

Understanding adaptive capacity to thermal stress in brook trout



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Cold-water fishes are vulnerable to climate change



Habitat loss: ~53% of brook trout habitat in Southern Appalachians by 2080



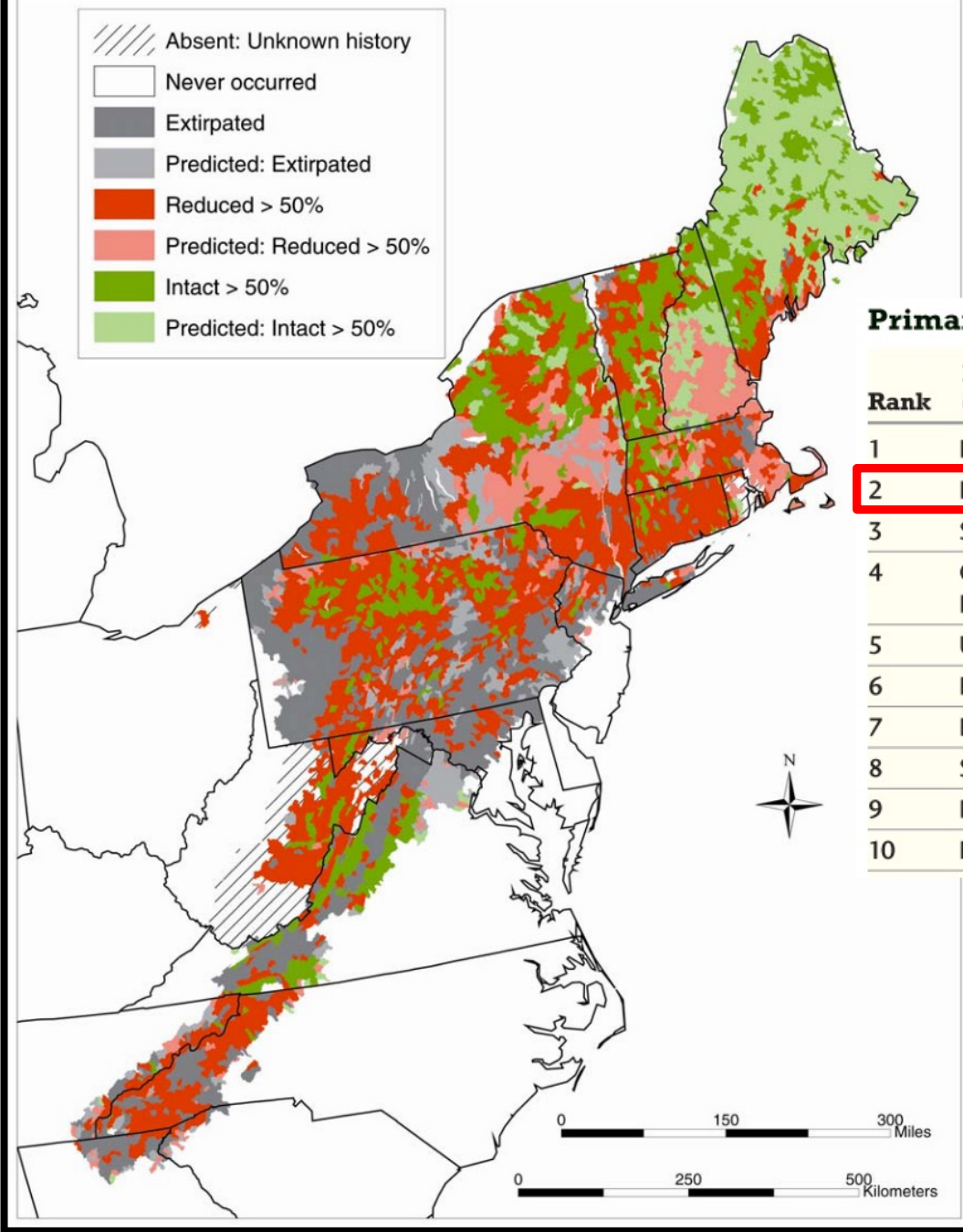
Habitat loss: ~58% of cutthroat trout habitat in Intermountain West

Population differences in response to environmental stress



1. Are there differences in response to heat stress over small spatial scales?
2. If so, what are the underlying causes of that difference?
3. Do the patterns we see at small scales translate to range wide patterns?

Eastern Brook Trout Joint Venture: Status and Threats Assessment



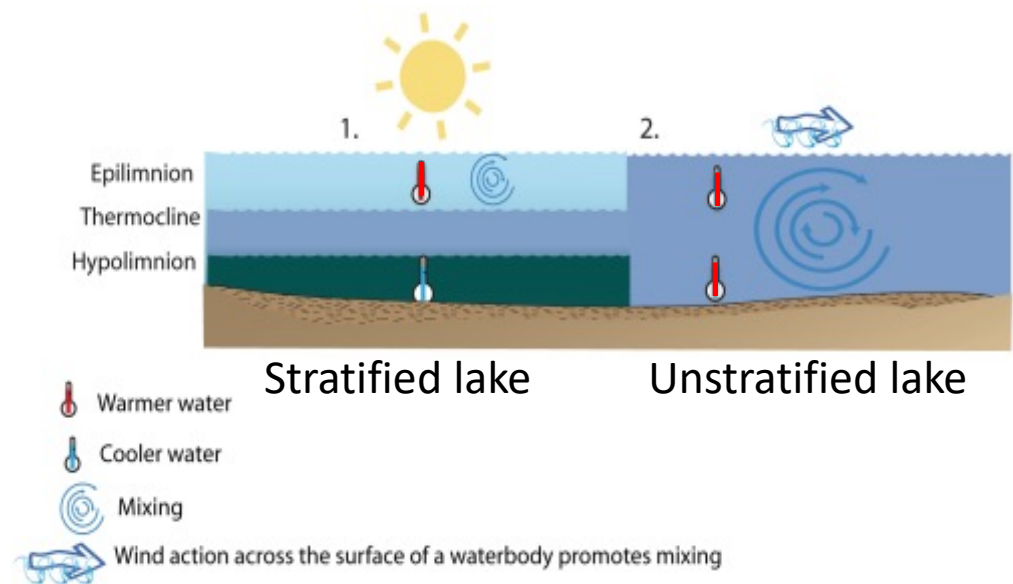
Primary Threats to Brook Trout

Rank	Disturbances (High or Medium)	Number of Subwatersheds	Percentage of Subwatersheds
1	Poor Land Management	1647	37%
2	High Water Temperature	1629	36%
3	Sedimentation (Roads)	1225	27%
4	One or More Non-Native Fish Species	1189	26%
5	Urbanization	1141	25%
6	Riparian Habitat	1029	23%
7	Brown Trout	853	19%
8	Stream Fragmentation (Roads)	767	17%
9	Dam Inundation/Fragmentation	705	16%
10	Forestry	642	14%

