

Currents of connectivity: Riverscape genomics and population structure of a freshwater fish species (*Etheostoma caeruleum*)

Kyle E. Rufo & Zachery D. Zbinden



Study Area

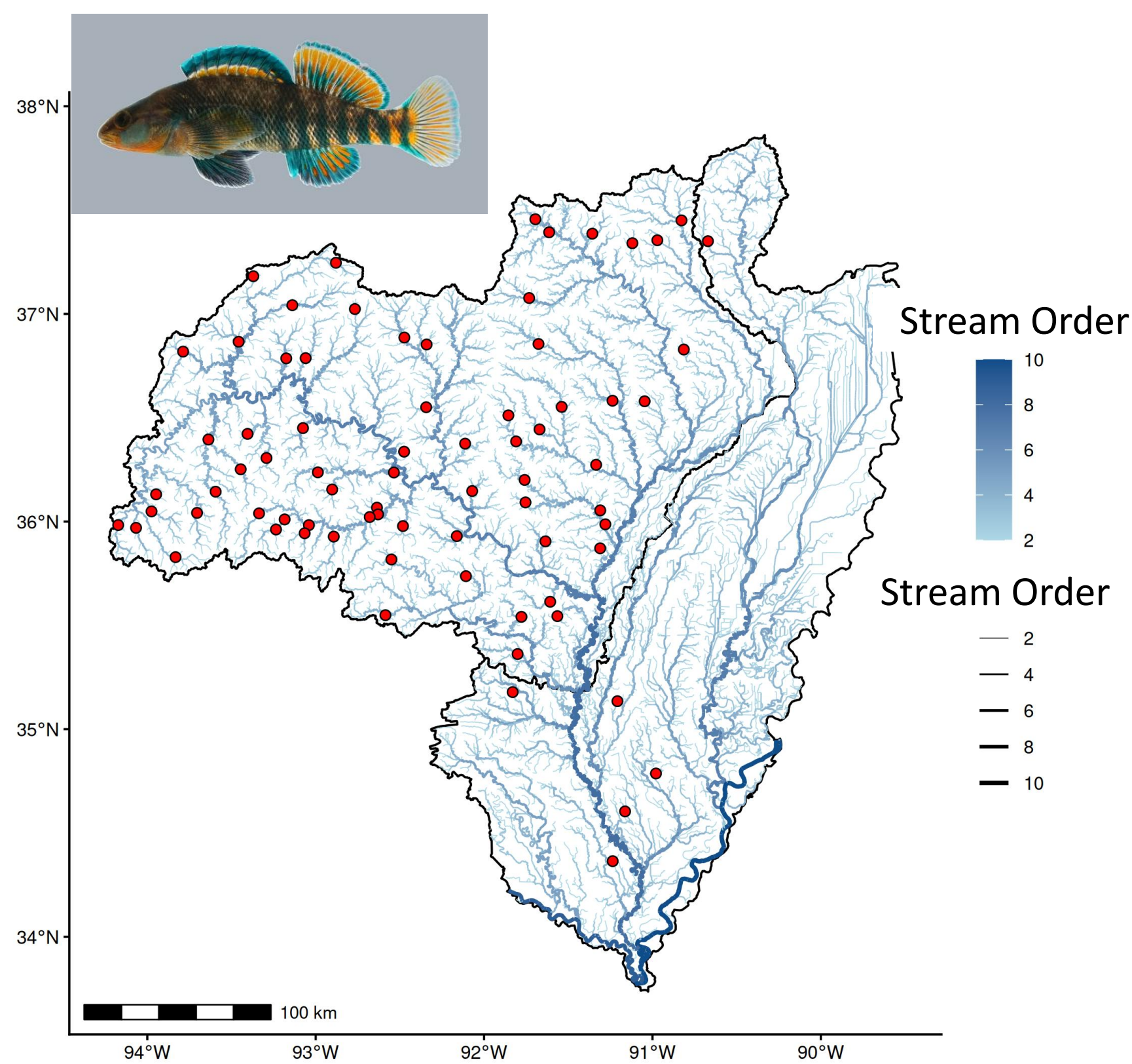


Figure 1. Study area map of the Upper White River basin, a tributary to the Mississippi River (bottom right) in the Ozark Highlands (Arkansas/Missouri, USA). Watershed boundaries are outlined in black. Stream segments are colored and sized by stream order (right legend). Sampling sites are represented by red circles. Study species, the Rainbow Darter (*Etheostoma caeruleum*) is pictured at the top left.

