Successful introduction of the Eurasian Tree Sparrow in Australia and North America

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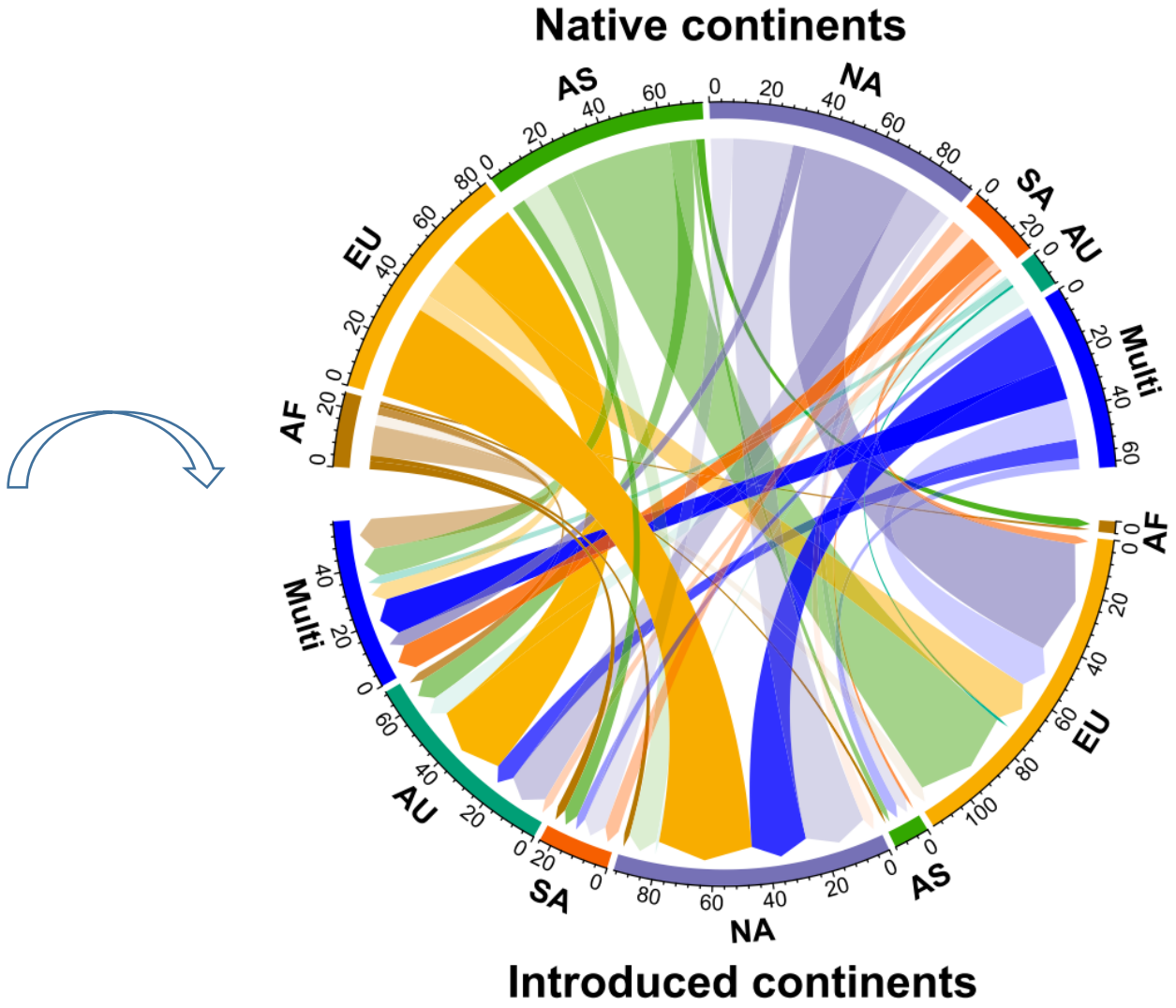
Eurasian Tree Sparrow

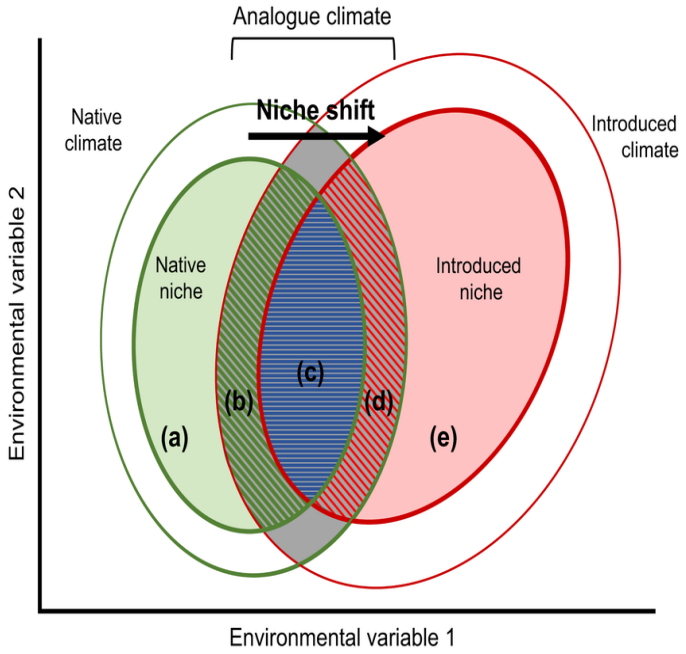
Human activities -- primary driver behind the global species invasion