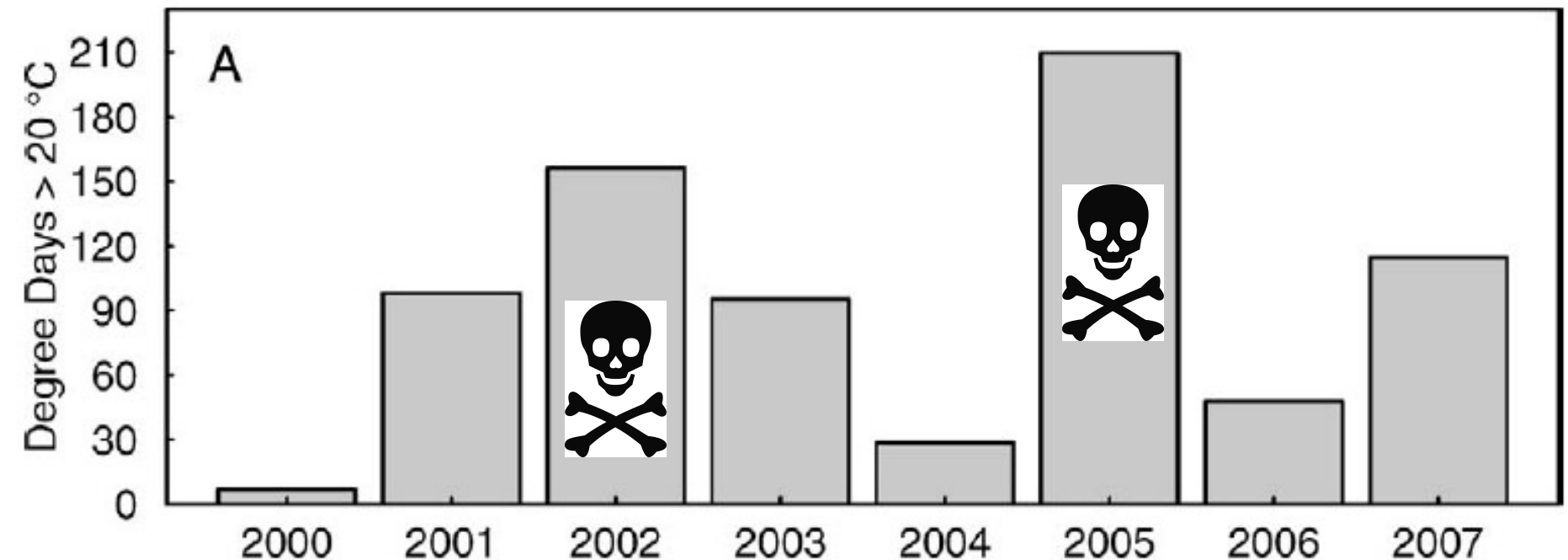
Brook trout in Adirondack Park



Brook trout in Adirondack Park

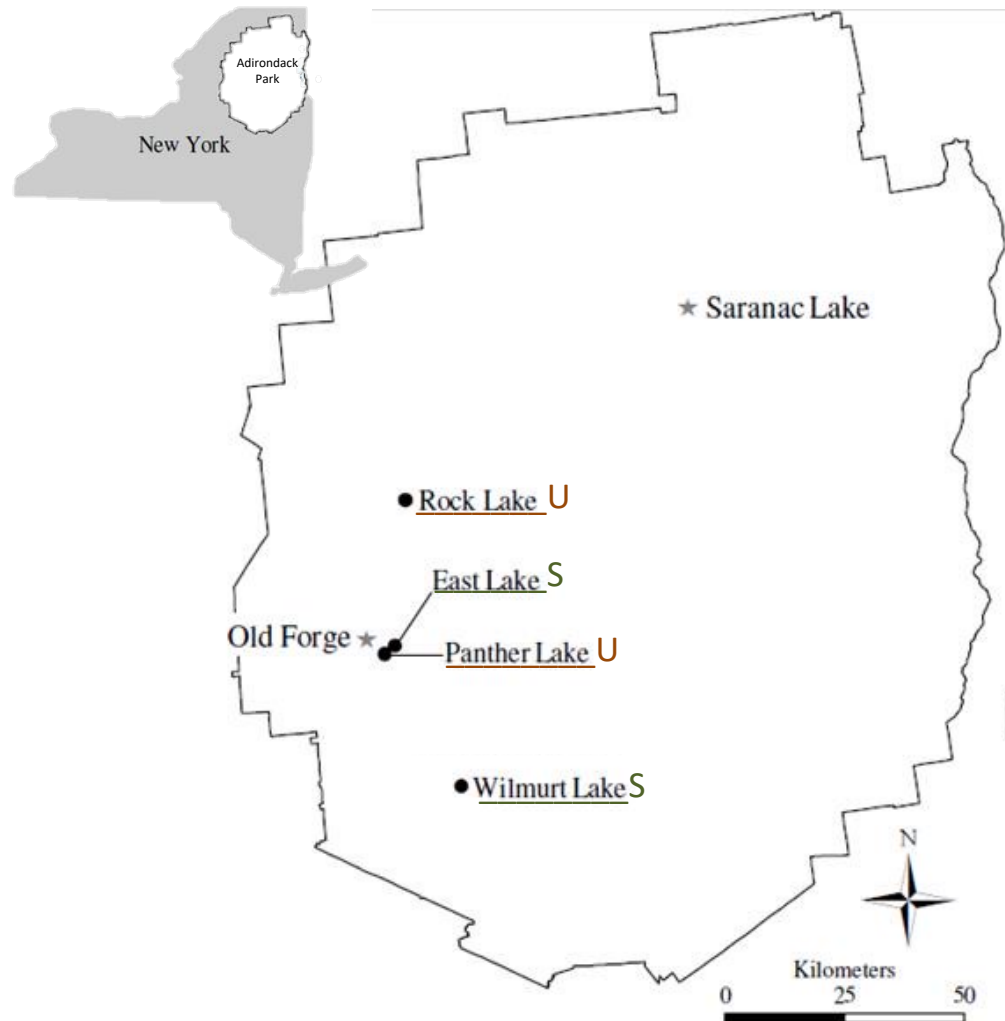


Brook trout in Adirondack Park

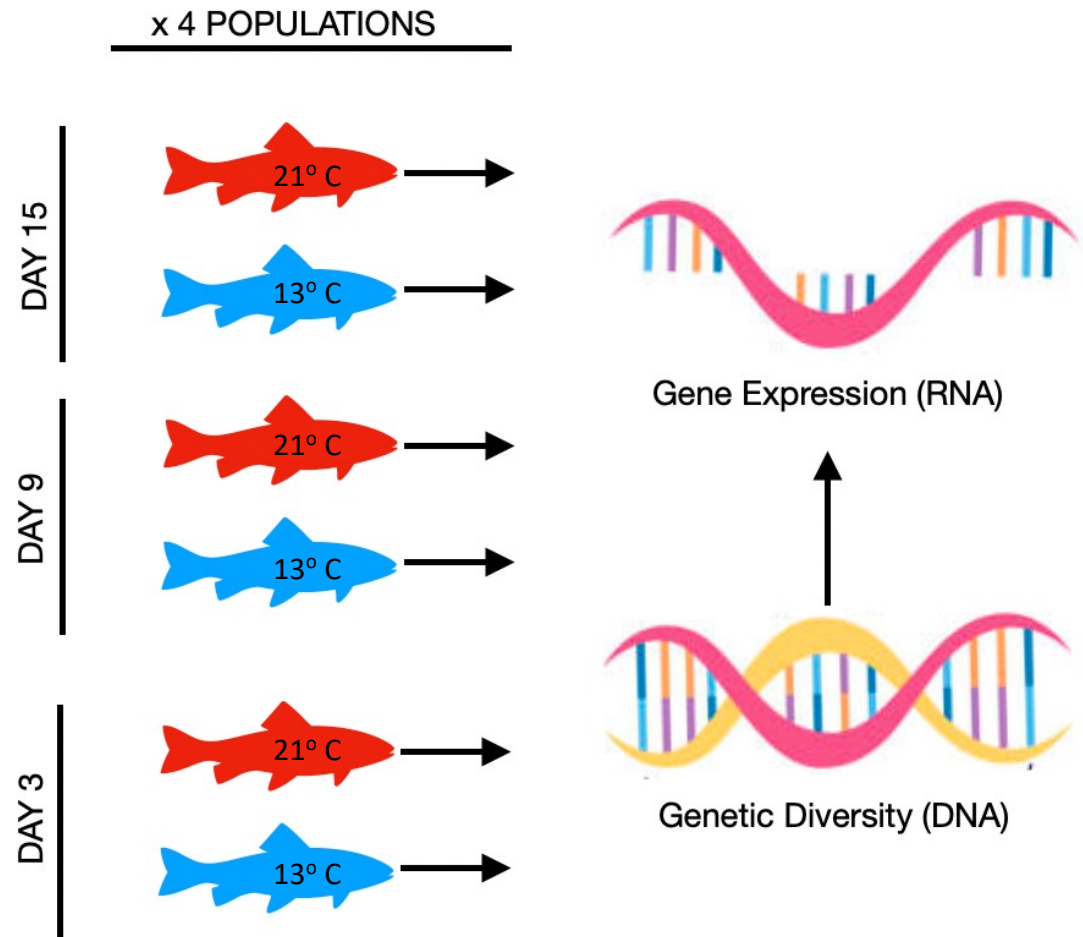


Robinson, Josephson, Weidel and Kraft 2010

Brook trout in Adirondack Park



Common garden experiment



Common garden experiment



1. Sequenced DNA and RNA

2. Evaluated population structure

SNP



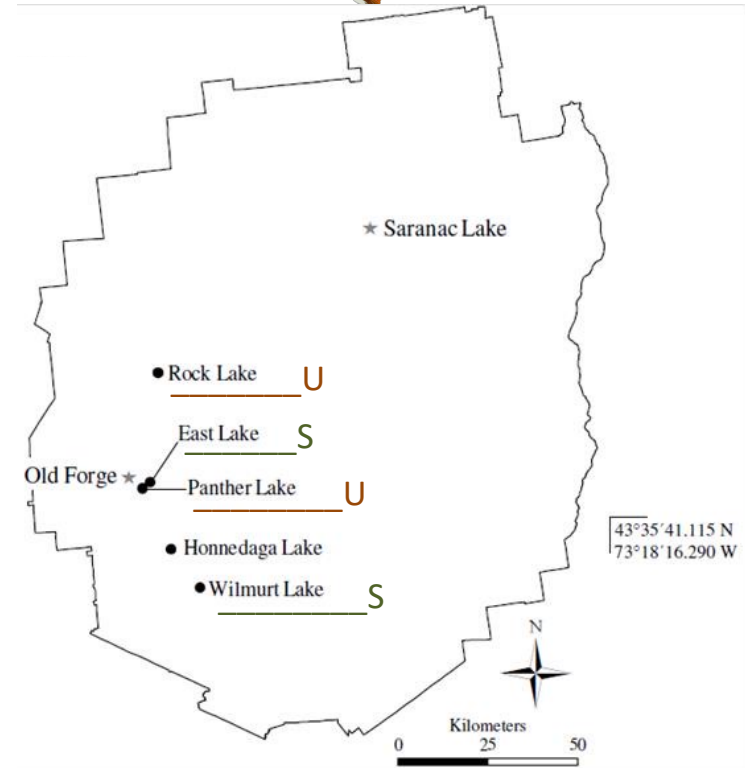
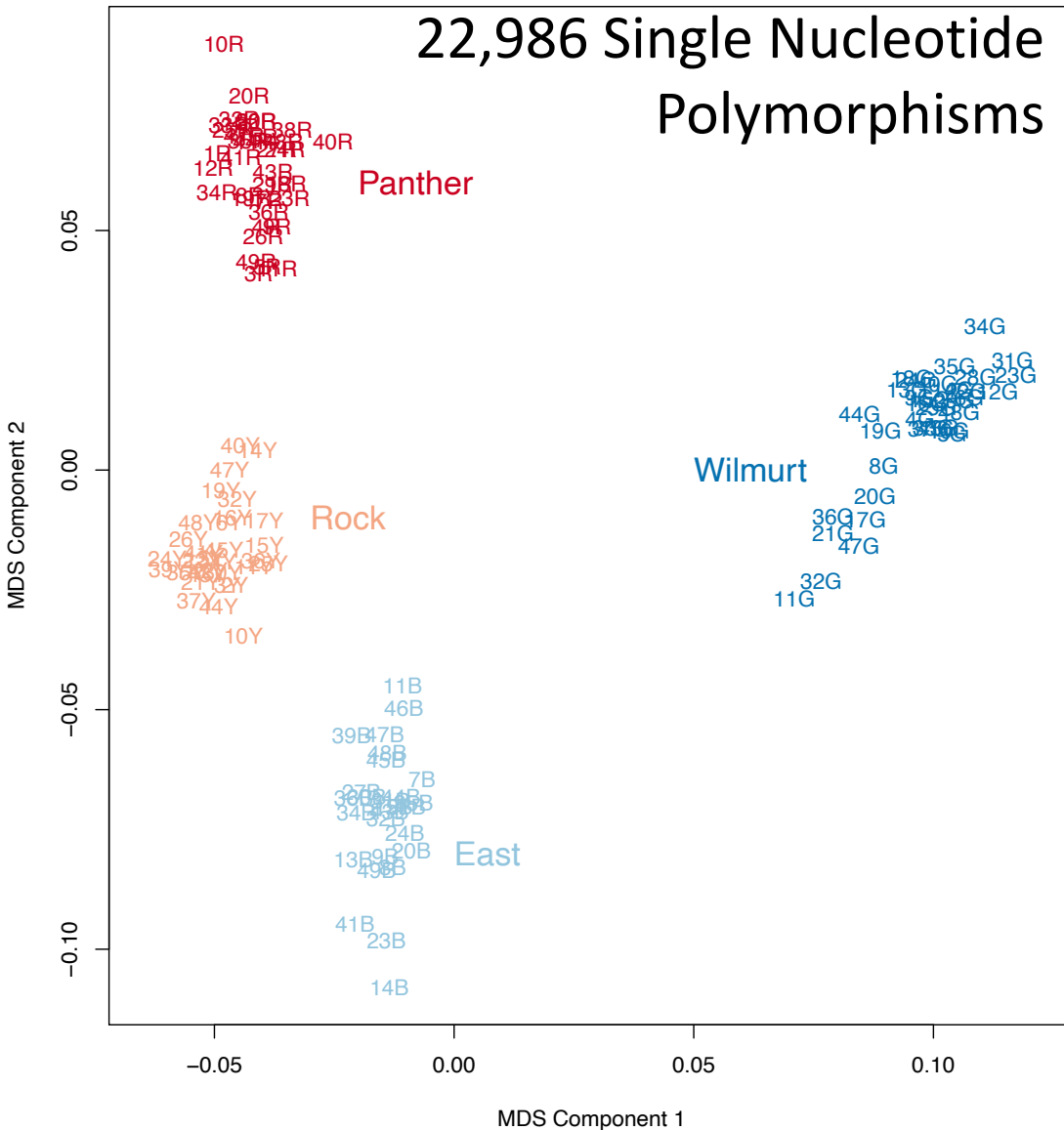
Individual 1: AACGCTTTGA**T**ATAGACTTG

