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EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Geography and climate shape genetic diversity in black soldier fly populations across native and introduced ranges

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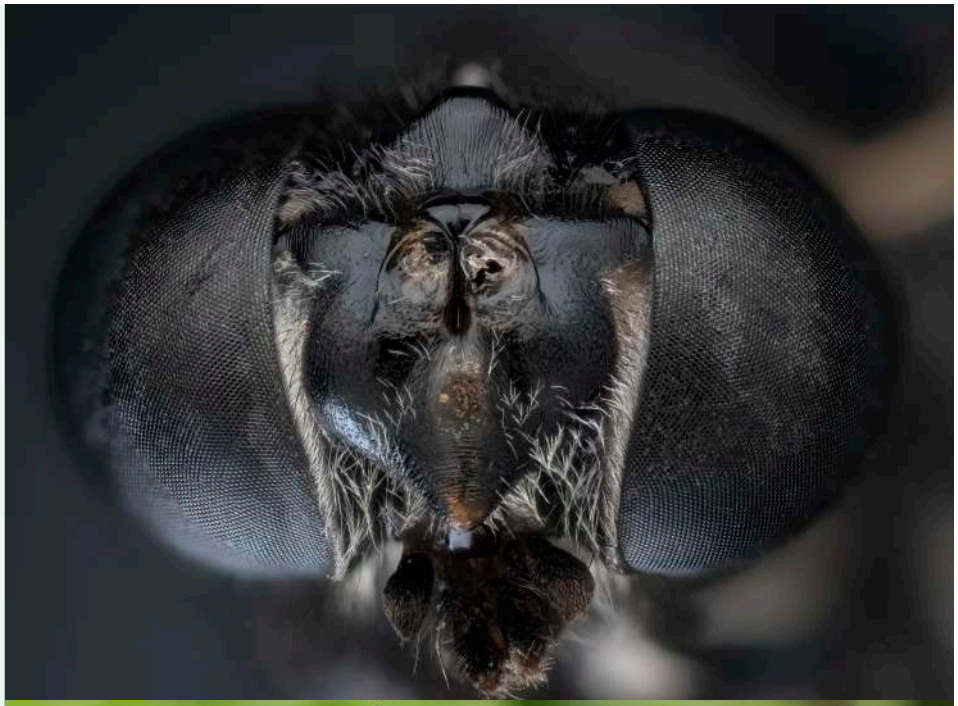
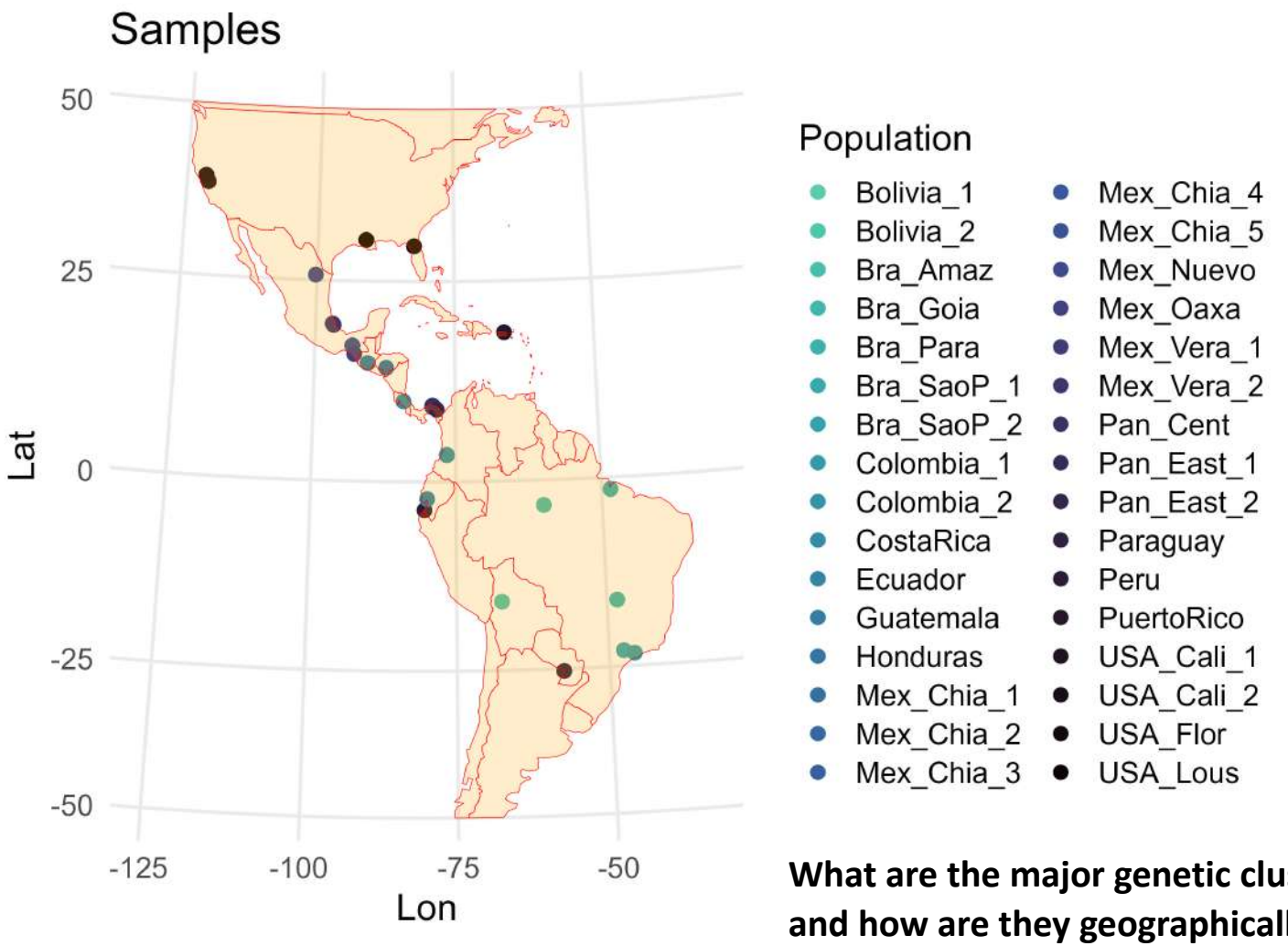
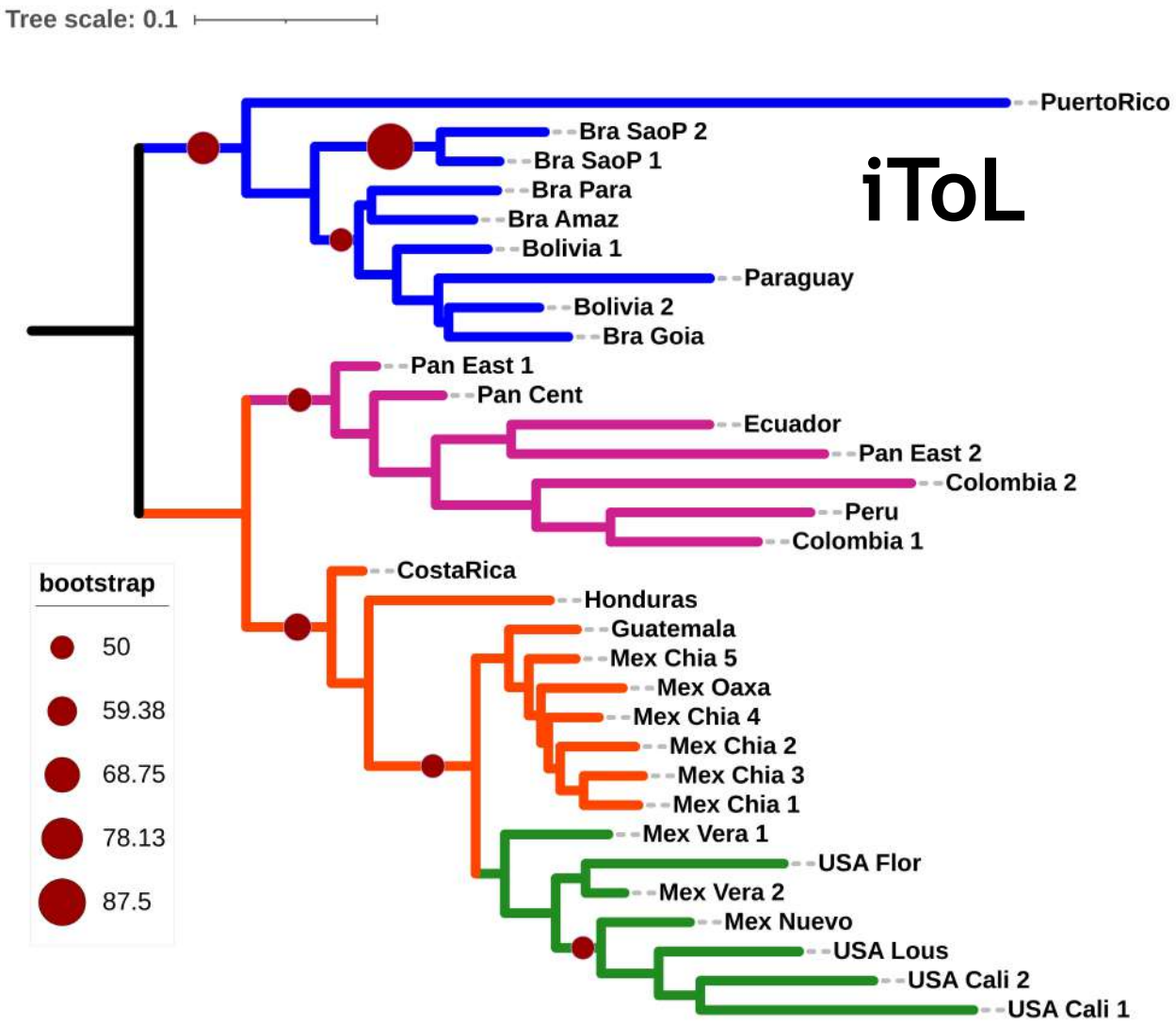
Genetic Landscape of BSF