Age of Discovery

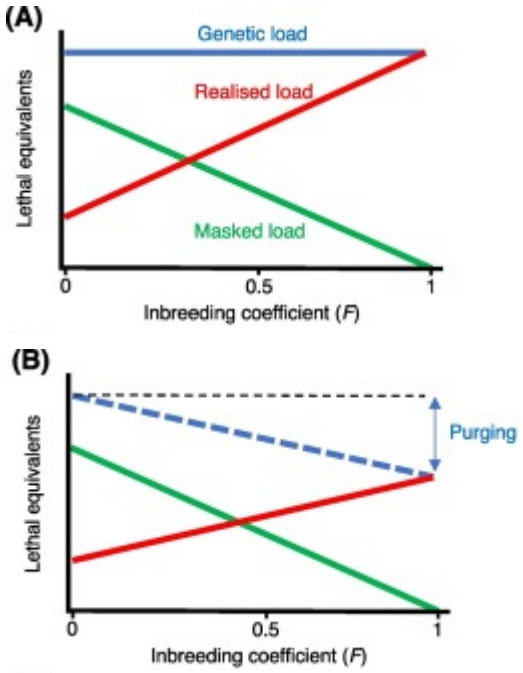


Biological invasions bring hazards

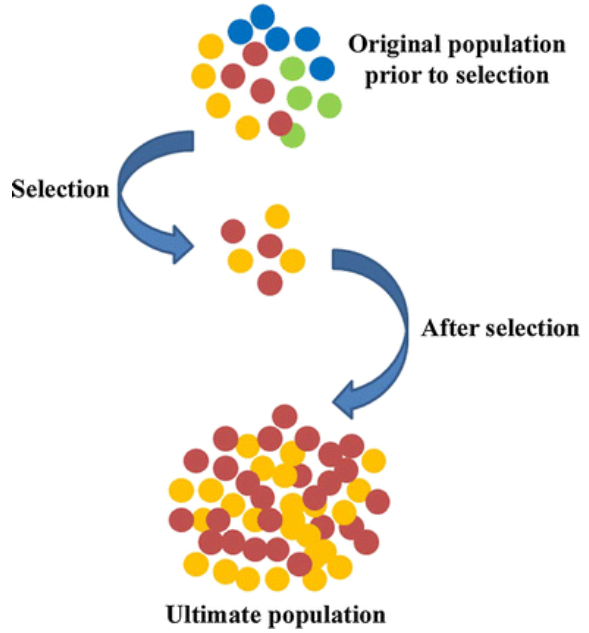
How exotic species become invader



Niche matching

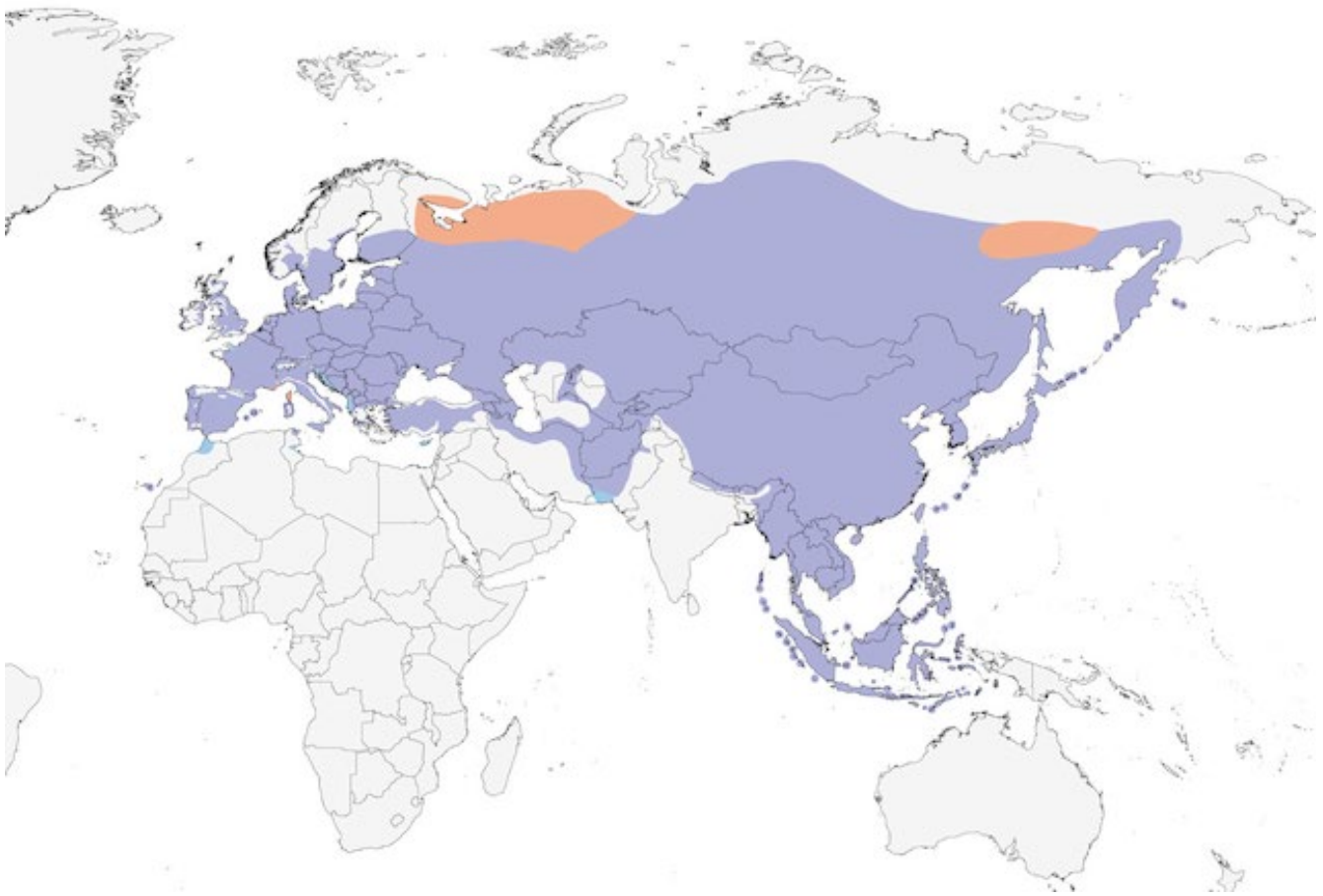


Purging



Natural selection

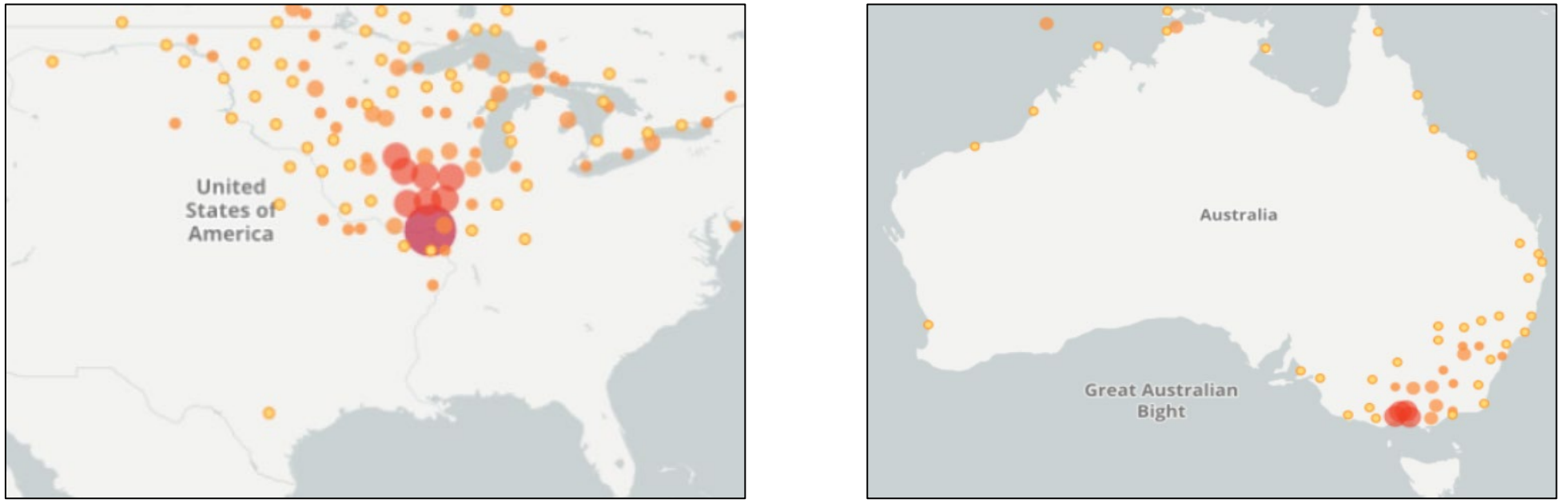
Invasion history of Eurasian Tree Sparrow