Individual 2: AACGCTTTGA**C**ATAGACTTG

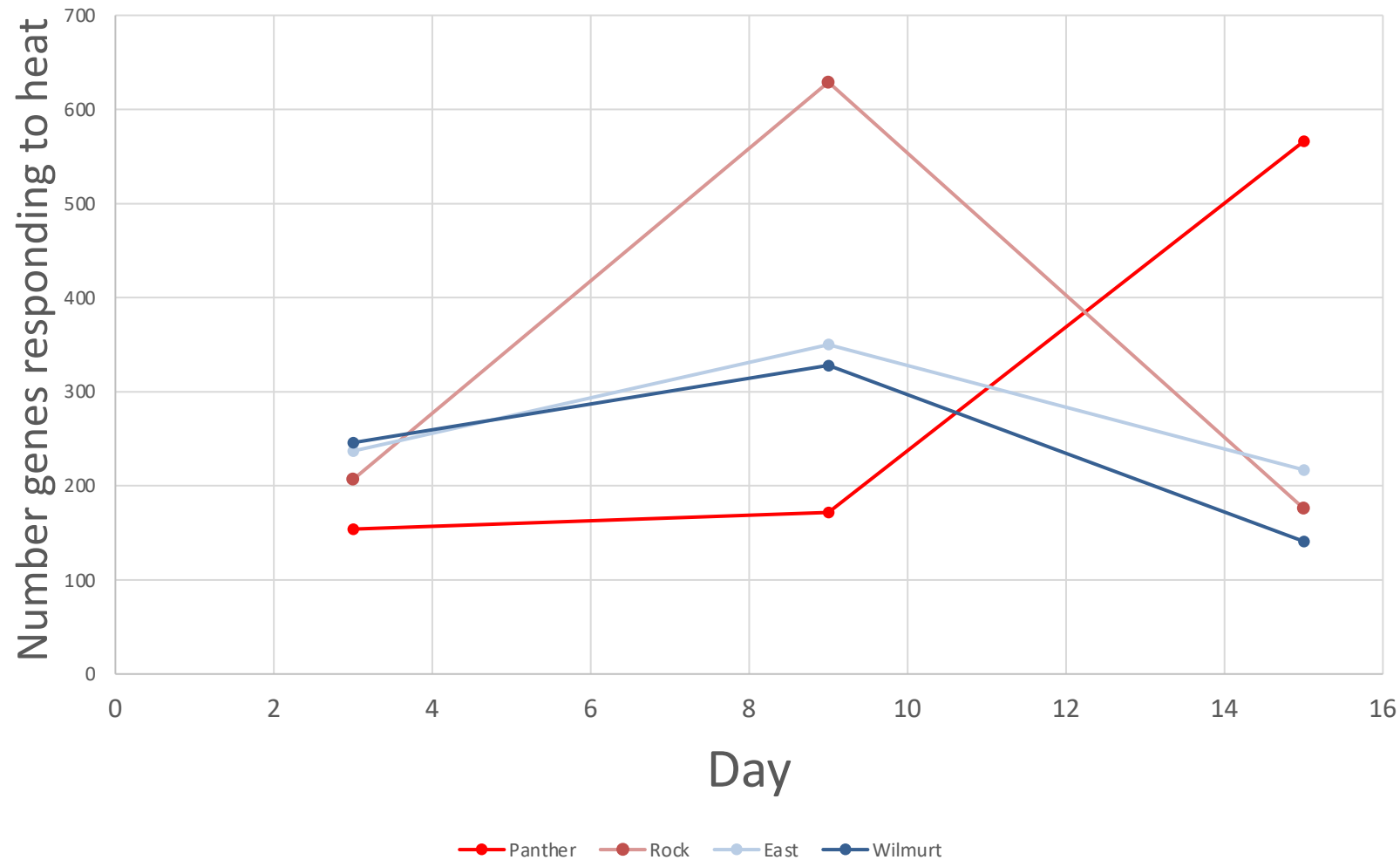
3. Analyzed RNA data for differences in gene expression patterns

4. Identified DNA changes associated with different gene expression patterns

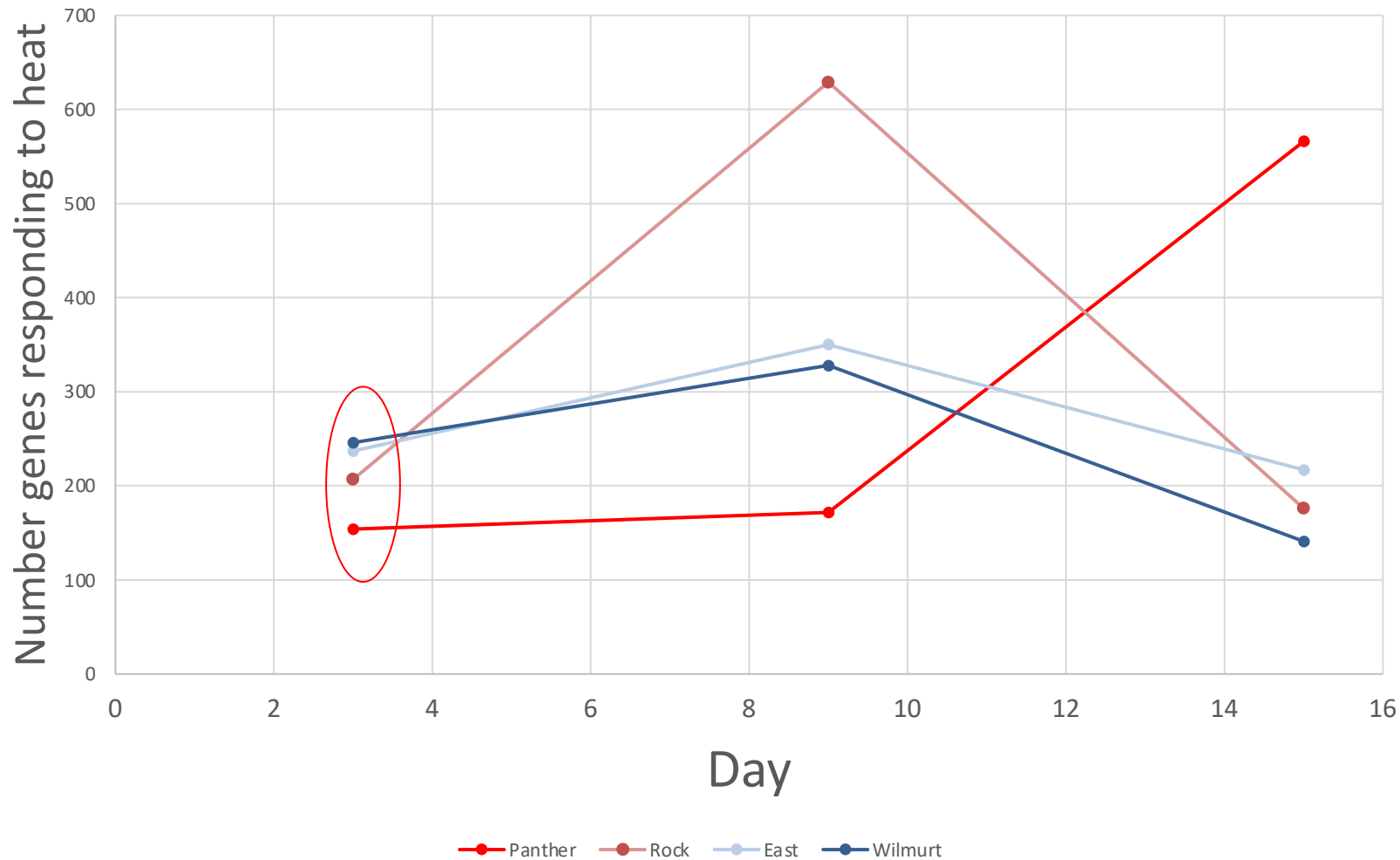
Populations are genetically distinct



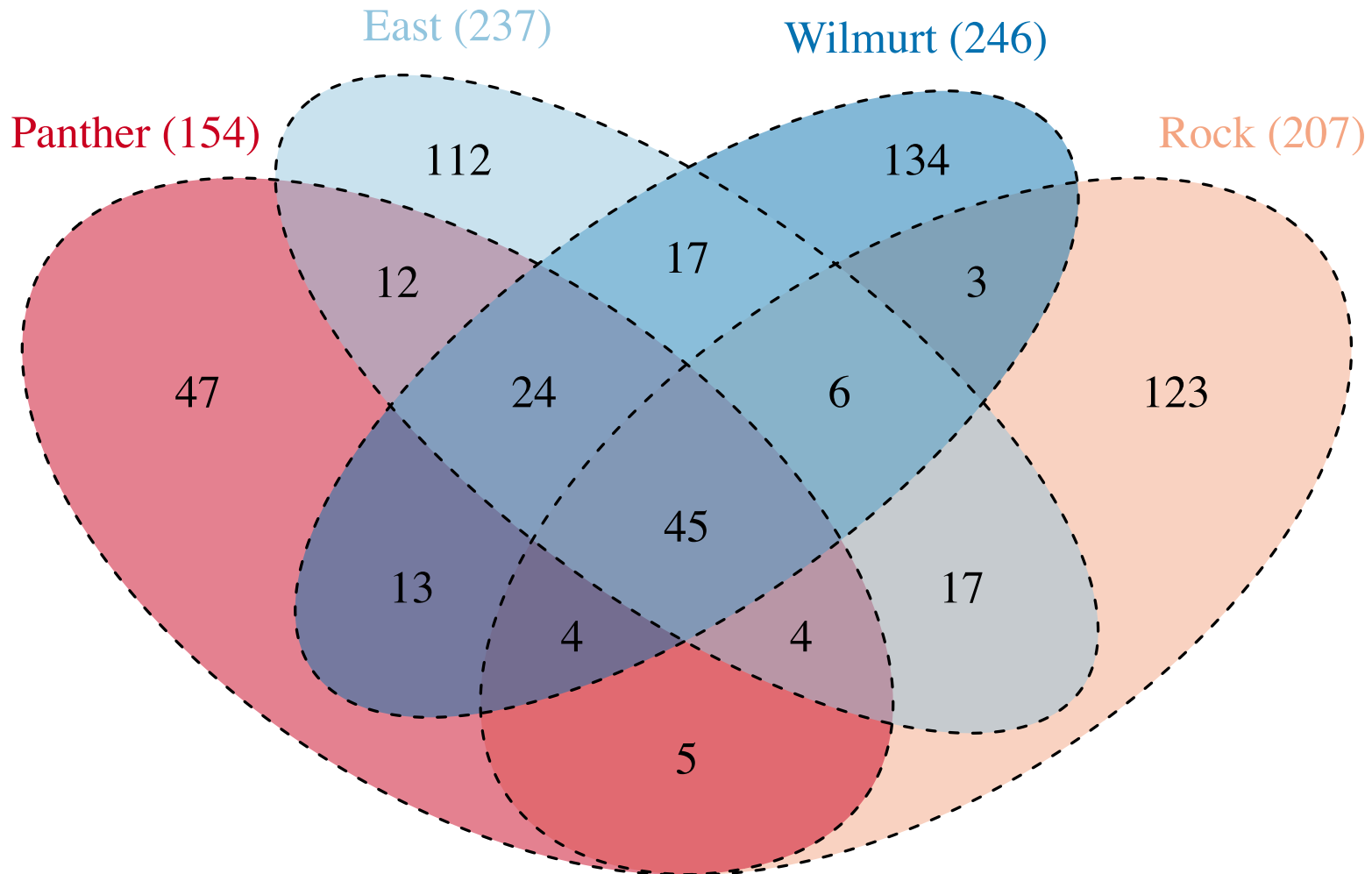
Populations show differences in gene expression patterns