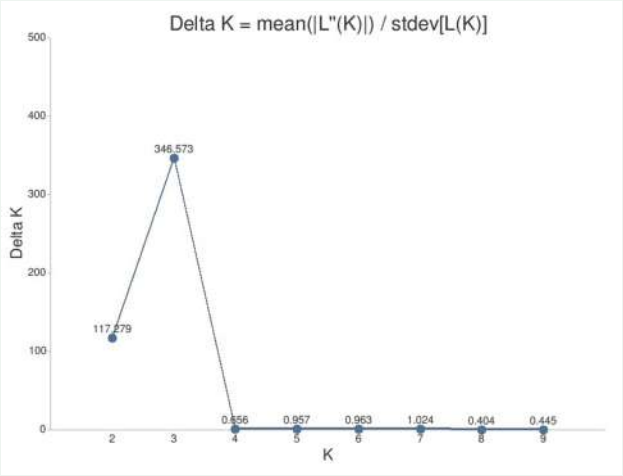
- Genetic diversity plays a crucial role in ecological adaptation and breeding potential.
- Unlike managed insects (e.g., honey bees, silkworms), BSF genetic diversity remains underexplored.
- Identifying ecological and geographic drivers of genetic differentiation can help understand adaptation and improve breeding strategies.

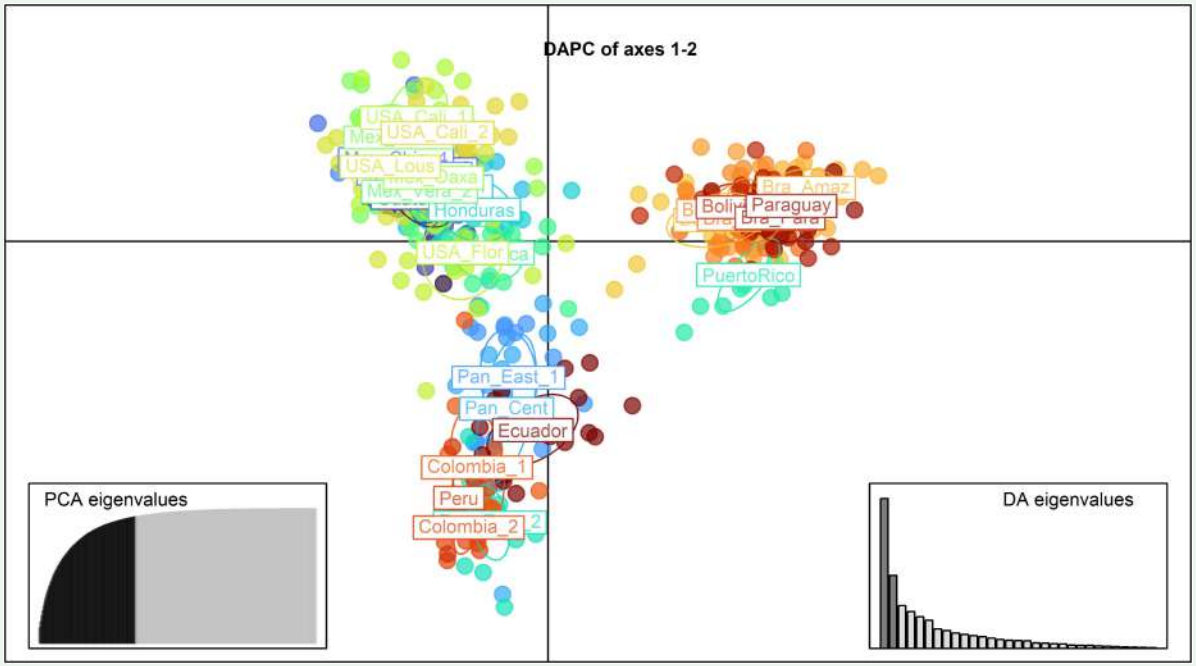


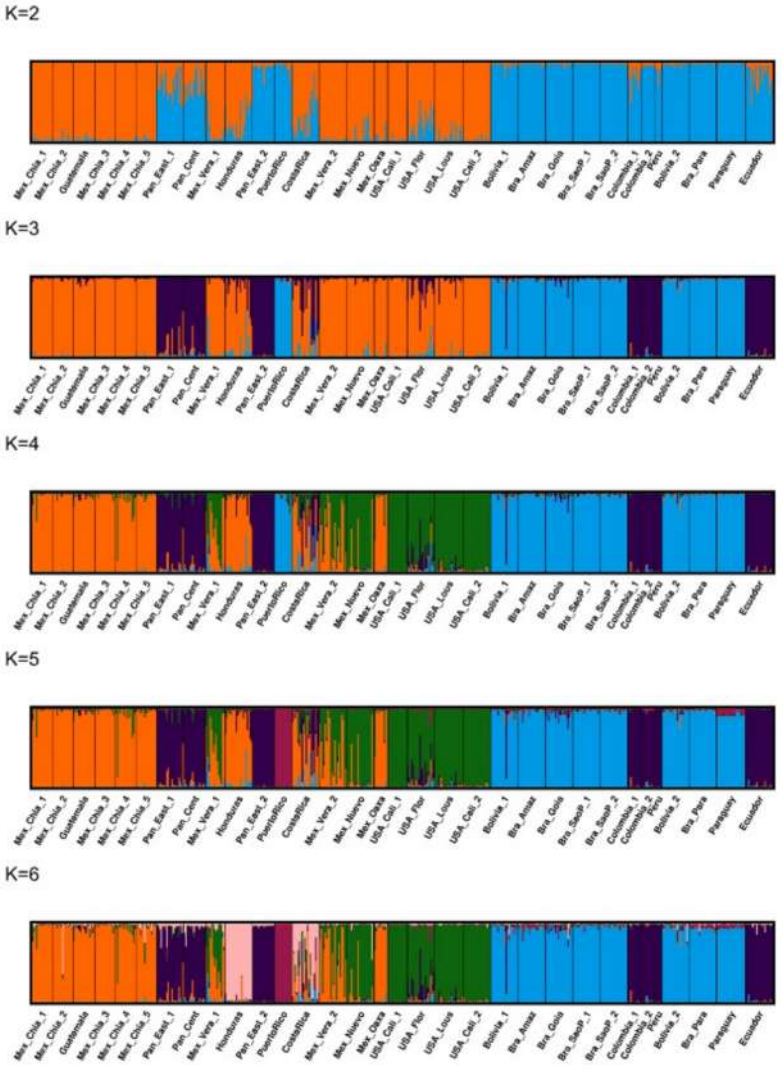


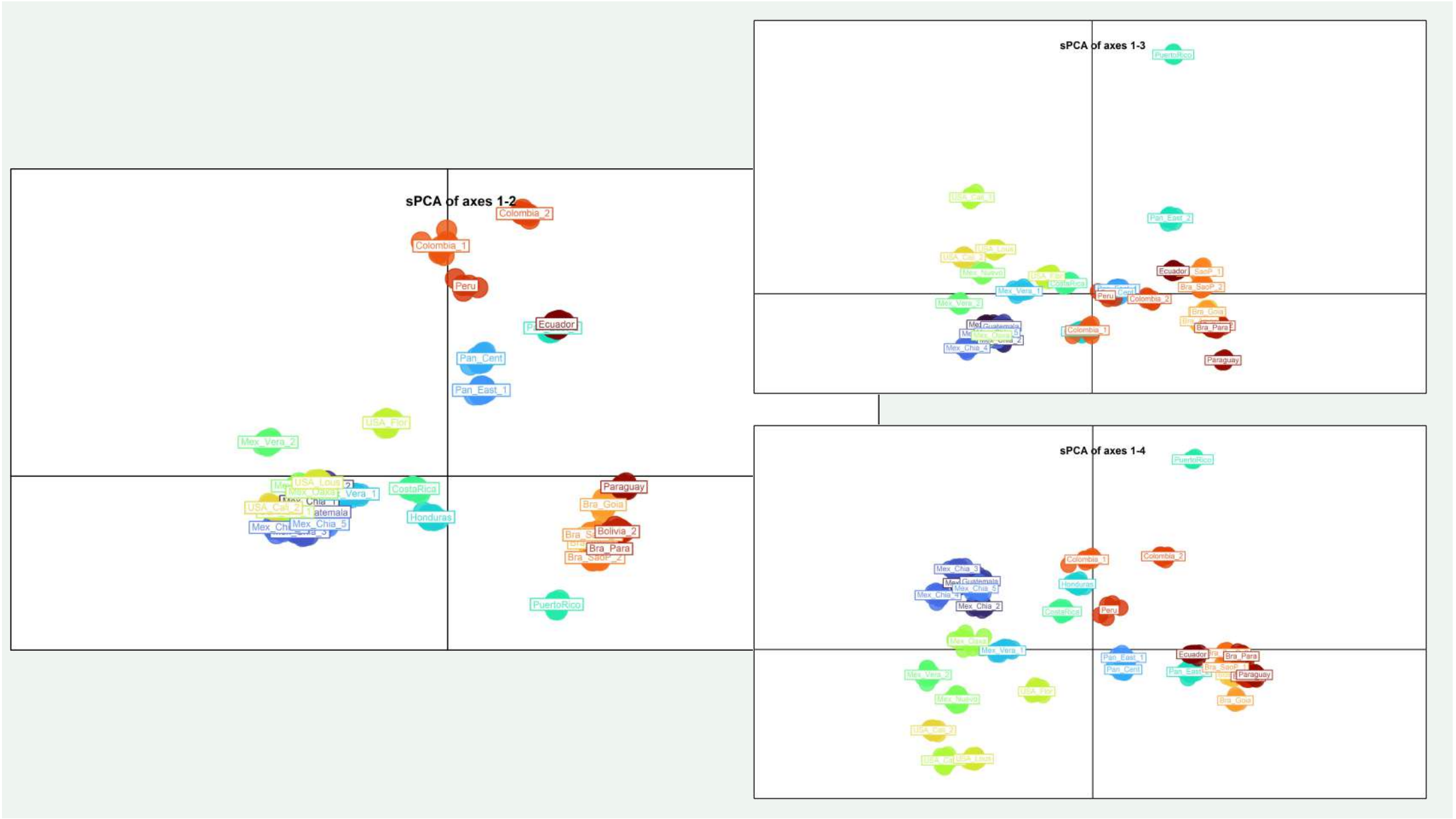
What are the major genetic clusters of BSF in its native range, and how are they geographically distributed?