Distribution of the Eurasian Tree Sparrow

Country unit	Year
SINGAPORE	1600
TAIWAN, PROVINCE OF CHINA	1728
BERMUDA	1800
PHILIPPINES	1850
AUSTRALIA Victoria	**1863**
AUSTRALIA New South Wales	1864
NEW ZEALAND	1868
UNITED STATES Missouri	**1870**
HONGKONG	1878
UNITED STATES Kentucky	1889
ITALY	1890

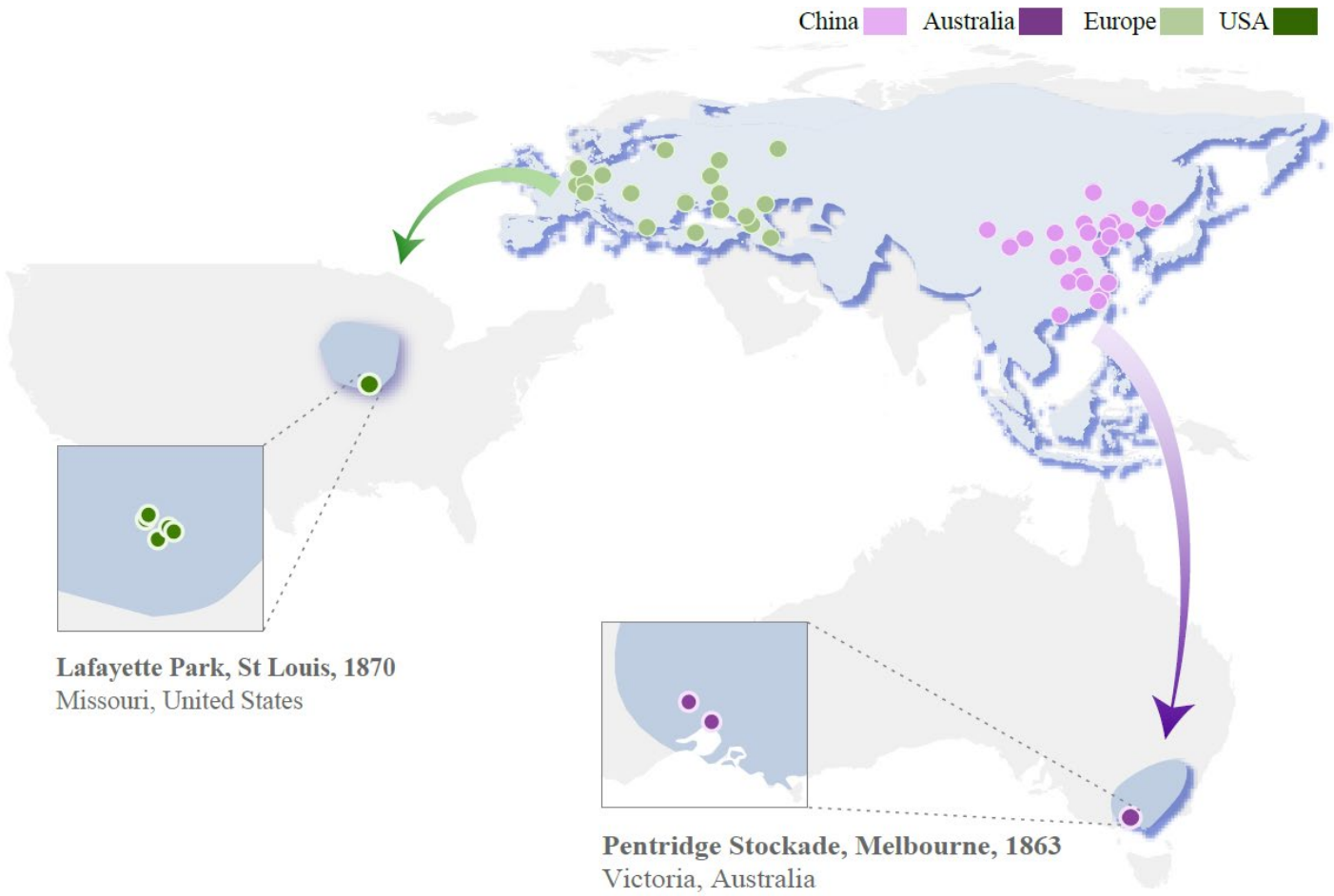
Invasion history of Eurasian Tree Sparrow



Records of the Eurasian Tree Sparrow in North America and Australia

How did tree sparrow invade successfully?

How tree sparrow invaded successfully



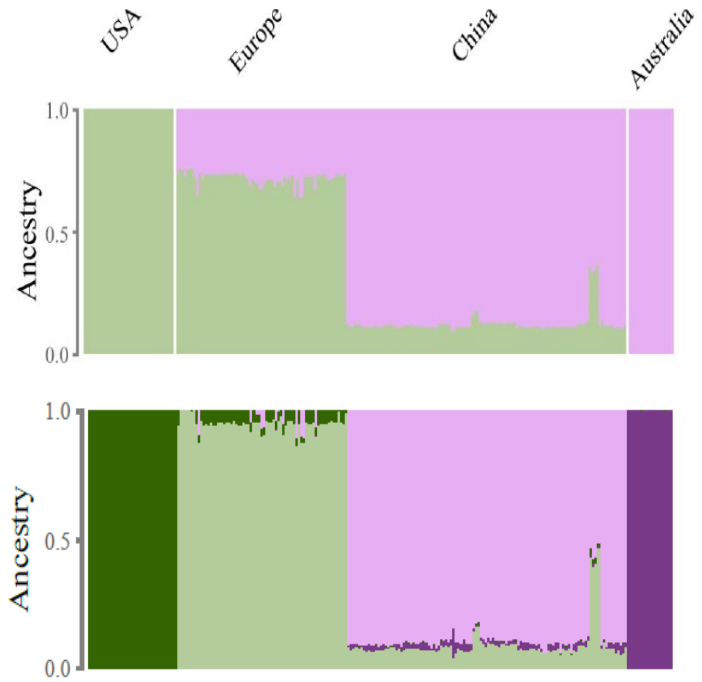
Sampling sites

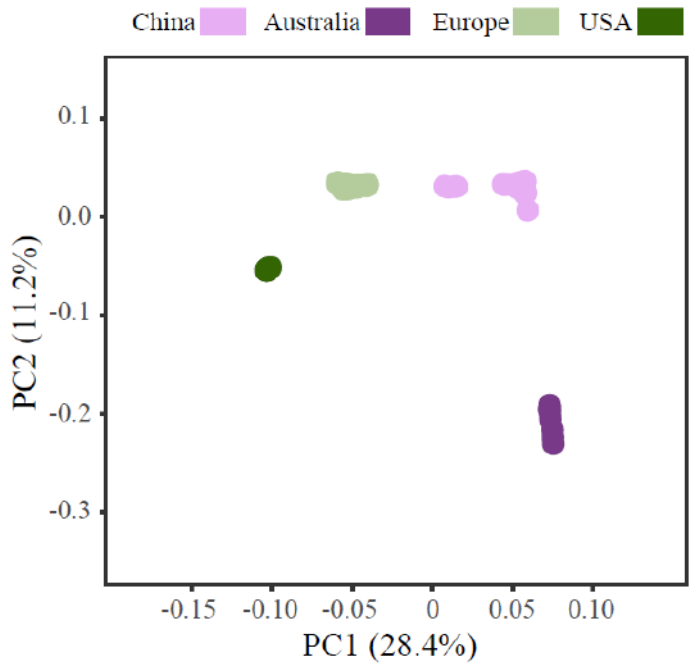
- Sequencing tree sparrow across Eurasia, North America and Australia
- Combined genomic and ecological approaches