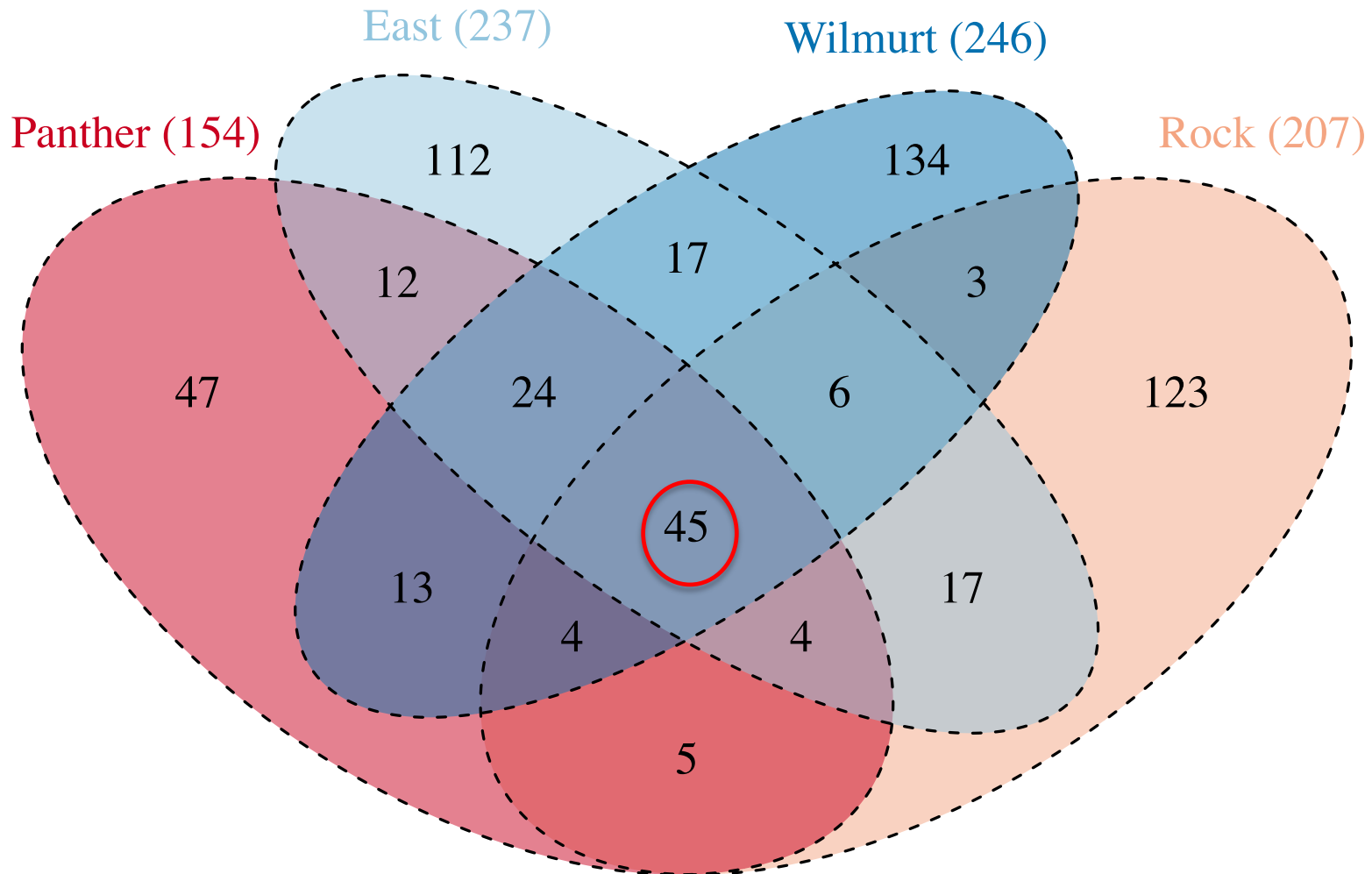
Populations show differences in gene expression patterns



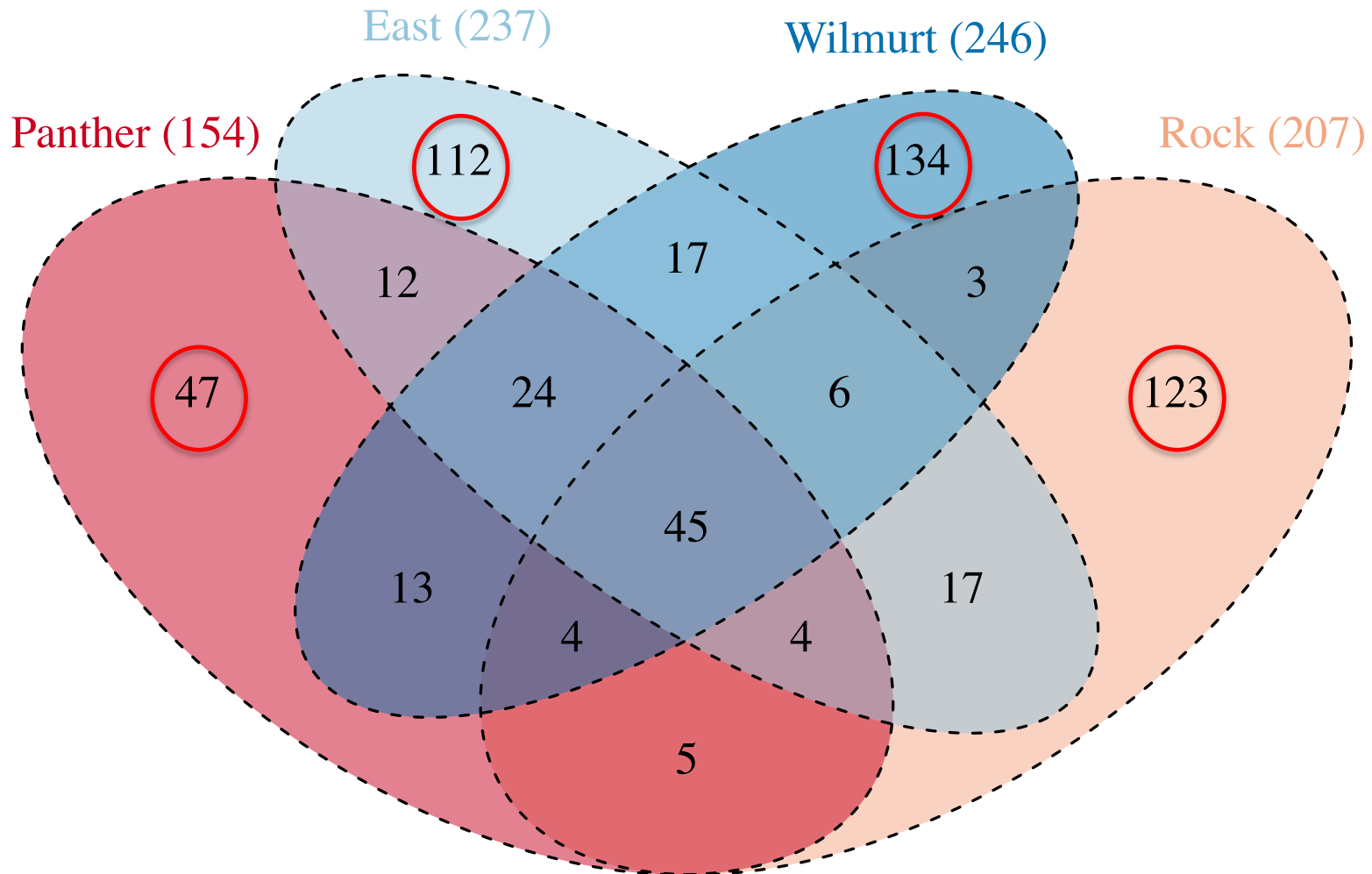
Populations show differences in gene expression patterns



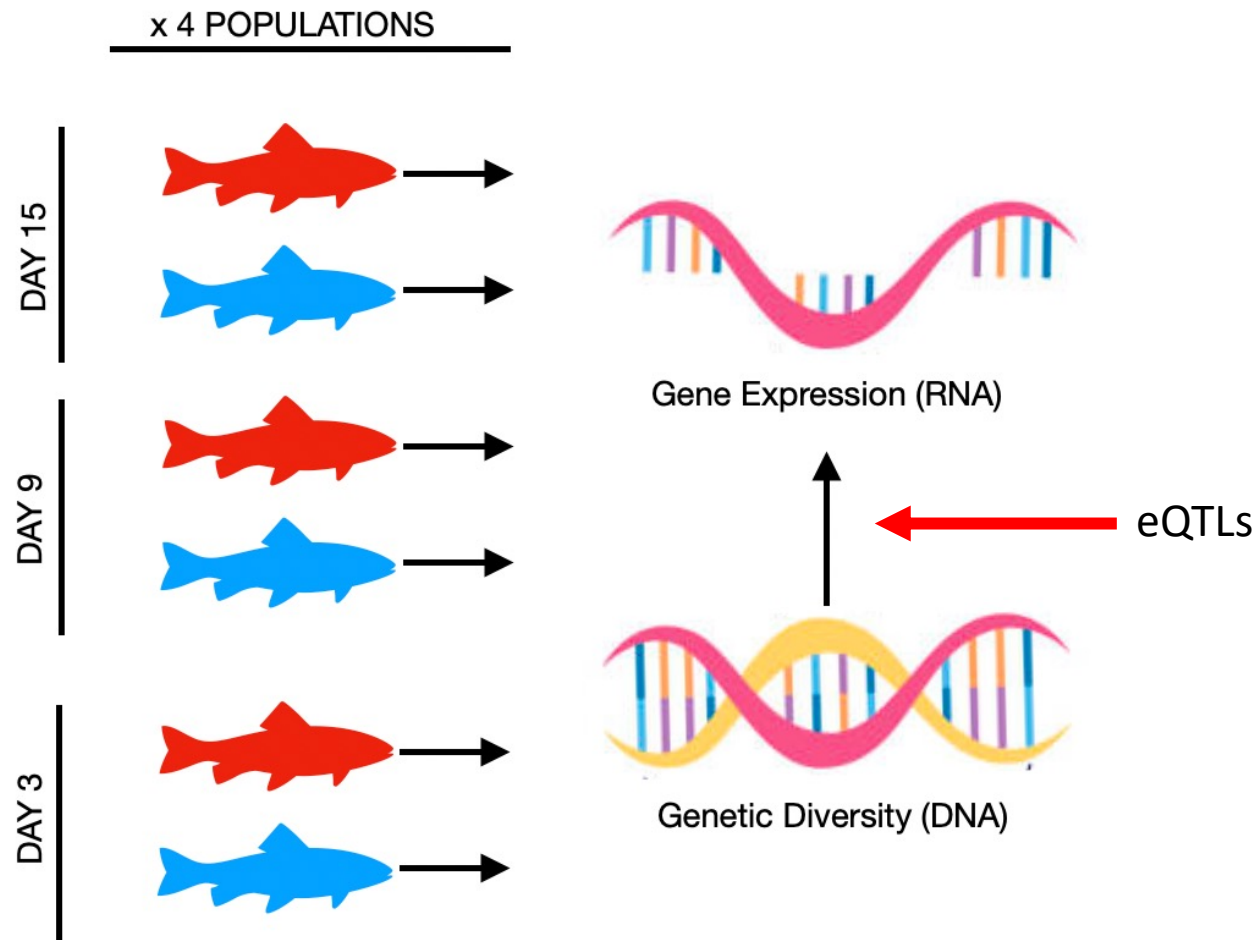
Populations show differences in gene expression patterns