Tree scale: 0.1
iToL
PuertoRico
Bra SaoP 2
Bra SaoP 1
Bra Para
Bra Amaz
Bolivia 1
Paraguay
Bolivia 2
Bra Goia
Pan East 1
Pan Cent
Ecuador
Pan East 2
Colombia 2
Peru
Colombia 1
CostaRica
Honduras
Guatemala
Mex Chia 5
Mex Oaxa
Mex Chia 4
Mex Chia 2
Mex Chia 3
Mex Chia 1
Mex Vera 1
USA Flor
Mex Vera 2
Mex Nuevo
USA Lous
USA Cali 2
USA Cali 1
bootstrap
50
59.38
68.75
78.13
87.5

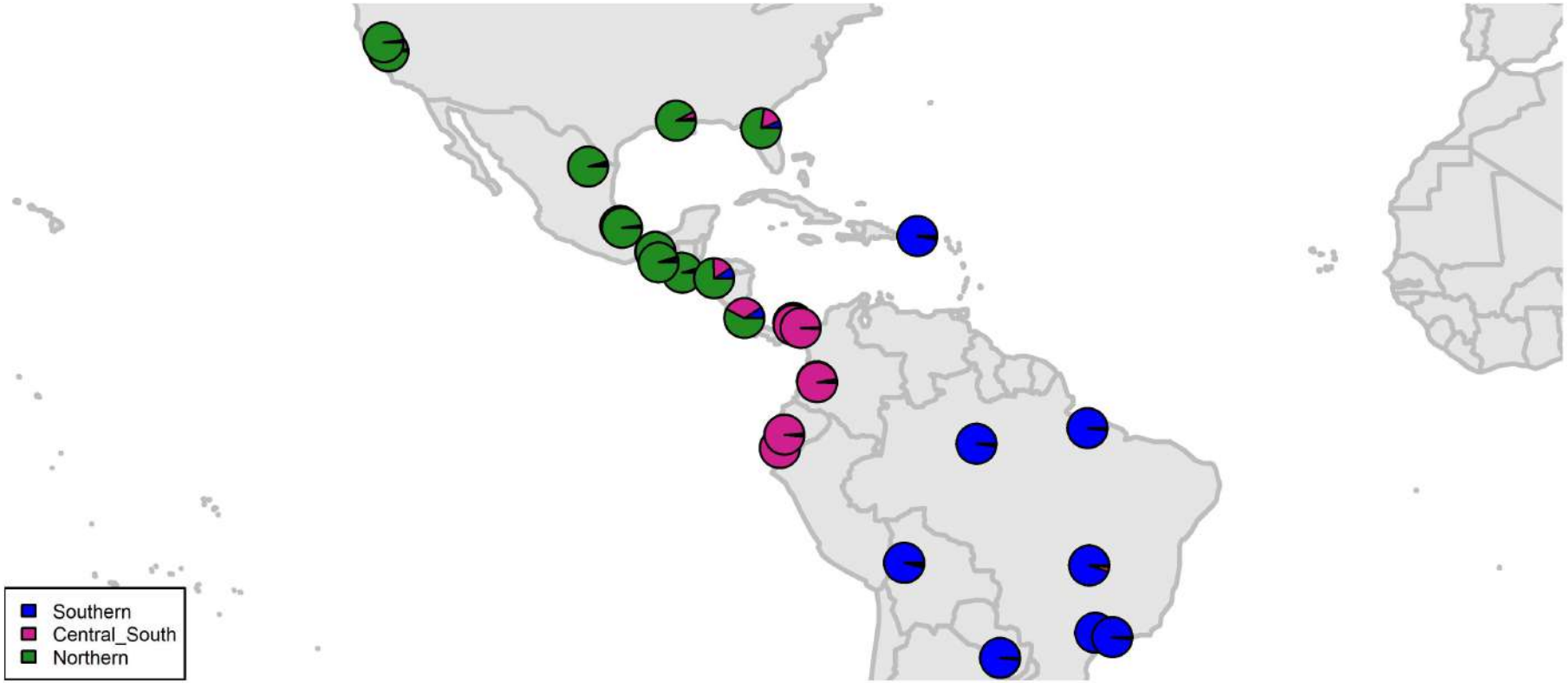

Delta K = mean(|L"(K)|) / stdev[L(K)]
Delta K
K
500
400
300
200
100
0
2
3
4
5
6
7
8
9
117.279
346.573
0.556
0.957
0.963
1.024
0.404
0.445


DAPC of axes 1-2
USA_Cali_1
USA_Cali_2
USA_Lous
Honduras
USA_Flor
Bra_Amaz
Paraguay
PuertoRico
Pan_East_1
Pan_Cent
Ecuador
Colombia_1
Peru
Colombia_2
PCA eigenvalues
DA eigenvalues