Diversity by Site

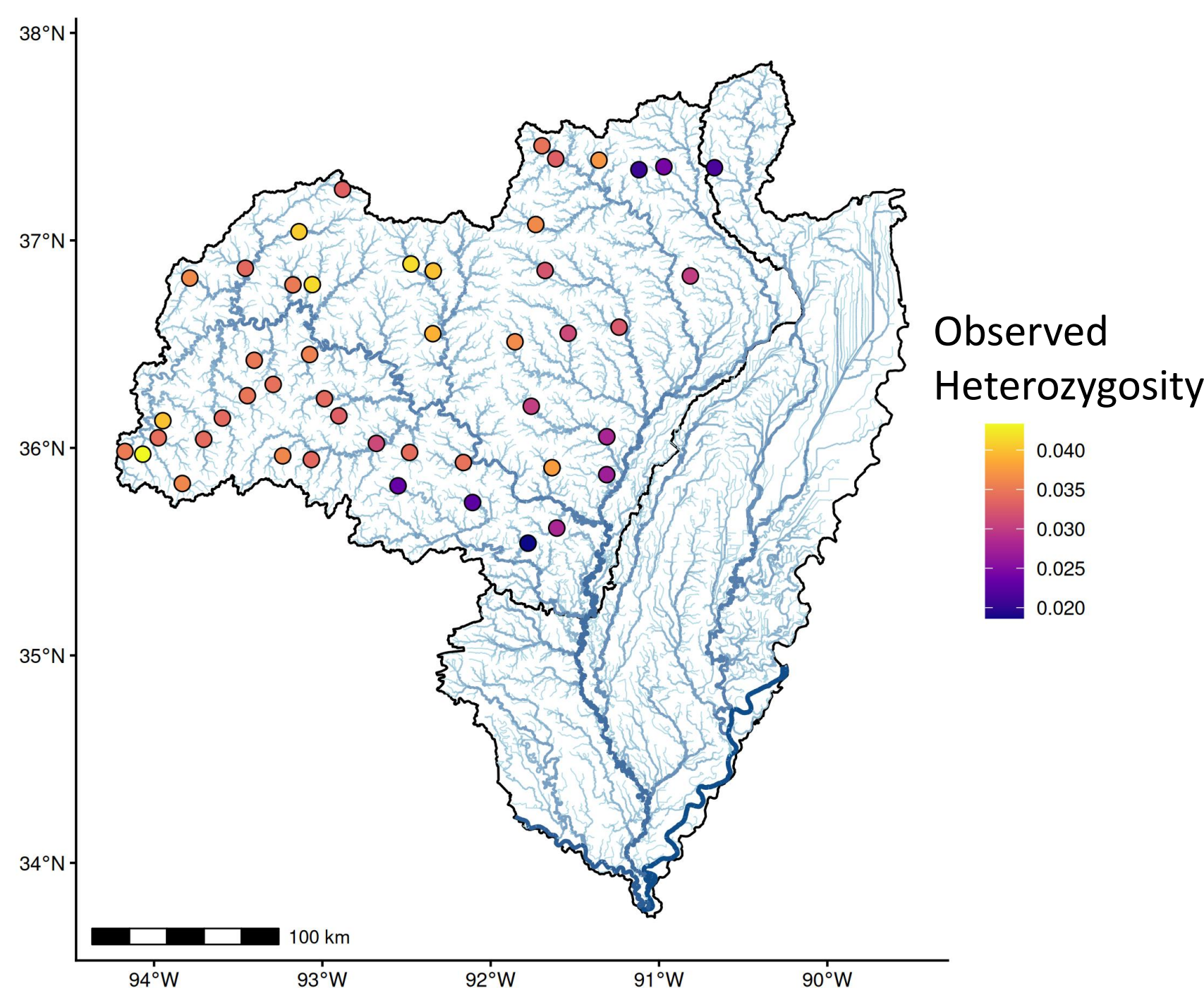


Figure 2. Study area map, as described in Fig. 1, with sampling sites colored by genetic diversity (right legend). Low genetic diversity (darker colors) are distributed to the northeast and south.