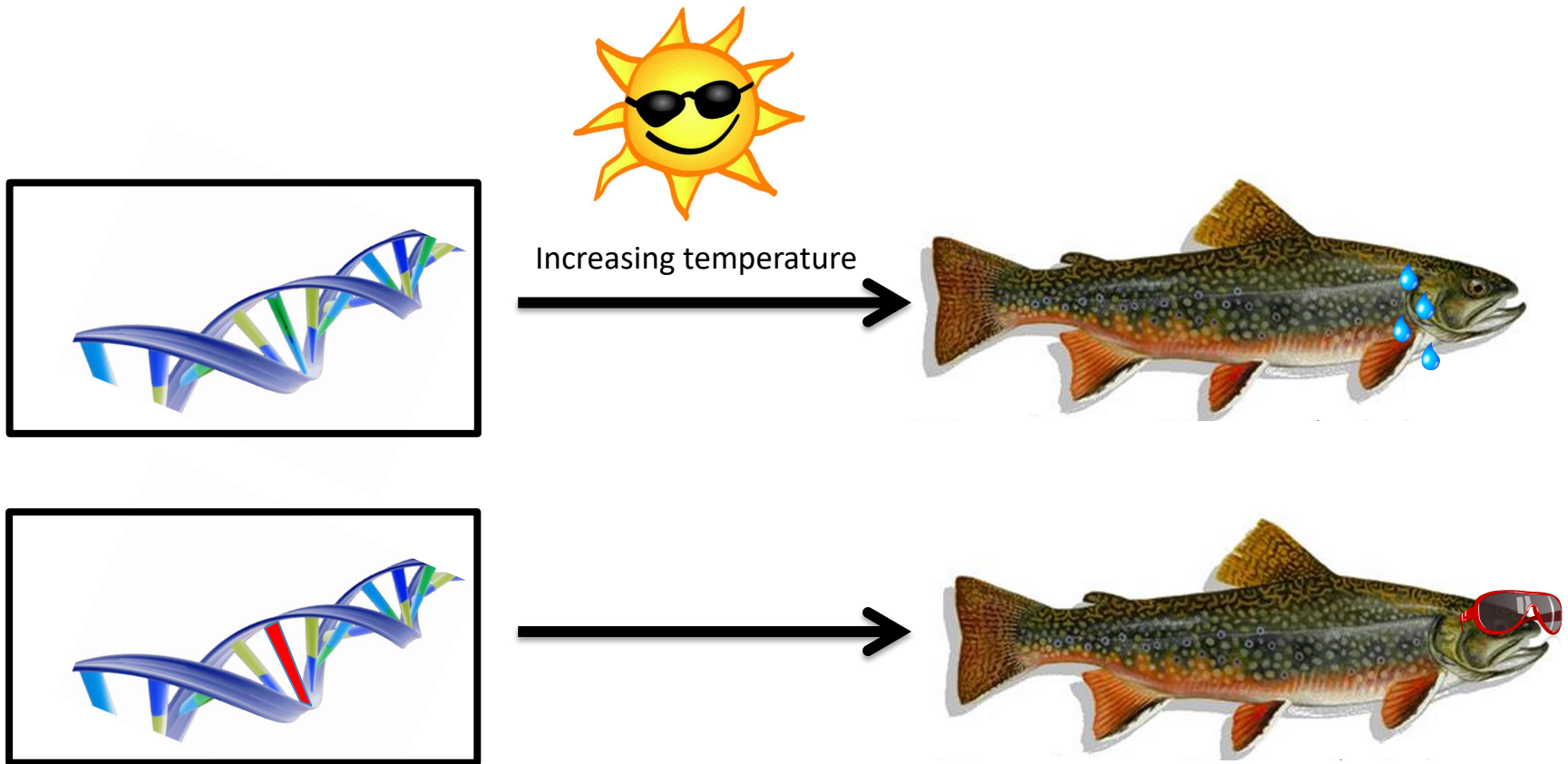
Populations show differences in gene expression patterns



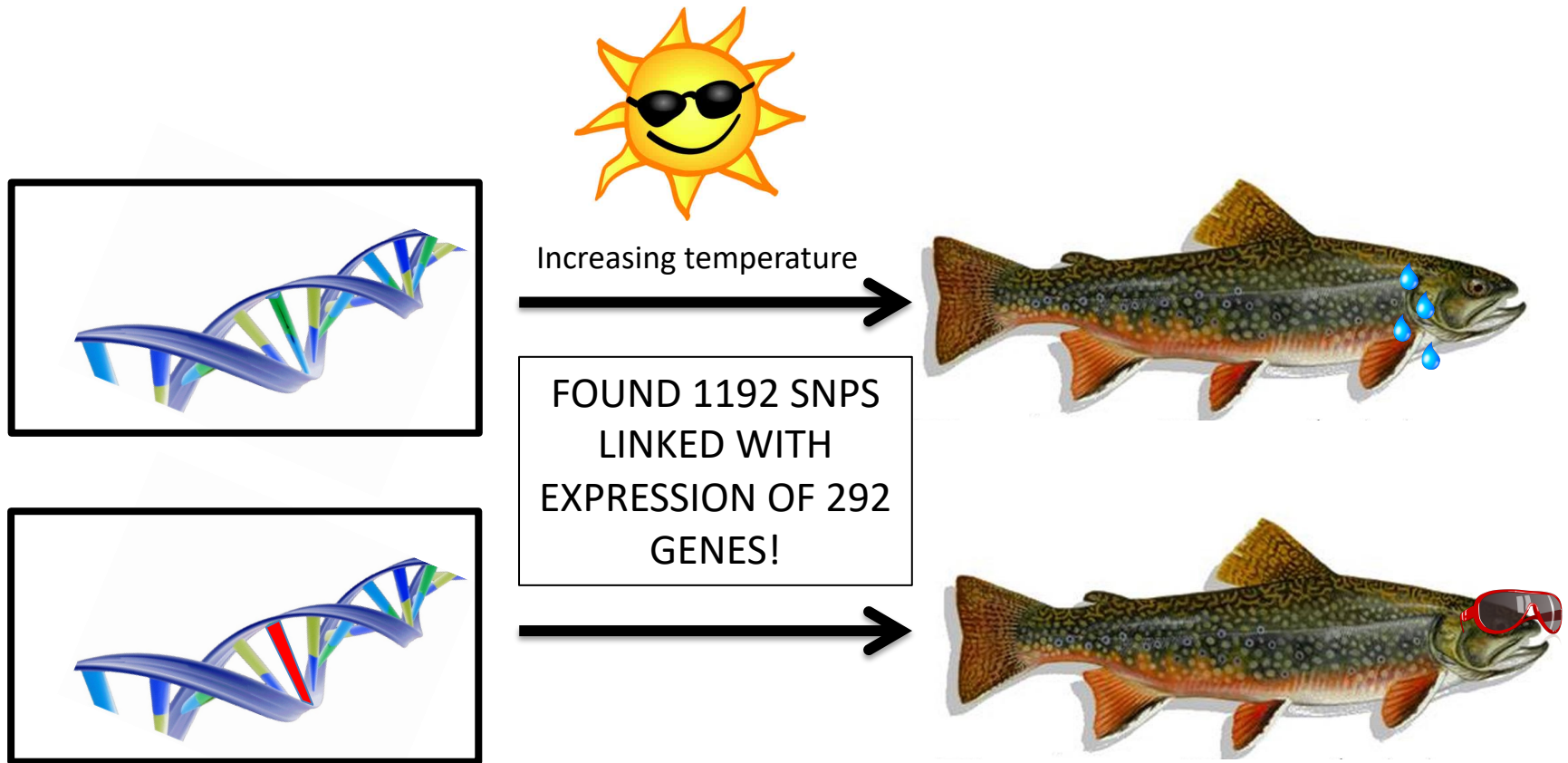
Linking Genotype to Phenotype: What genetic variation is linked with response to heat stress?



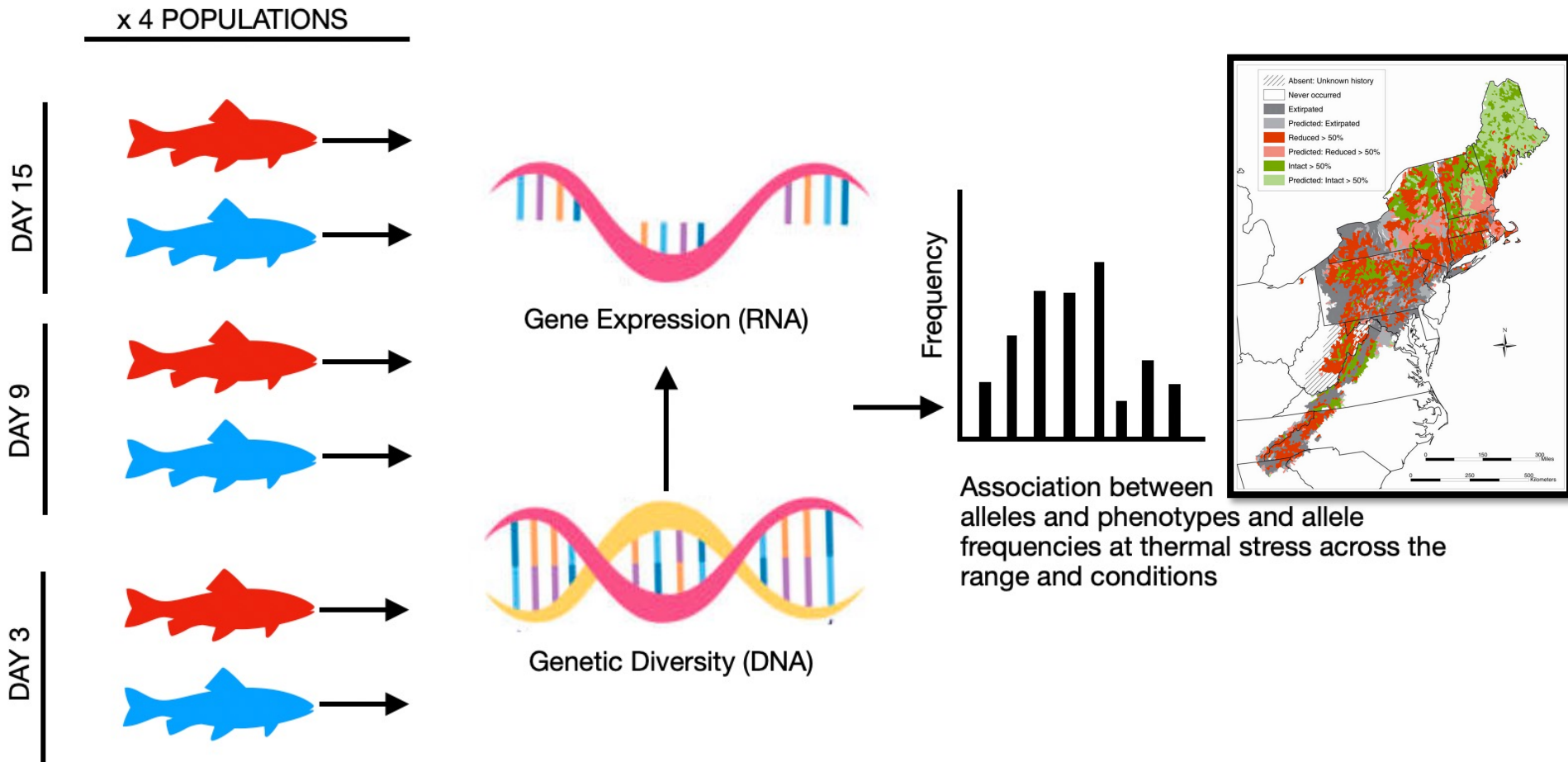
Linking Genotype to Phenotype: What genetic variation is linked with response to heat stress?