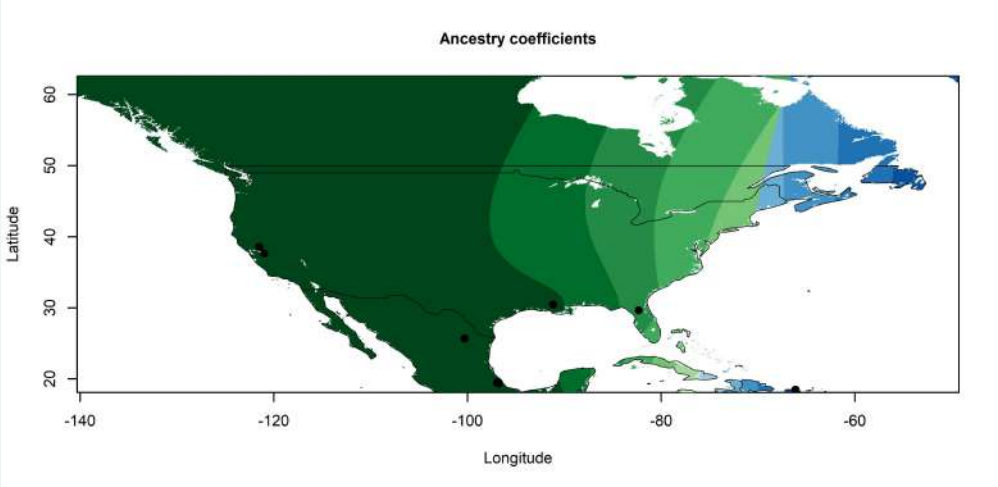

K=2
K=3
K=4
K=5
K=6

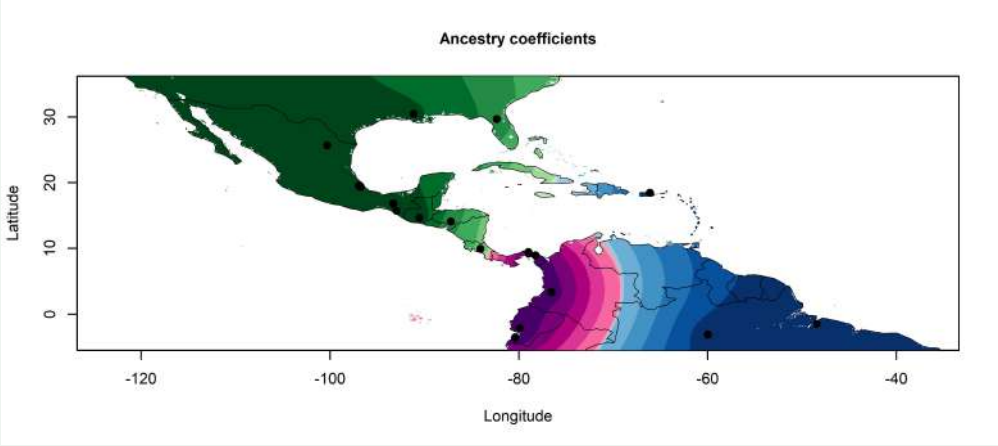

sPCA of axes 1-2
Colombia_2
Colombia_1
Peru
Ecuador
Pan_Cent
Pan_East_1
USA_Flor
Mex_Vera_2
CostaRica
Honduras
Paraguay
Bra_Goia
Bolivia_2
Bra_Para
PuertoRico
sPCA of axes 1-3
PuertoRico
Pan_East_2
Ecuador
Bra_SaoP_1
Bra_SaoP_2
Peru
Colombia_2
Bra_Goia
Bra_Para
Paraguay
Colombia_1
Mex_Chia_4
sPCA of axes 1-4
PuertoRico
Colombia_1
Colombia_2
Mex_Chia_3
Honduras
Mex_Chia_5
Mex_Chia_4
Mex_Chia_2
CostaRica
Peru
Mex_Vera_1
Pan_East_1
Pan_Cent
Ecuador
Bra_Para
Bra_SaoP_1
Paraguay
Bra_Goia
Mex_Vera_2
Mex_Nuevo
USA_Flor
USA_Cali_2