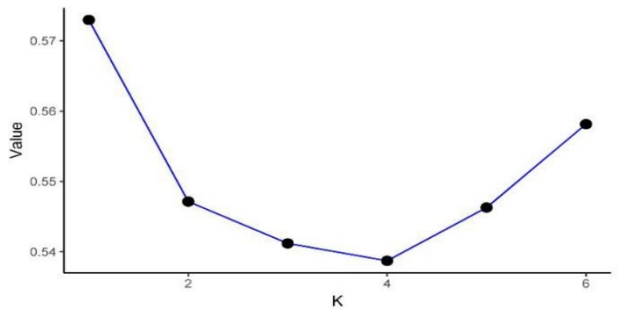
Population diverged follow introduction history

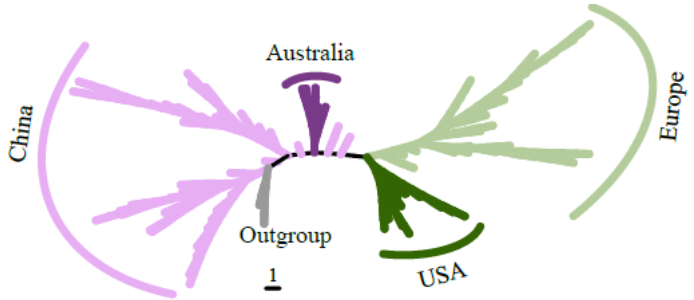
K=2

K=4

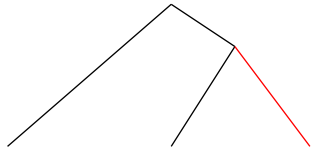




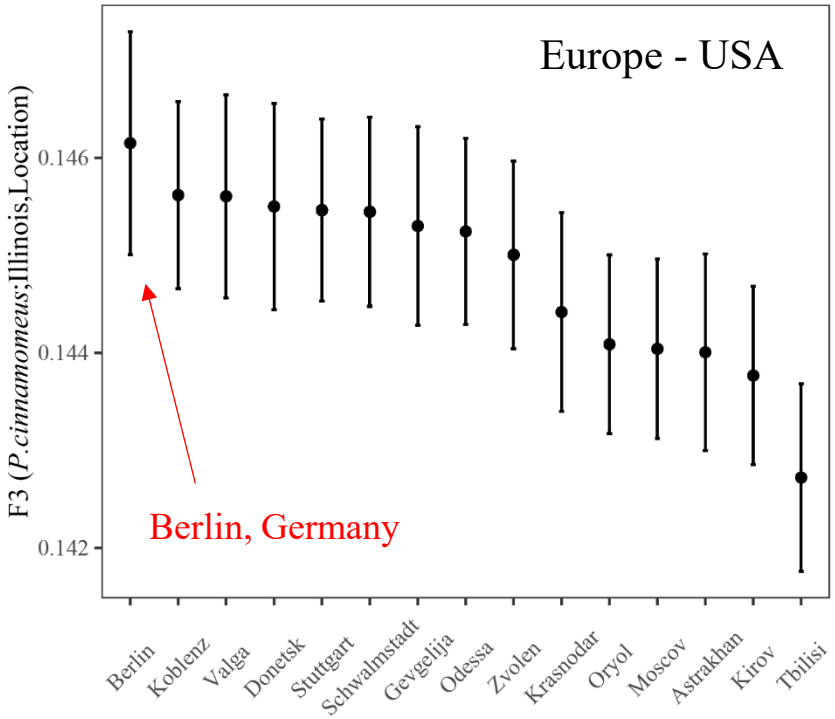


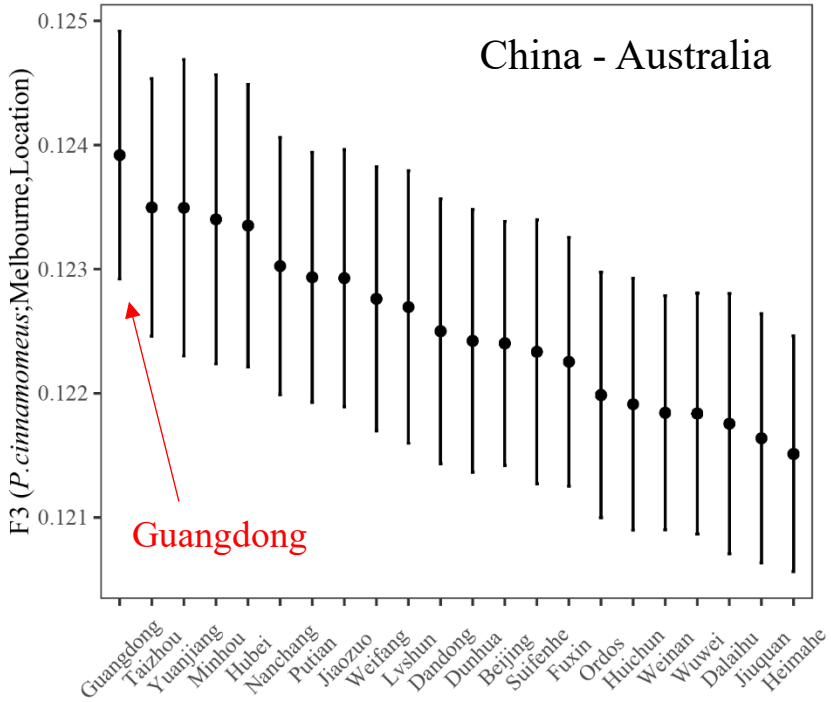


Where introduced populations come from