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Linking Genotype to Environment

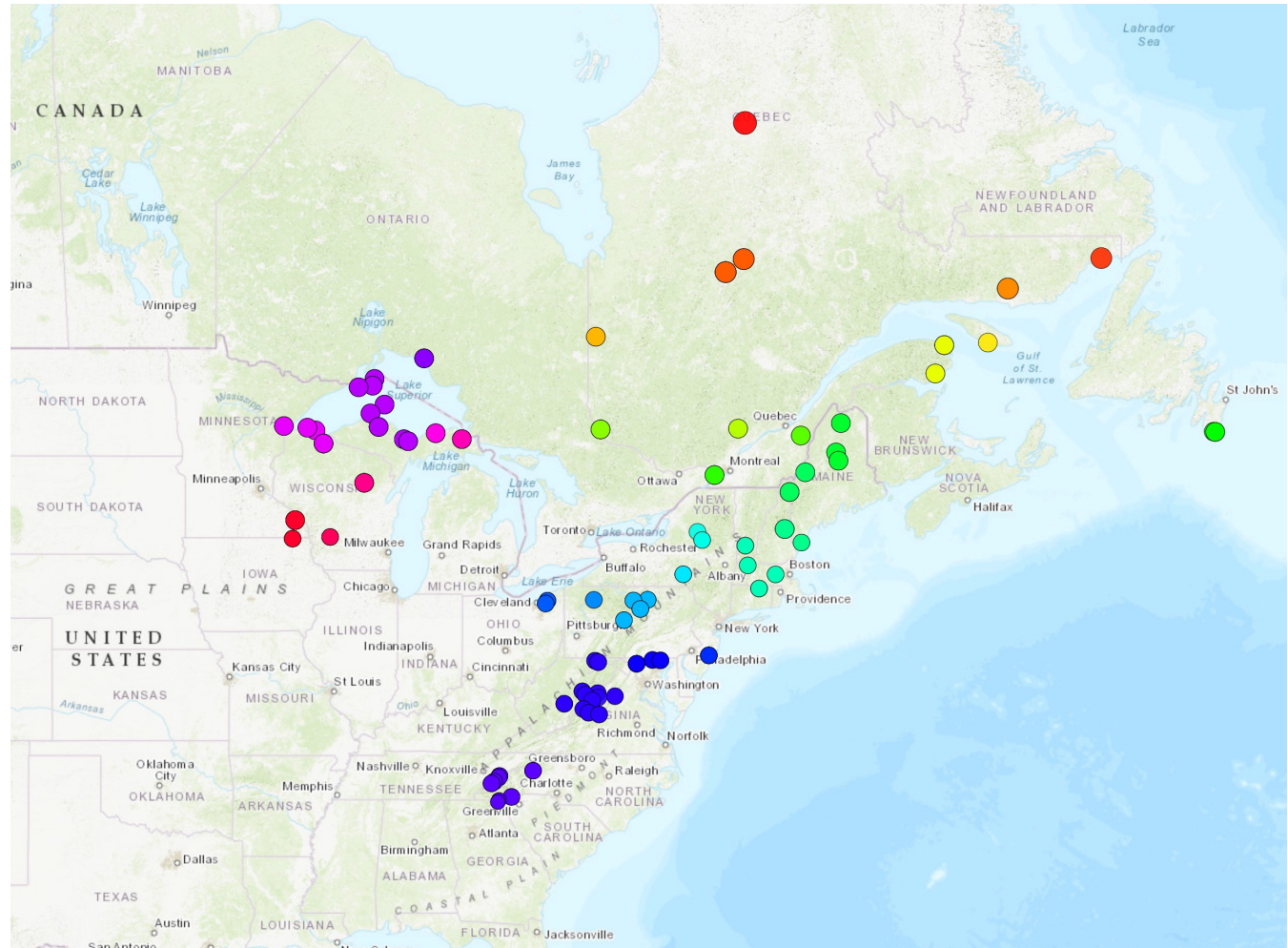


Linking genotype to environment: How does this diversity map to the species range?

RADseq on 201 samples from across 81 sites (1-6 individuals per site)

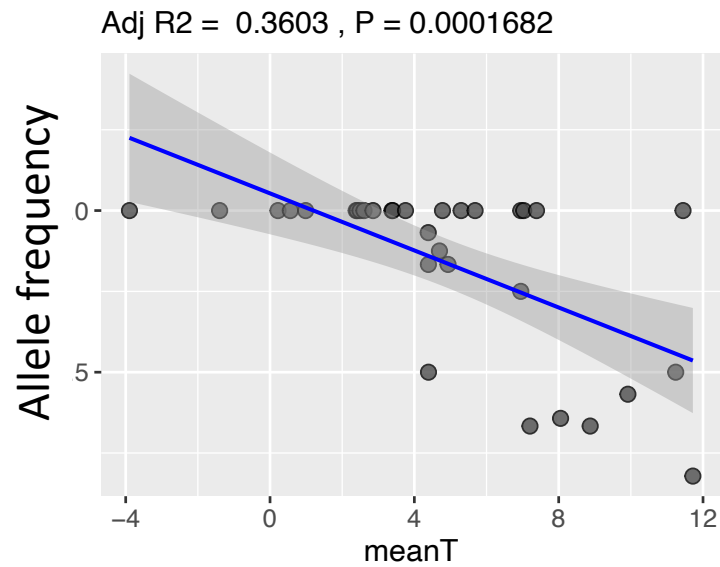
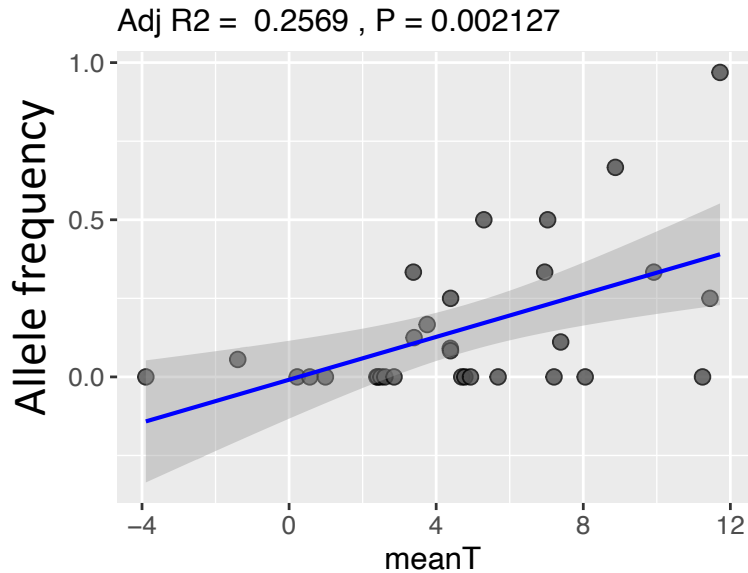
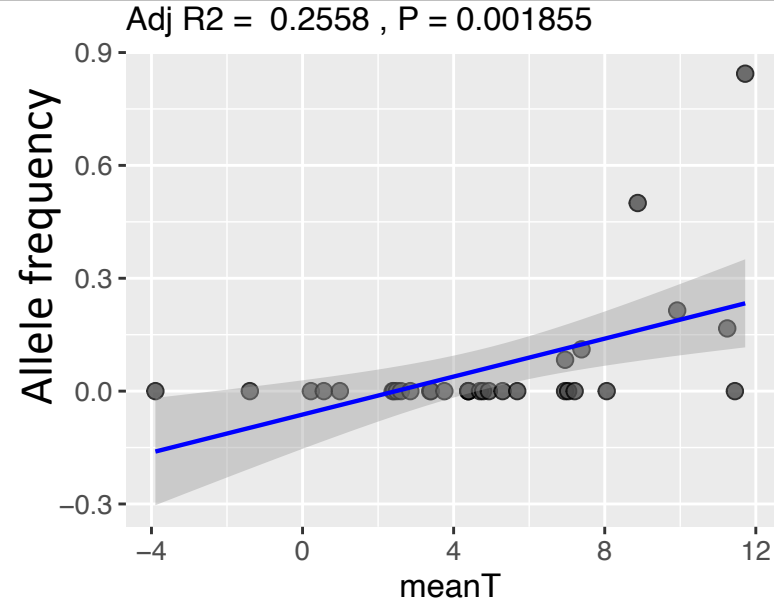
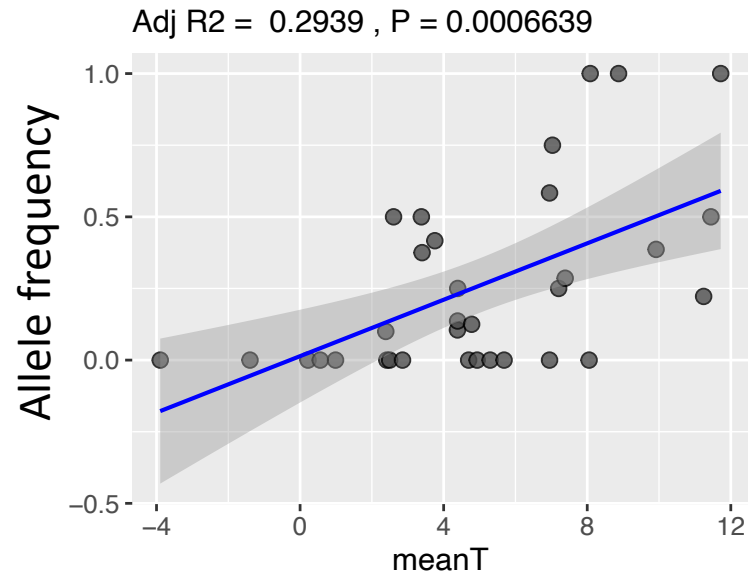
Grouped samples by 1° lat/long and 3° C

