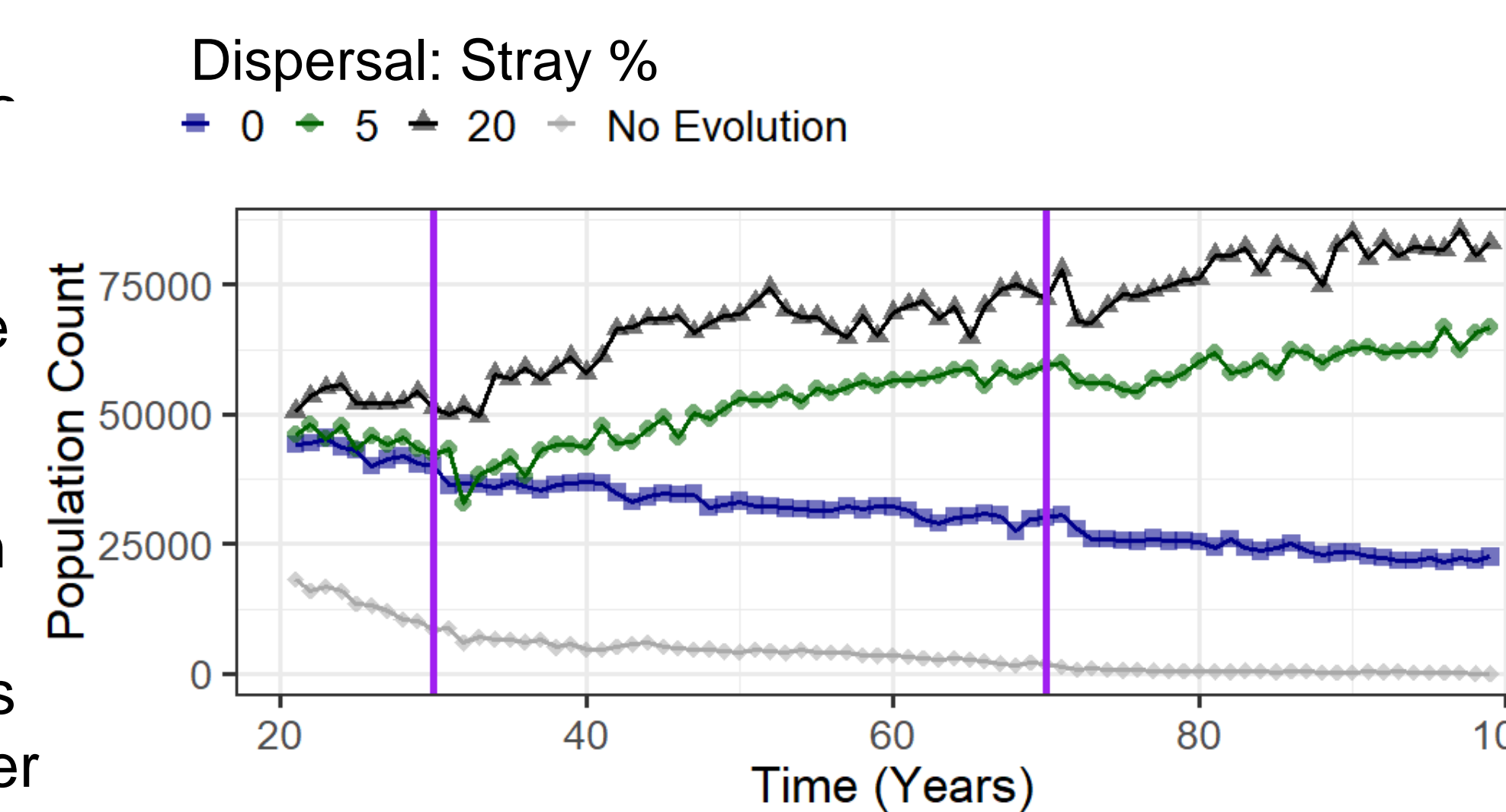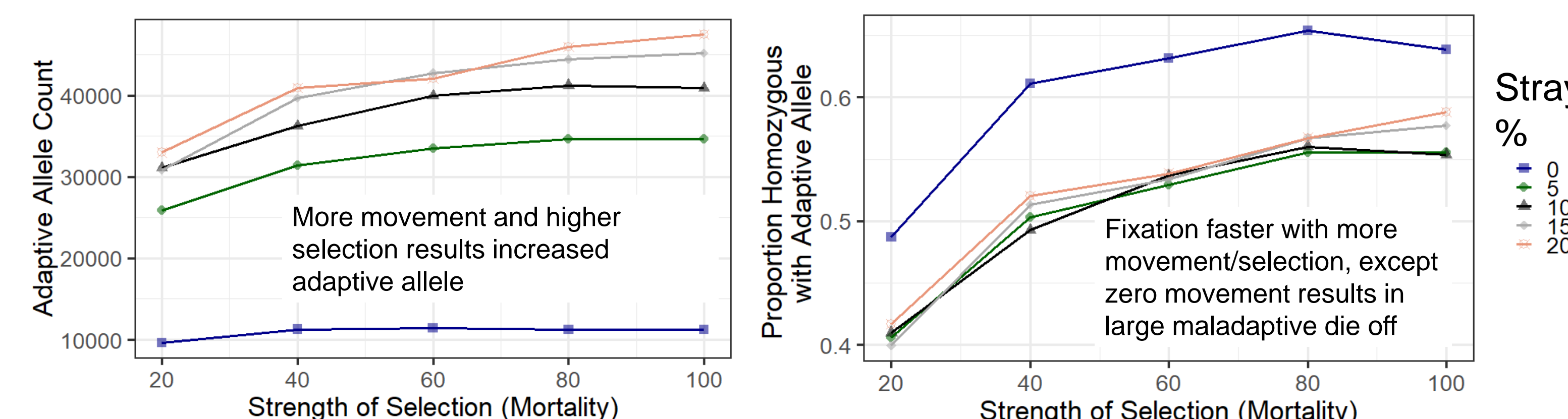
Acknowledgements and Literature

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