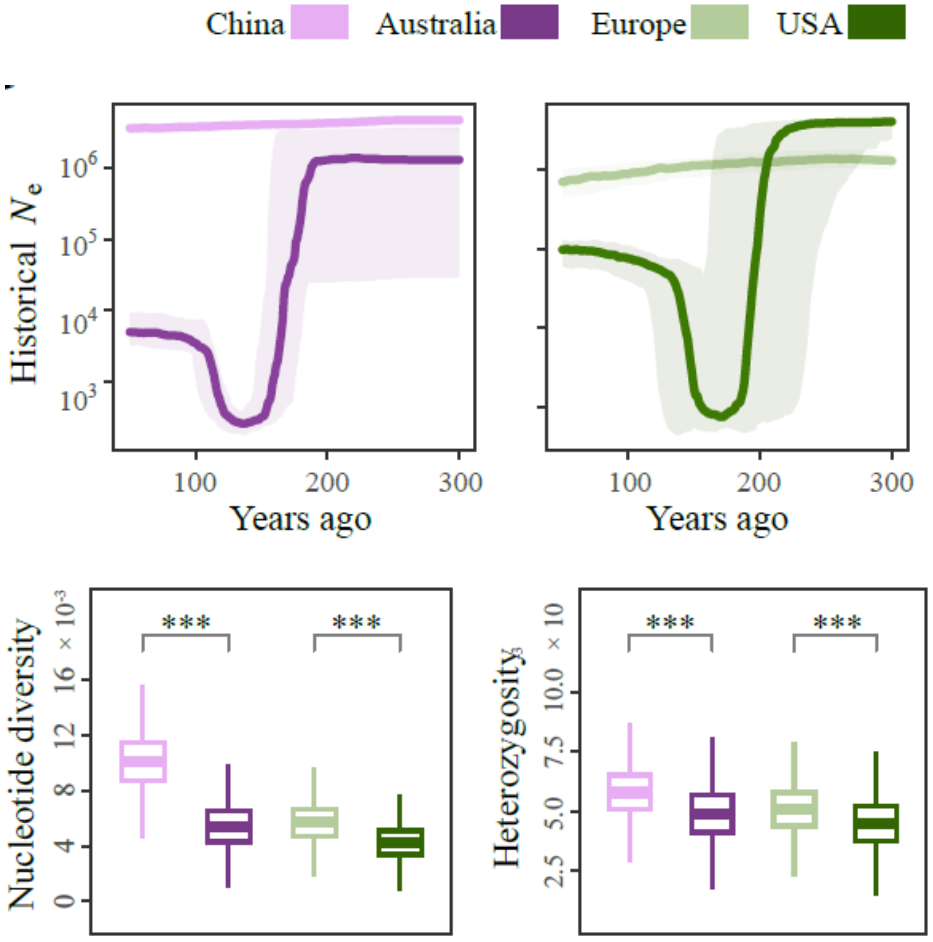


F3(Outgroup; invader, tests) -- highest F3 indicates source



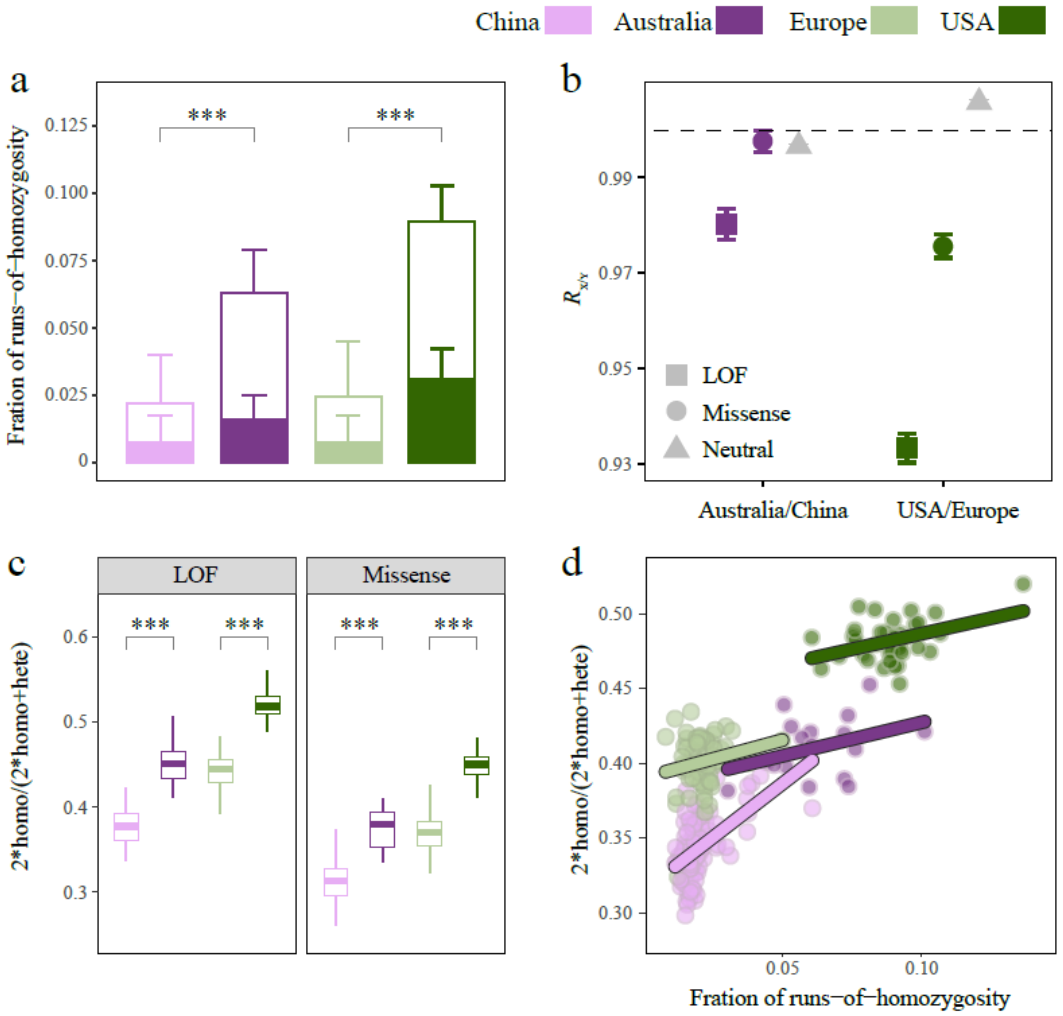


Founder events left footprints on genome



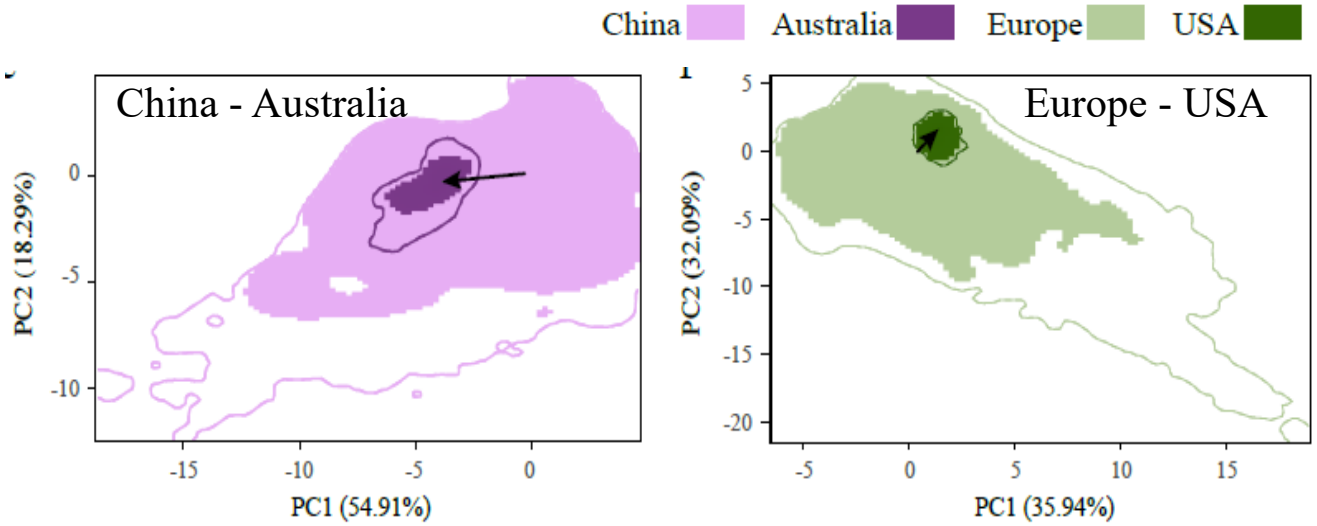
- Bottleneck ~150 years ago
- Introduced populations with lower effective size and genomic diversity