Population Structure

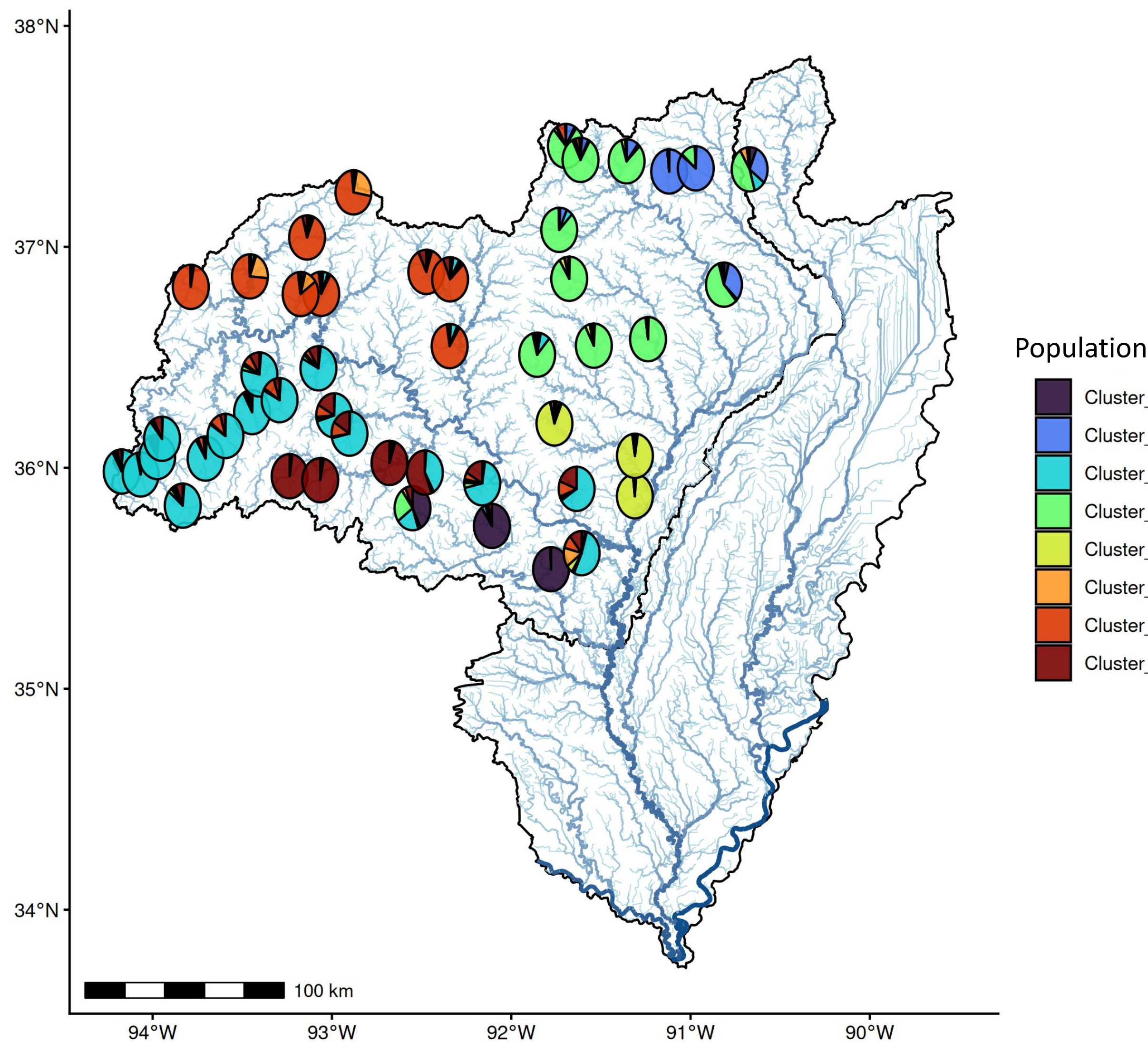


Figure 3. Study area map, as described in Fig. 1, with sampling sites colored by genetic population ($K = 8$, right legend). Pie charts represent individual assignment, based on sNMF ($K = 1:15$, $rep. = 20$, $a = 100$), to these genetic populations. Most sites assignment primarily to one population and populations are localized to certain sampling regions. While eight populations is most likely (based on minimal cross-entropy), populations (clusters) occur unevenly in the sampled individuals.