Tested for associations with climate variables in BioClim dataset

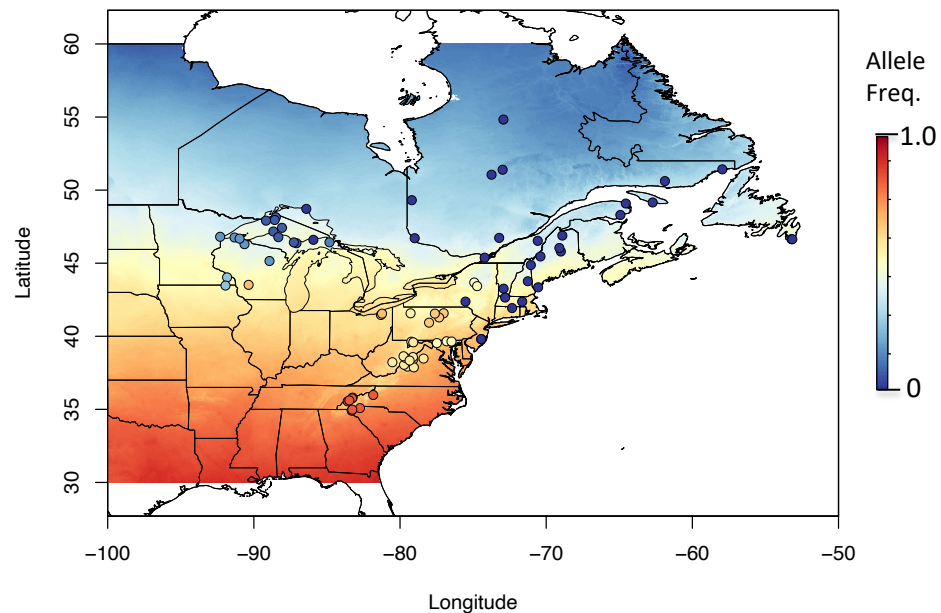
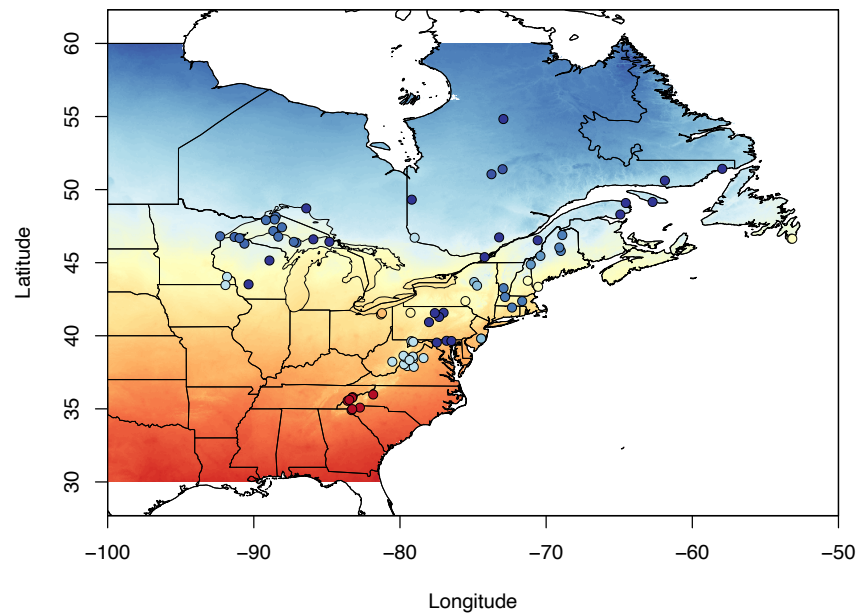
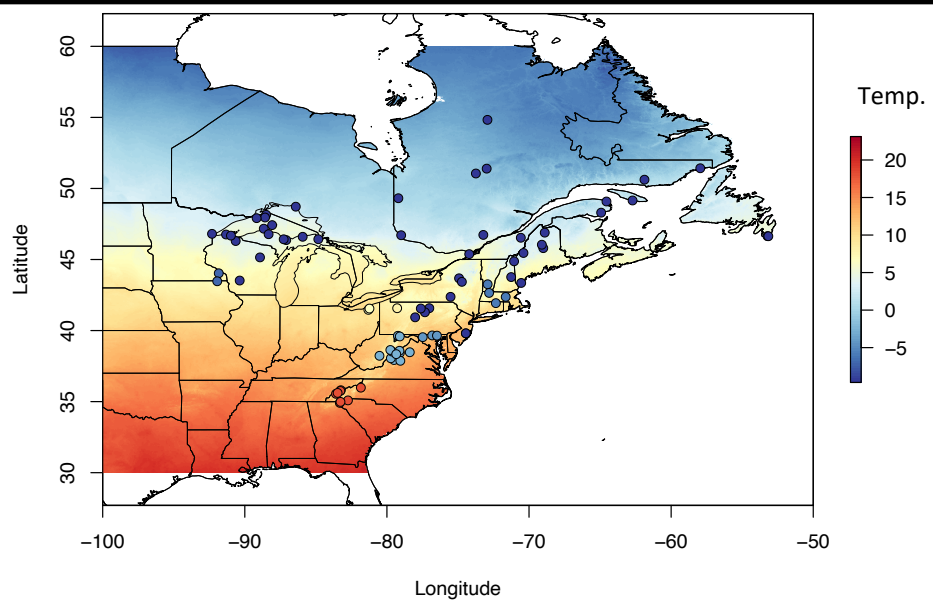
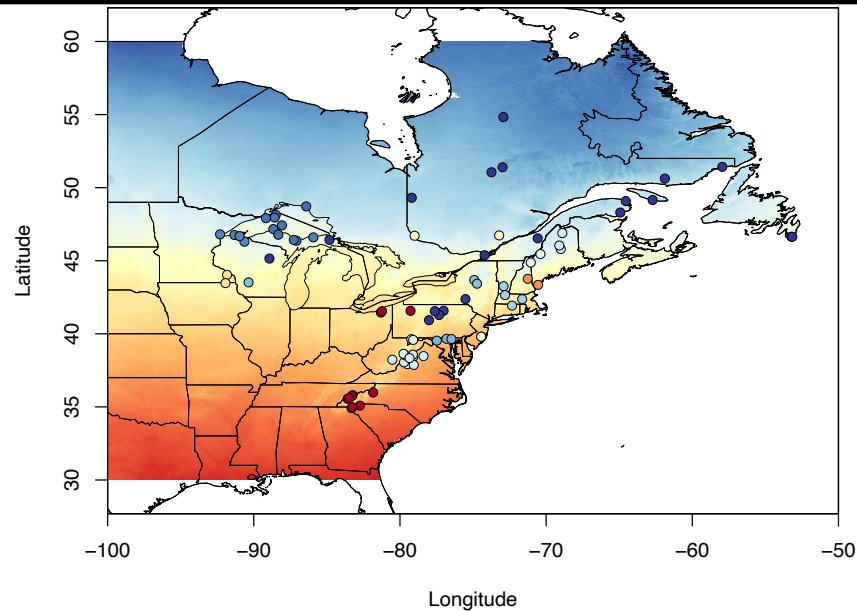


Mamoozadeh, N., Whiteley, A., Letcher, B., Kazyak, D., Tarsa, C., & Meek, M. Evaluating genomic relationships across spatial and temporal scales to guide conservation and management of imperiled species. *Submitted to Molecular Ecology Resources*.

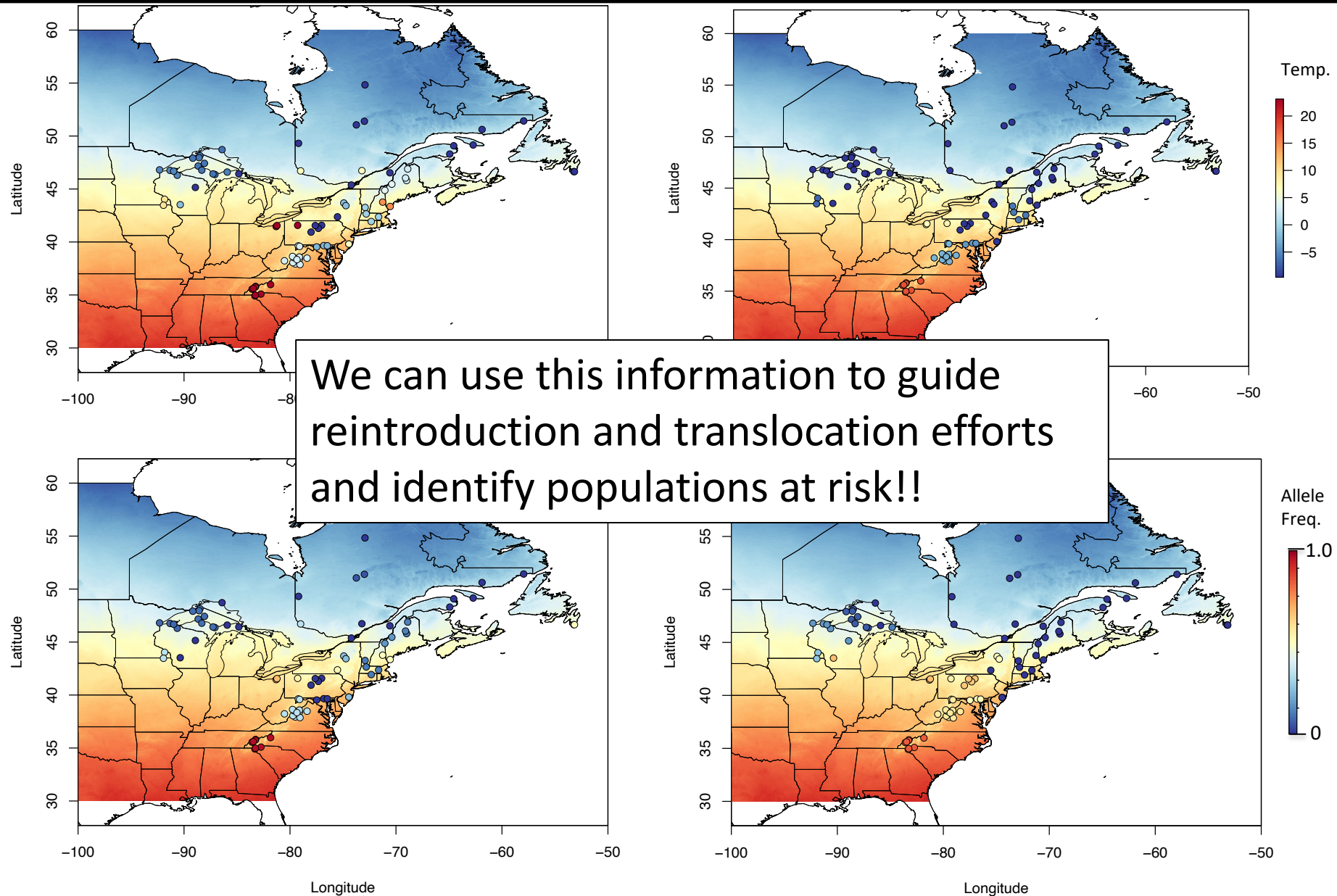
Genotypes are significantly correlated with temperature across the range