Founder events left footprints on genome

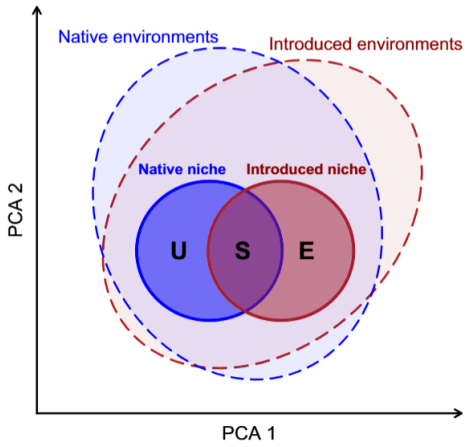


- Introduced population with higher inbreeding (ROH) and genetic load (LOF & Missense)
- Purging helped Introduced population remove deleterious mutations

Niche conserved between native and Introduced



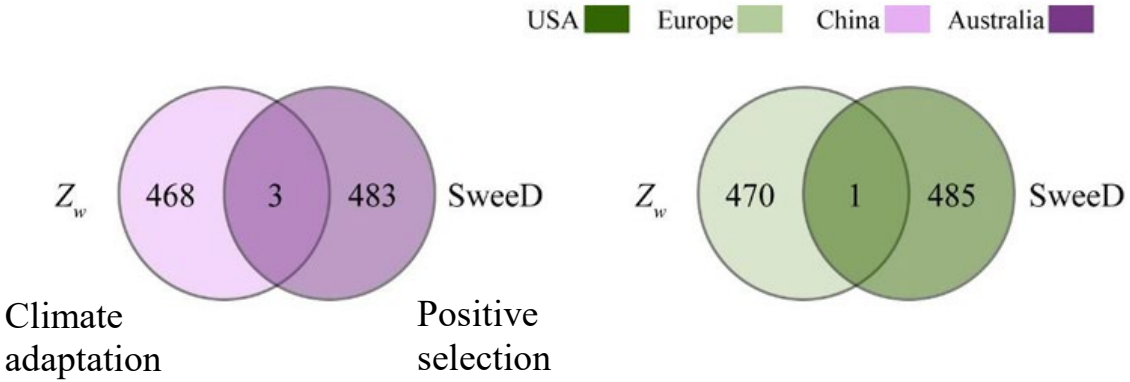
- Introduced population did not explore novel niche

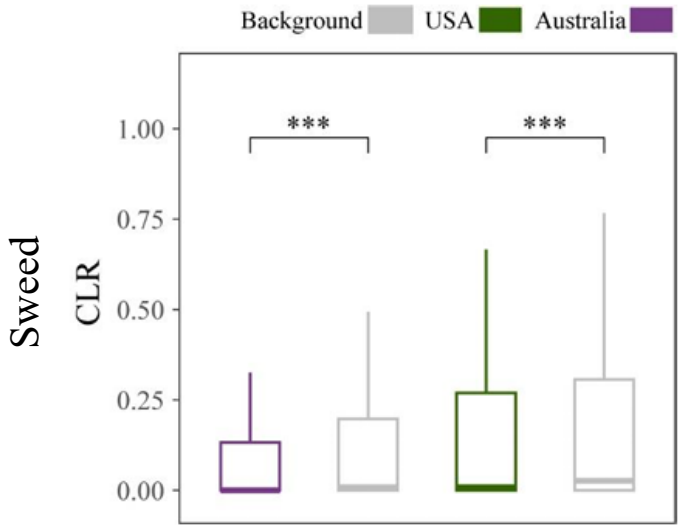


COUE scheme

COUE	Expansion	Stability	Unfilling
China - Australia	0	1	0.44
Europe - USA	0	1	0.23

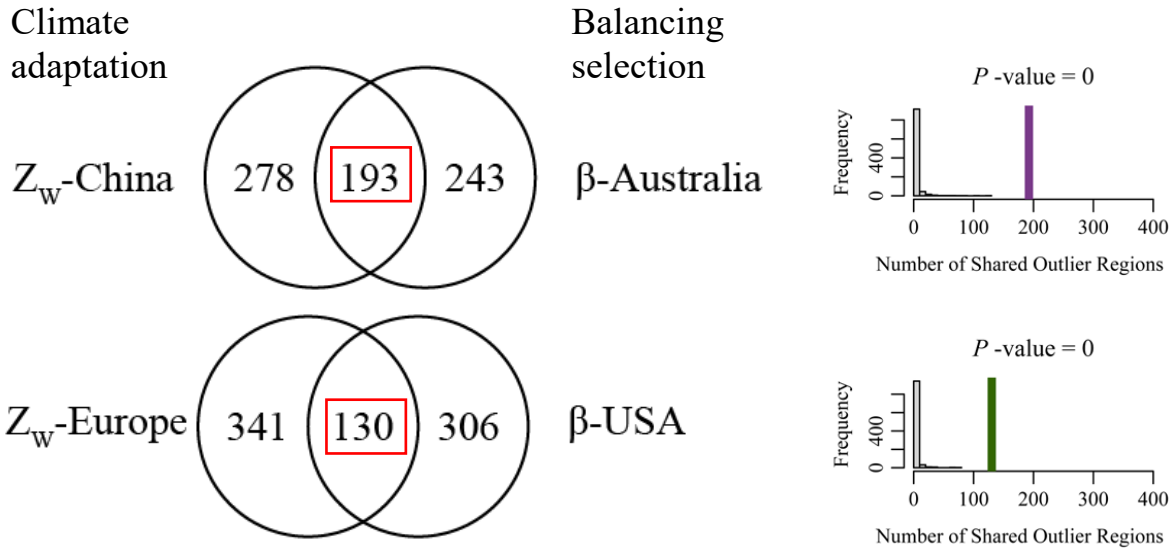
Active maintain of ancestry polymorphisms