Main Takeaways

- 1) Strong genetic population structure is observed (Fig. 3)
- 2) This structure is influenced by gene flow (distance between sites and populations) in the study area (Fig. 3, 4)
- 3) Genetic diversity by site and by population follow similar trends. Low-diversity sites are grouped into low-diversity populations (Fig. 2, 5)

Distance and Gene Flow

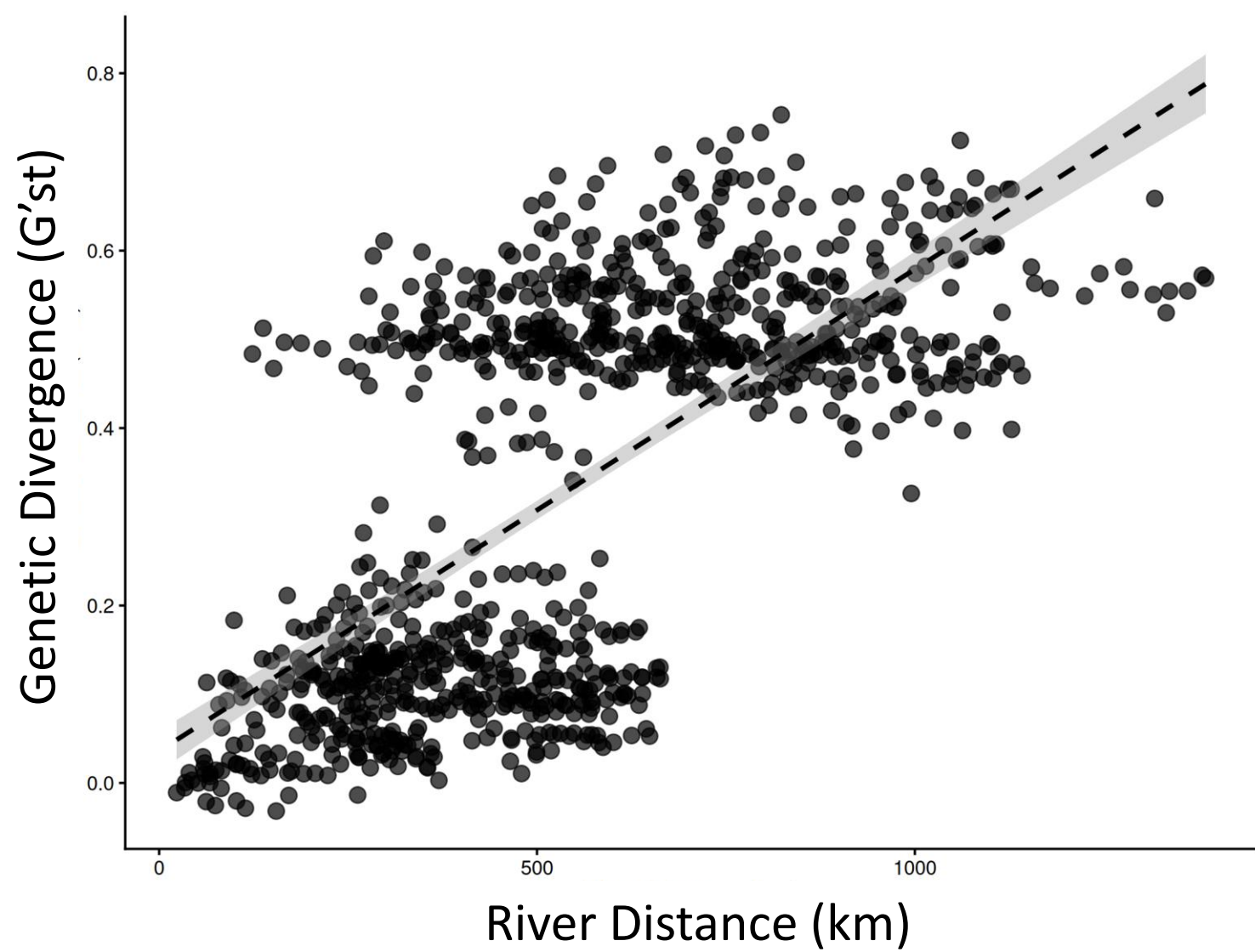


Figure 4. Isolation by distance of sample sites based on river distance and genetic divergence. Dashed trendline shows strong correlation, indicating that physical distance between sites explains genetic divergence. This trend is likely a result of gene flow dictating genetic composition of sampling sites.