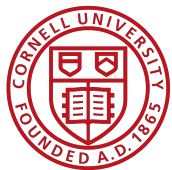
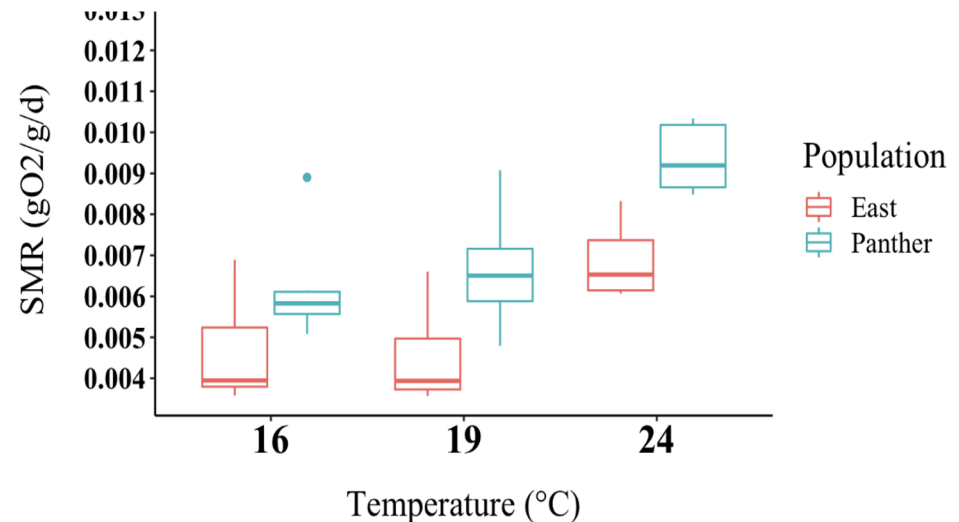
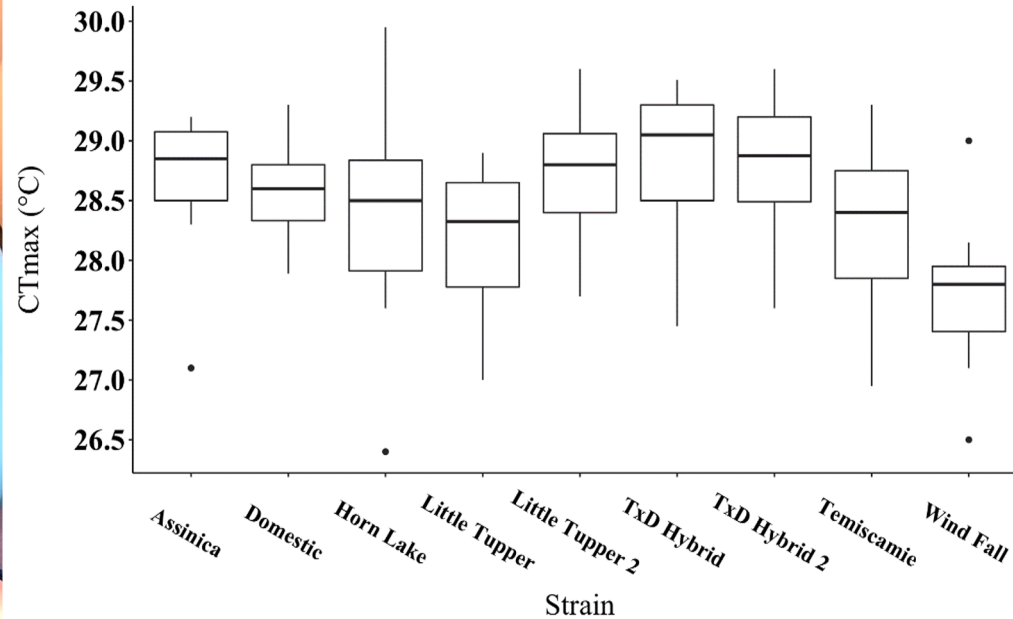
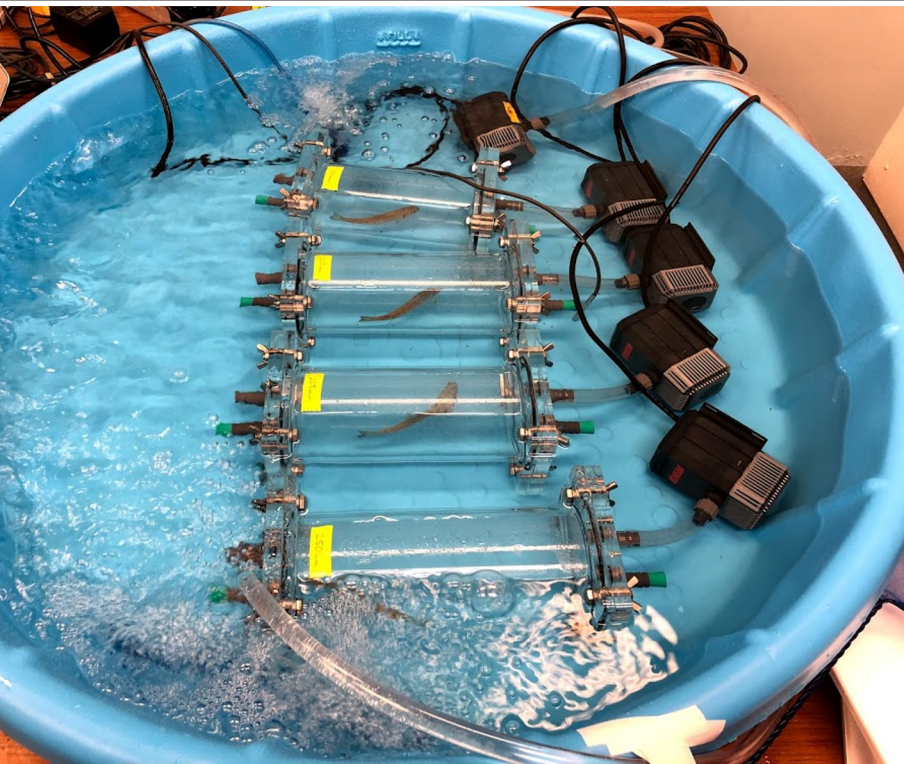
Genotypes are significantly correlated with temperature across the range



Genotypes are significantly correlated with temperature across the range



Next steps: Linking Genotype to Phenotype



Nick Hudson



Pete McIntyre

Conclusions

Genetic variation at particular loci is linked with response to heat stress, as well as current temperature across the range!



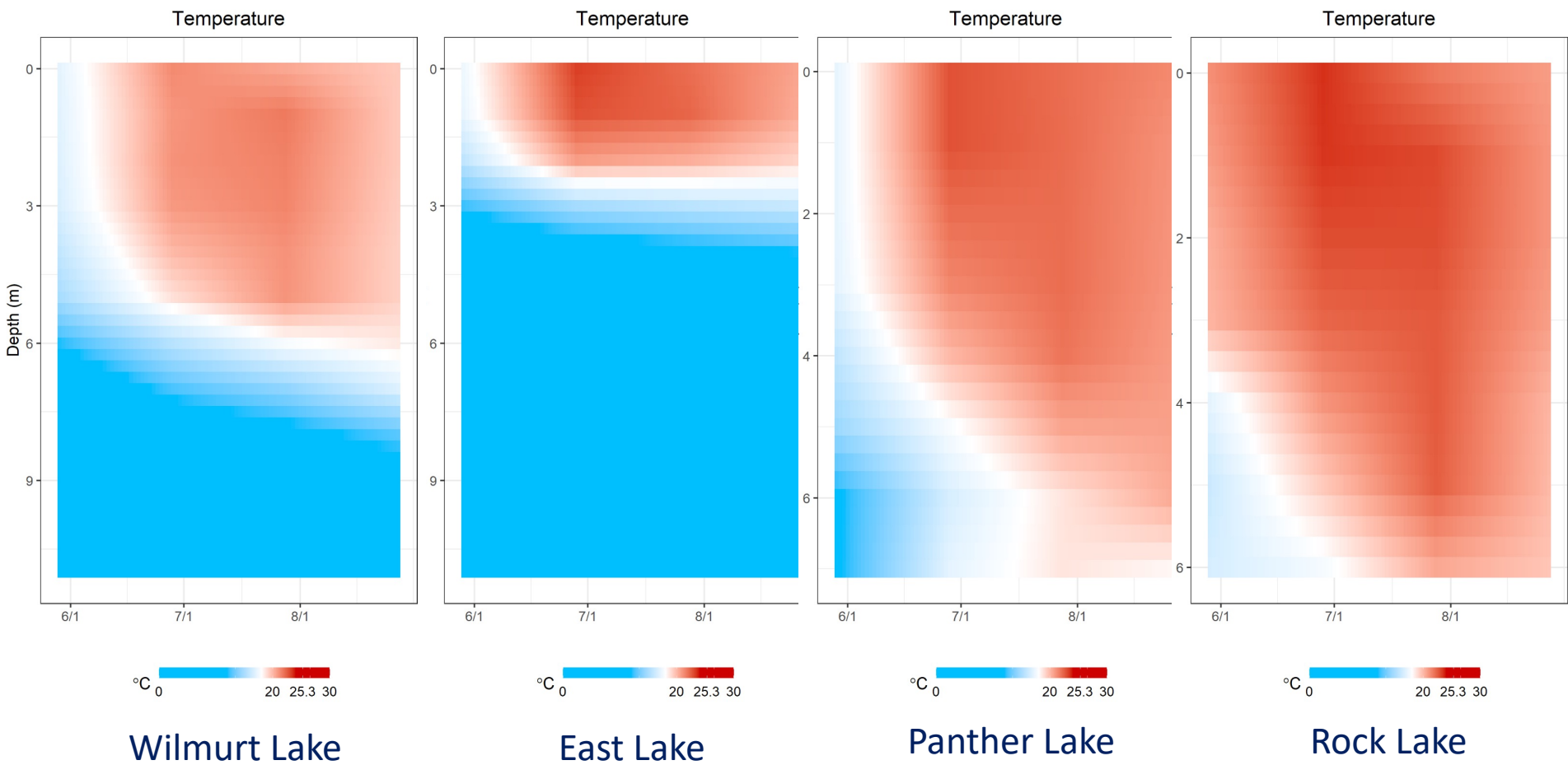
How will this help conservation and management?

1. Can use markers that respond similarly across populations to monitor for heat stress
2. Identify populations at greatest risk due to decreased genetic diversity at important loci
3. Use to inform translocations and reintroductions



THANKS!





Kraft and Marcy-Quay, unpublished data