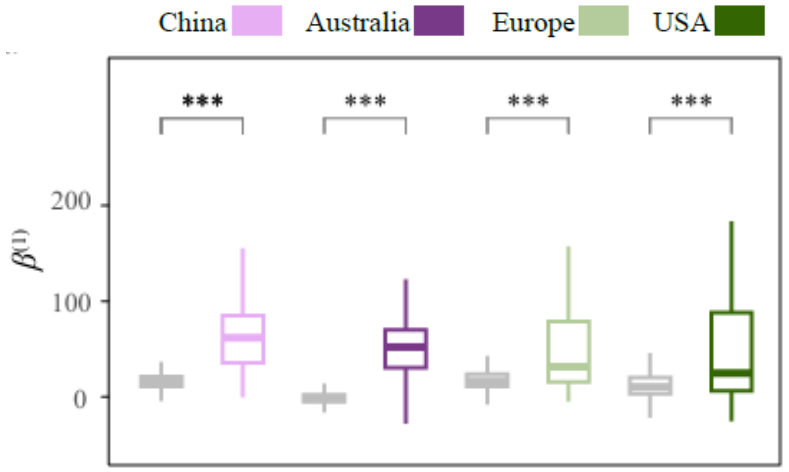




- Detect climate adaptation loci in native populations
- Climate adaptation loci in native populations did not show positive selection signal in Introduced populations

Active maintain of ancestry polymorphisms



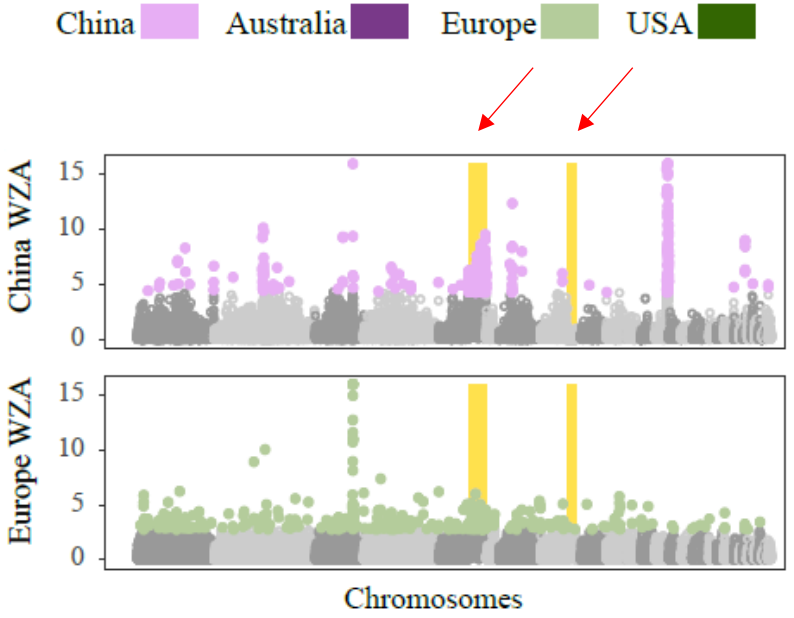


Balancing selection of climate-adaptive regions

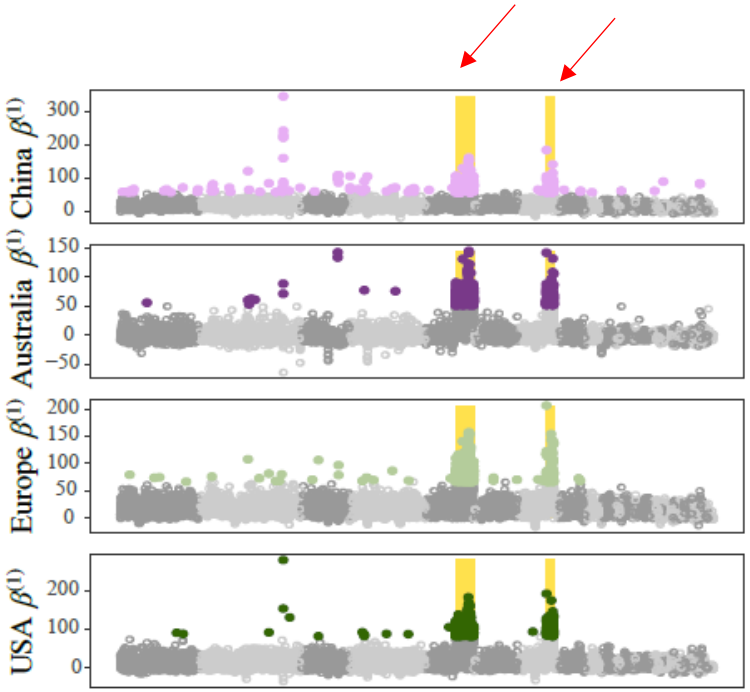
- Climate adaptation loci in native populations show balancing selection signal in Introduced populations

Active maintain of ancestry polymorphisms

- Climate adaptation loci inherited from ancestors may facilitate the tree sparrow's successful introduction