Diversity by Population

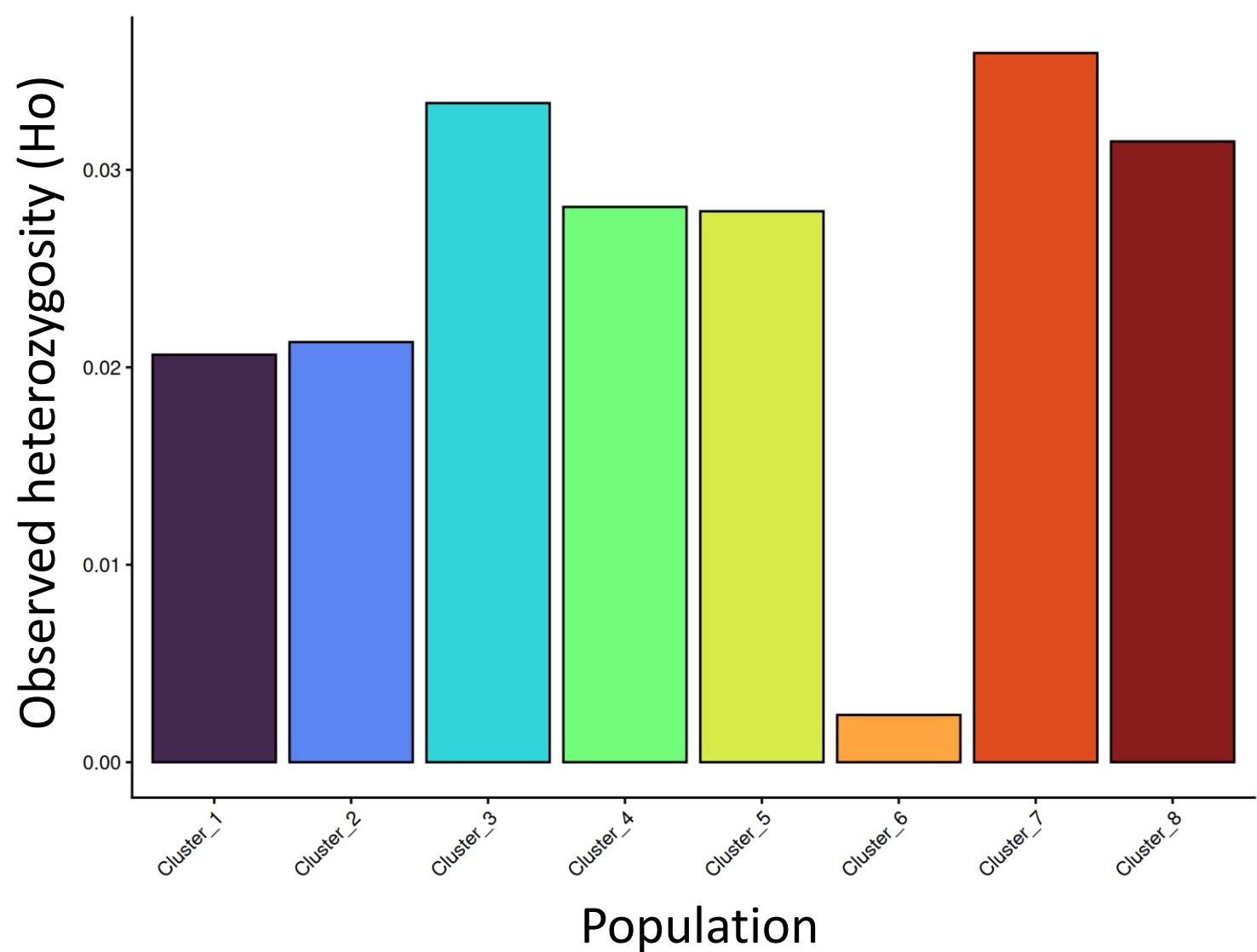


Figure 5. Genetic diversity by population, as described in Fig. 3. This is the same diversity measure used in Fig. 2. Bars are colored based on genetic cluster (Fig. 3). Populations 1, 2, and 6 have the lowest diversity, but 6 has only a few individuals that assign to it. Populations 1 and 2 are made up of sites that had low genetic diversity in Fig. 2.