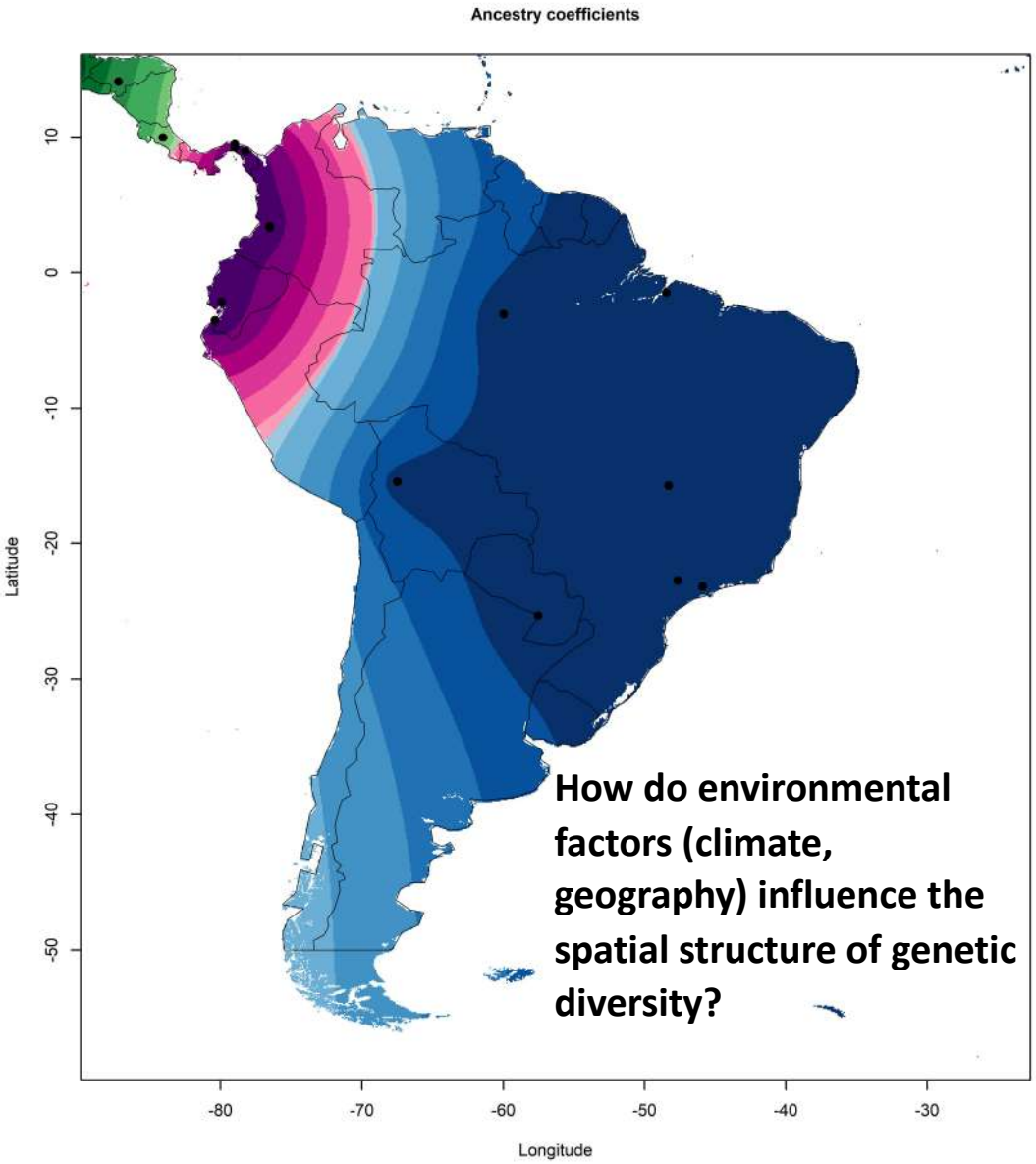
Ancestry Compositions



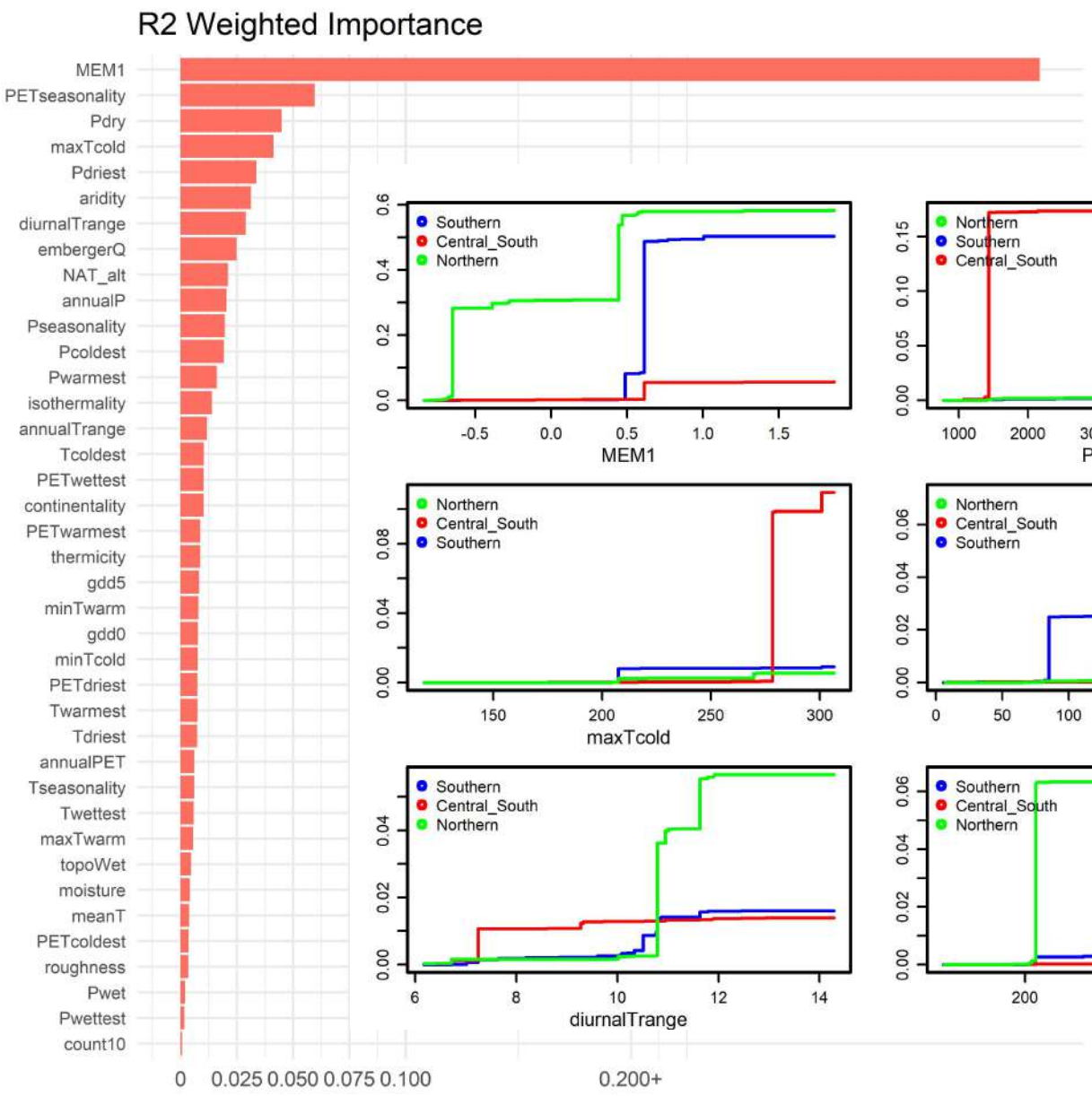
Kriged Ancestries

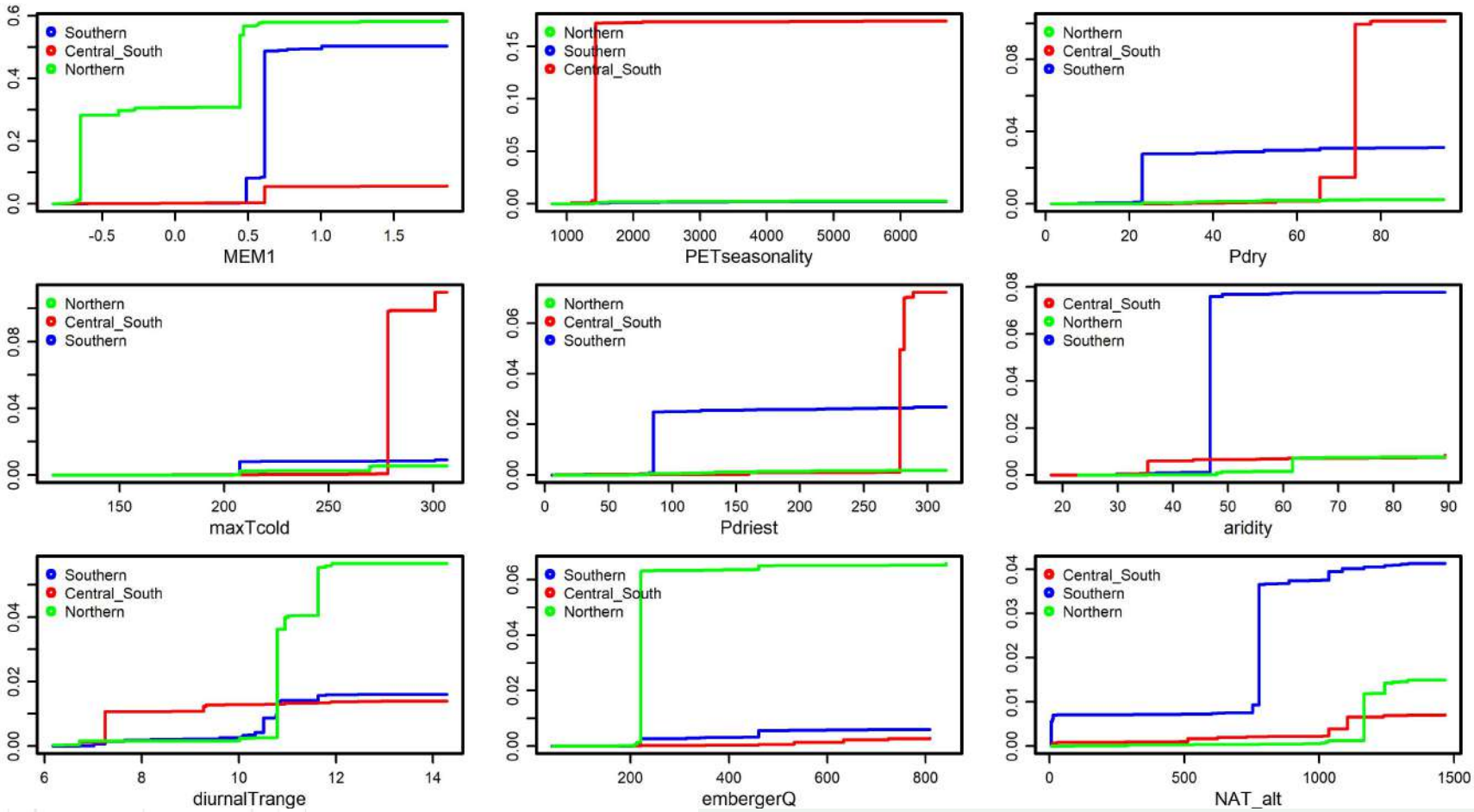




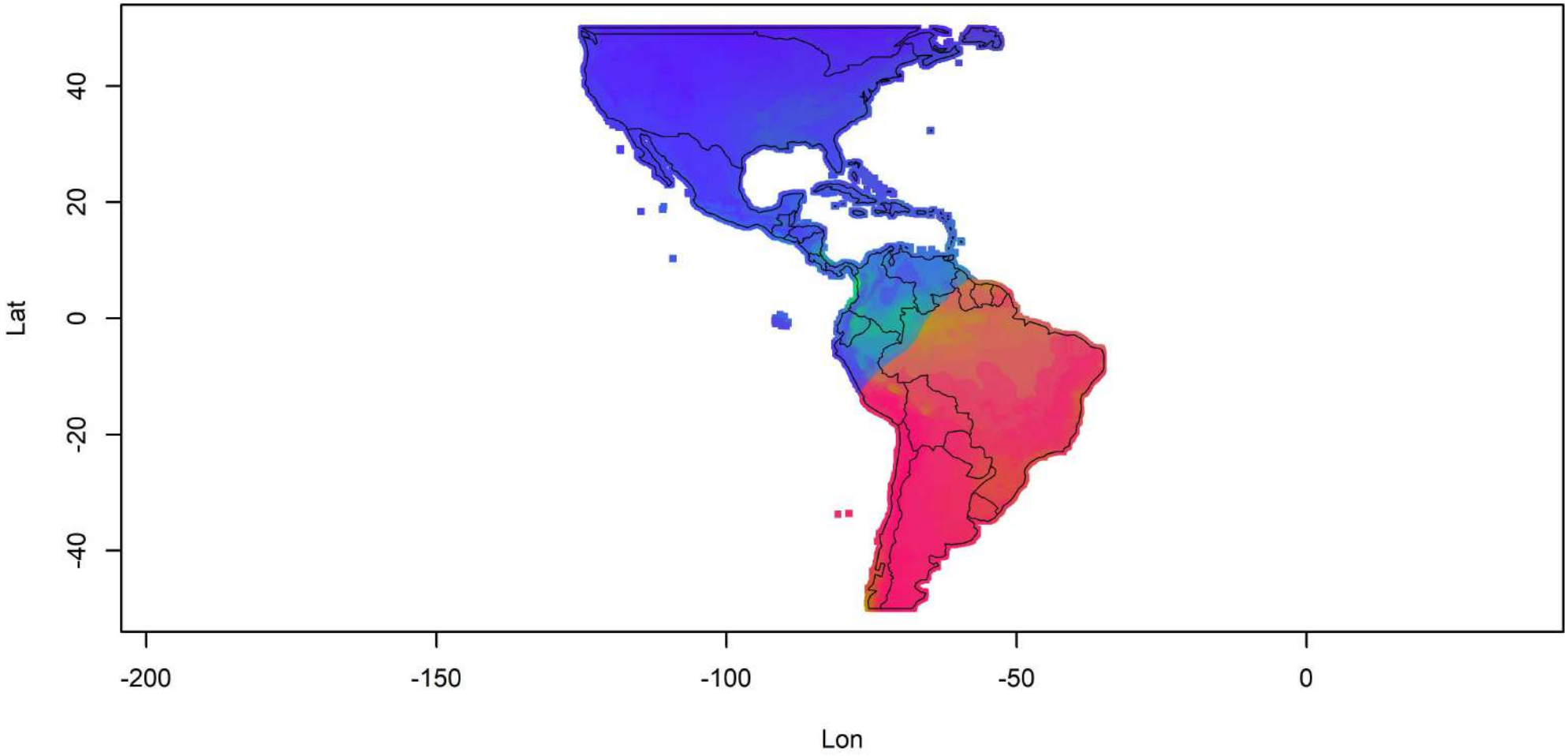


Gradient Forest Analysis

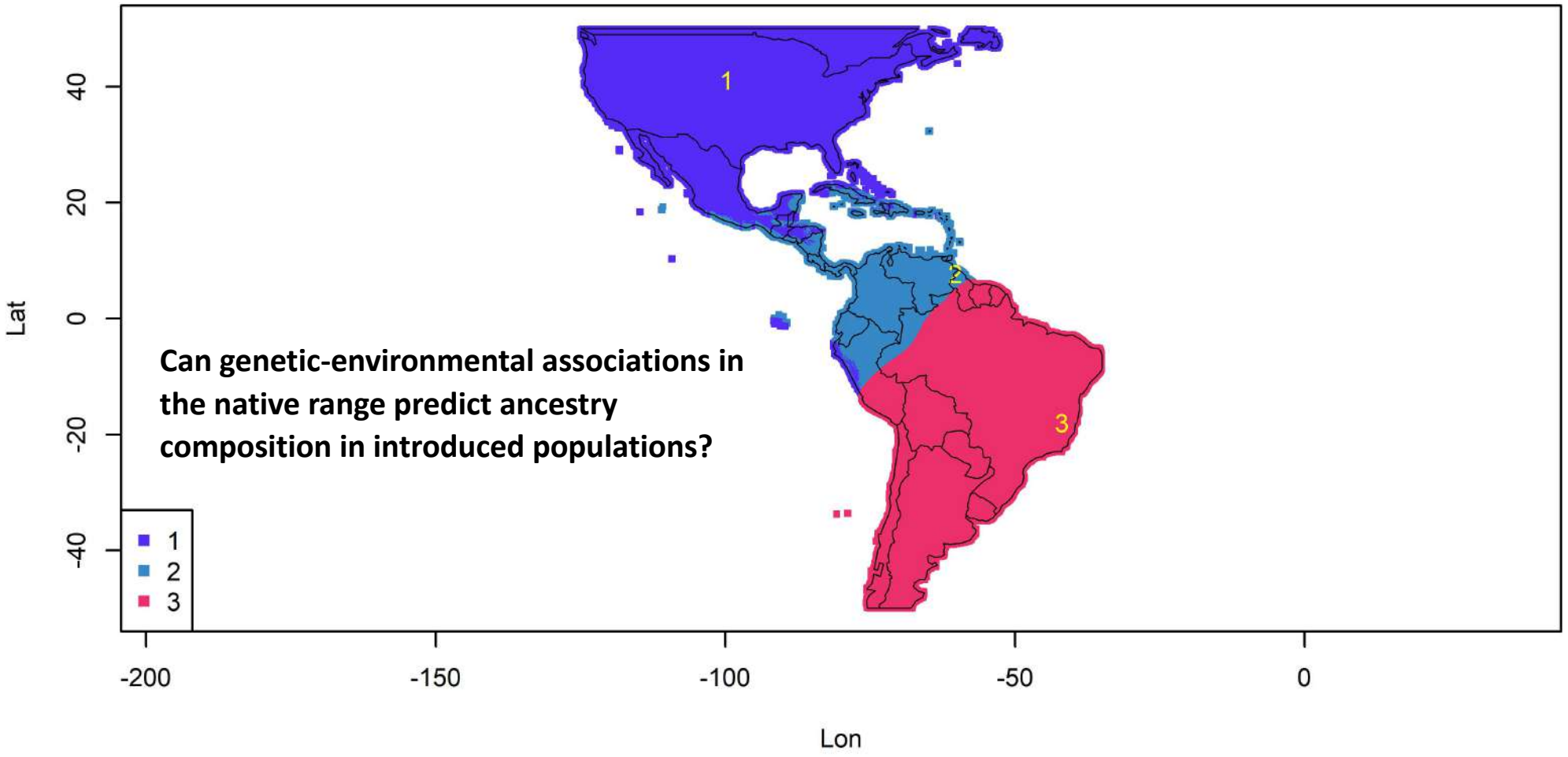




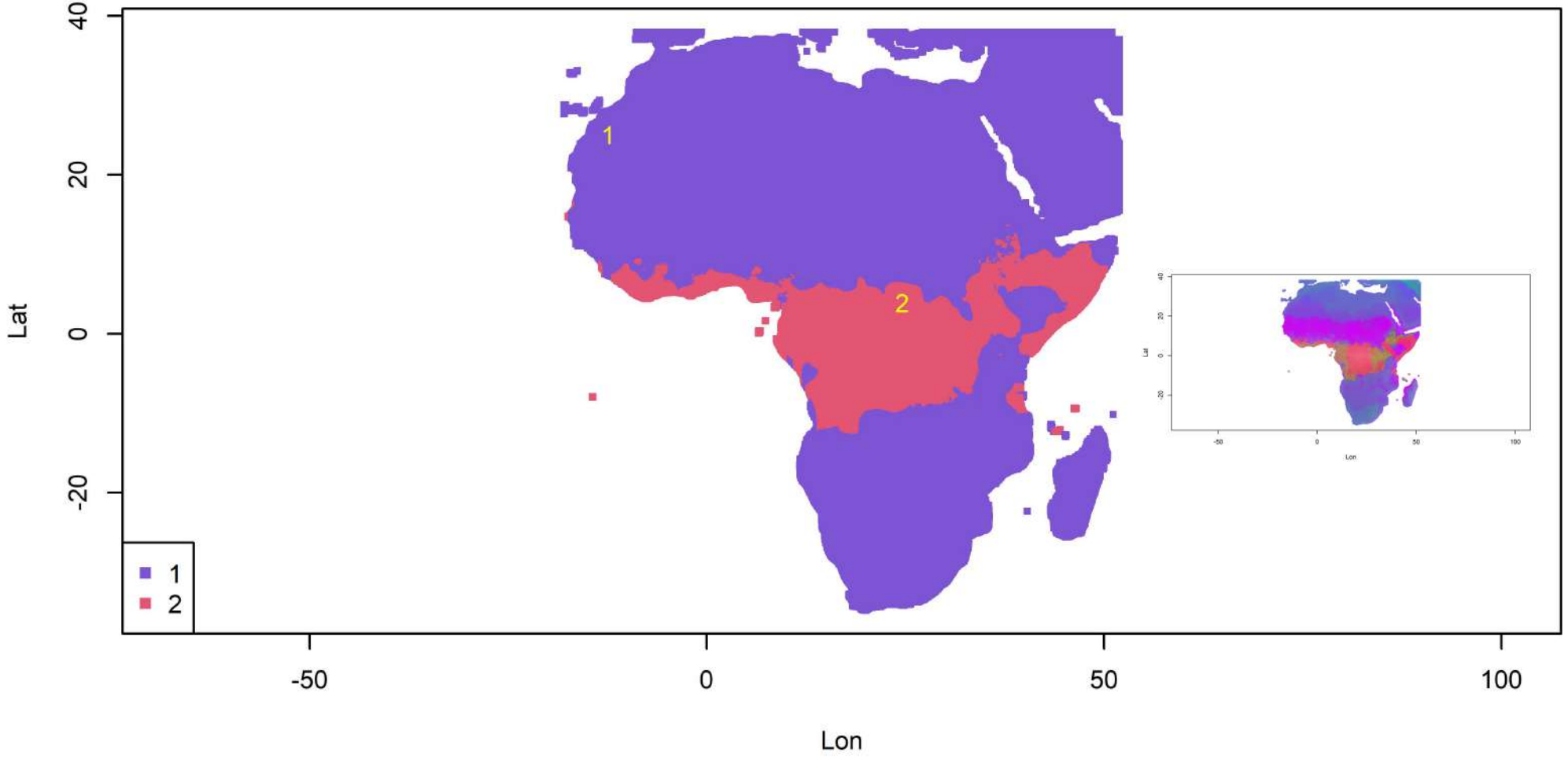
Prediction Across The Native Range



Predicted Clusters



Prediction At The Introduced Range



Insights & Next Steps

- Three major ancestry clusters identified, with breaks around geographic barriers.
- Precipitation and temperature shape genetic differentiation at the interfaces.
- Ancestry predictions in Africa suggest non-random establishment patterns.

- Genome-wide signatures of selection → Identify adaptive loci → Link genetic differentiation to morphology, physiology, and behavior → Test ecological performance across different climates → Develop targeted breeding programs using insights from genetic diversity and local adaptation

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