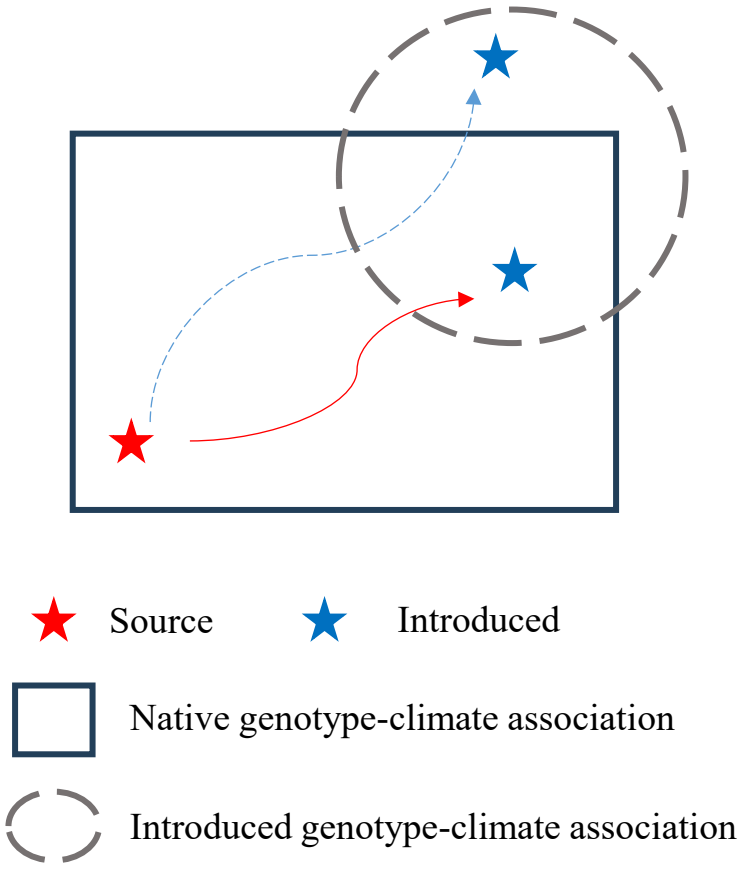


Climate adaptation in native

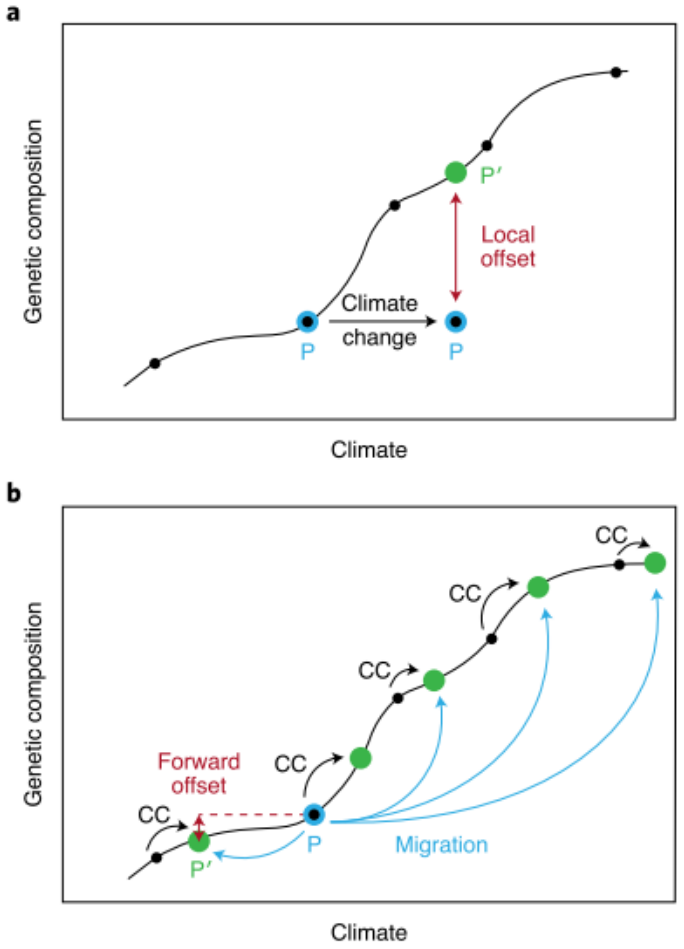


Balancing selection

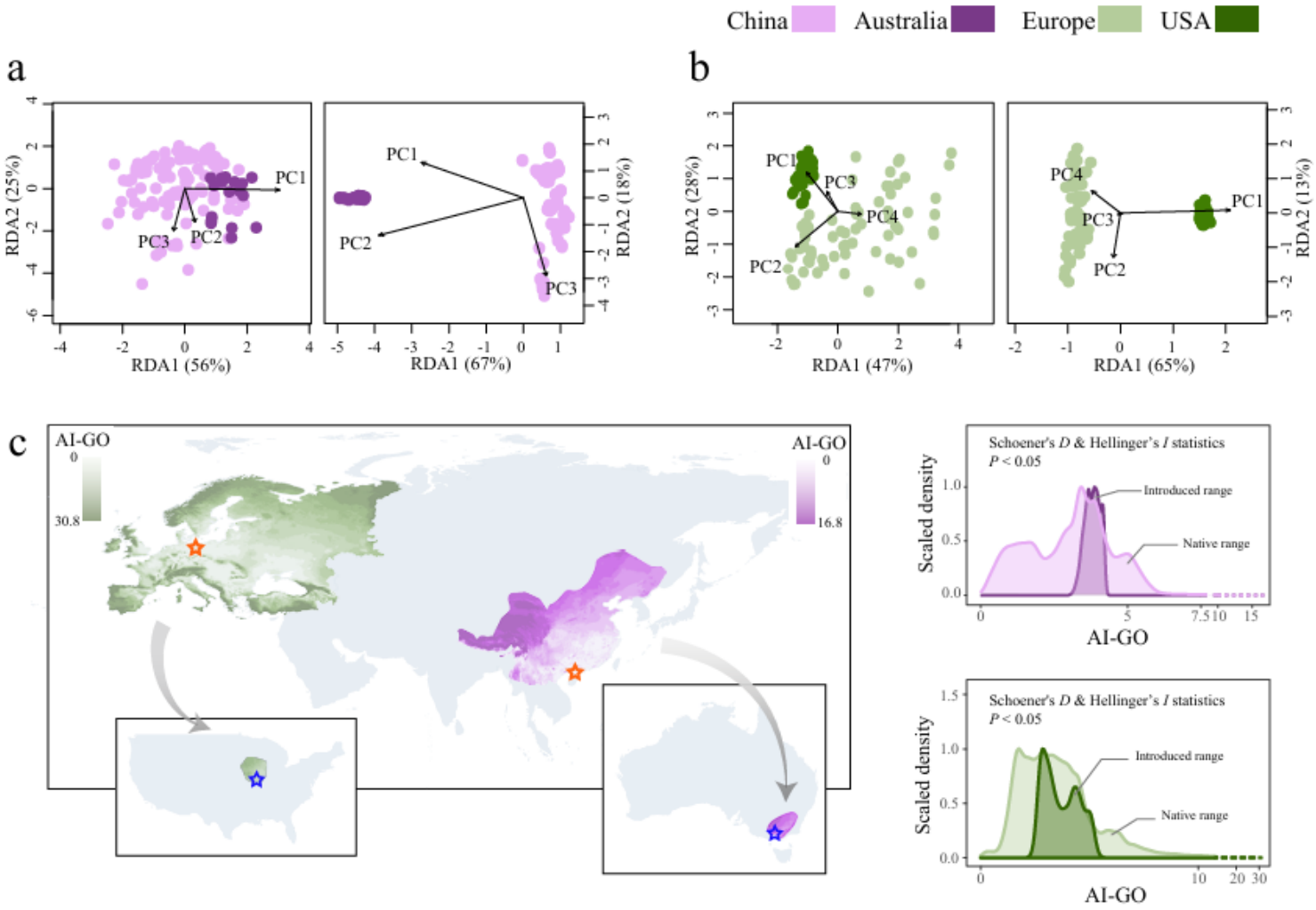
Integrate genetic and migration to predict potential of invasion



Genetic offset framework



Integrate genetic and migration to predict potential of invasion



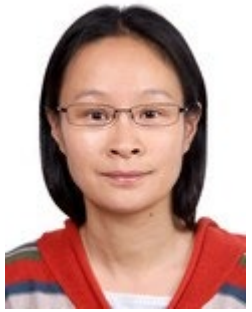
- Genetic change required for adaptation in introduced region fall within the natural adaptive capacity of source population

Conclusions

For tree sparrow's successful introduction

- Purging effect helped remove deleterious mutations, fitness increased
- Climatic niche conserved
- Climate adaptation loci inherit to introduced populations under balancing selection

Acknowledgement



Yanhua Qu

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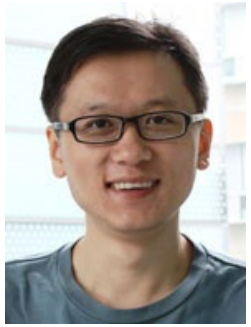

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Thanks!