Divergence by Population

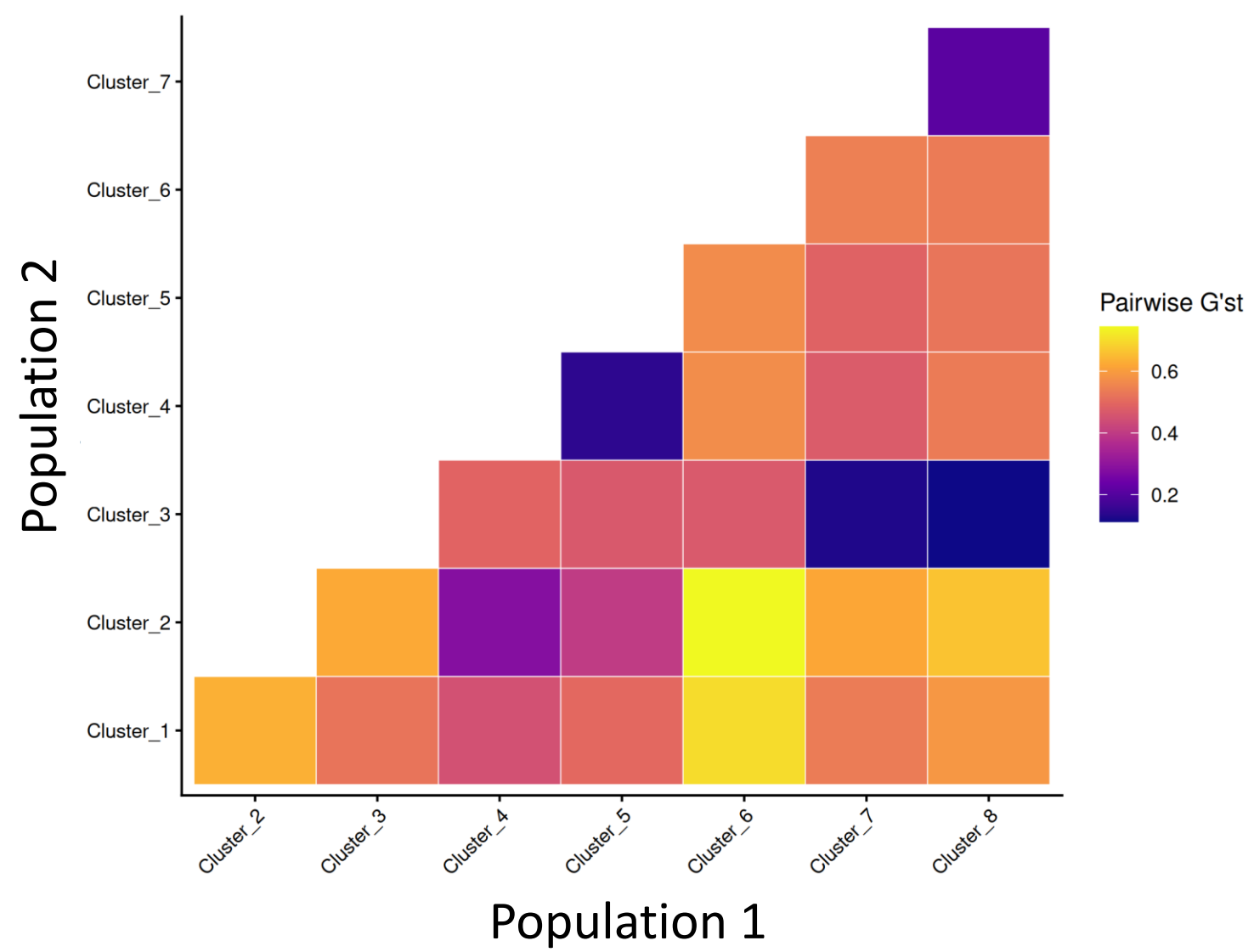


Figure 5. Genetic divergence by population, as described in Fig. 3. Light colors indicate greater genetic difference between populations, dark colors indicate the opposite (right legend). Heatmap matrix explains physical distribution seen in Fig. 3.