

Holocene sea level change drives different fates of two Asian horseshoe crab species

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Overlapping distribution range but different habitat preference

Preferred habitats:
Mangroves, mudflats



The mangrove horseshoe crab
Carcinoscorpius rotundicauda

CR hereafter



Introduction

Two of four extant horseshoe crab species, widely distributed across Southeast Asia¹

Ecological & commercial values

Conservation status is still under evaluation

The coastal horseshoe crab
Tachypileus gigas

TG hereafter



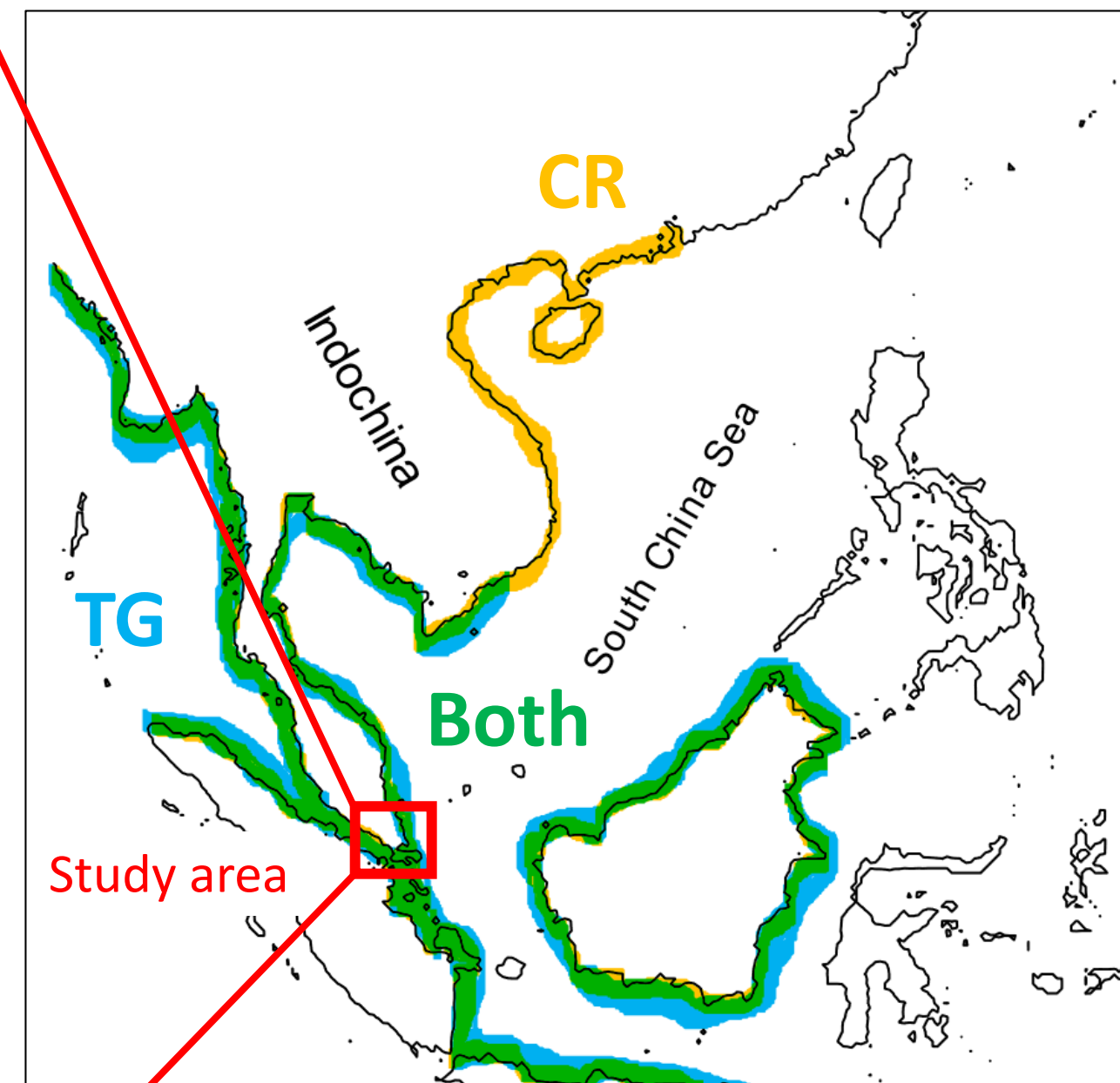
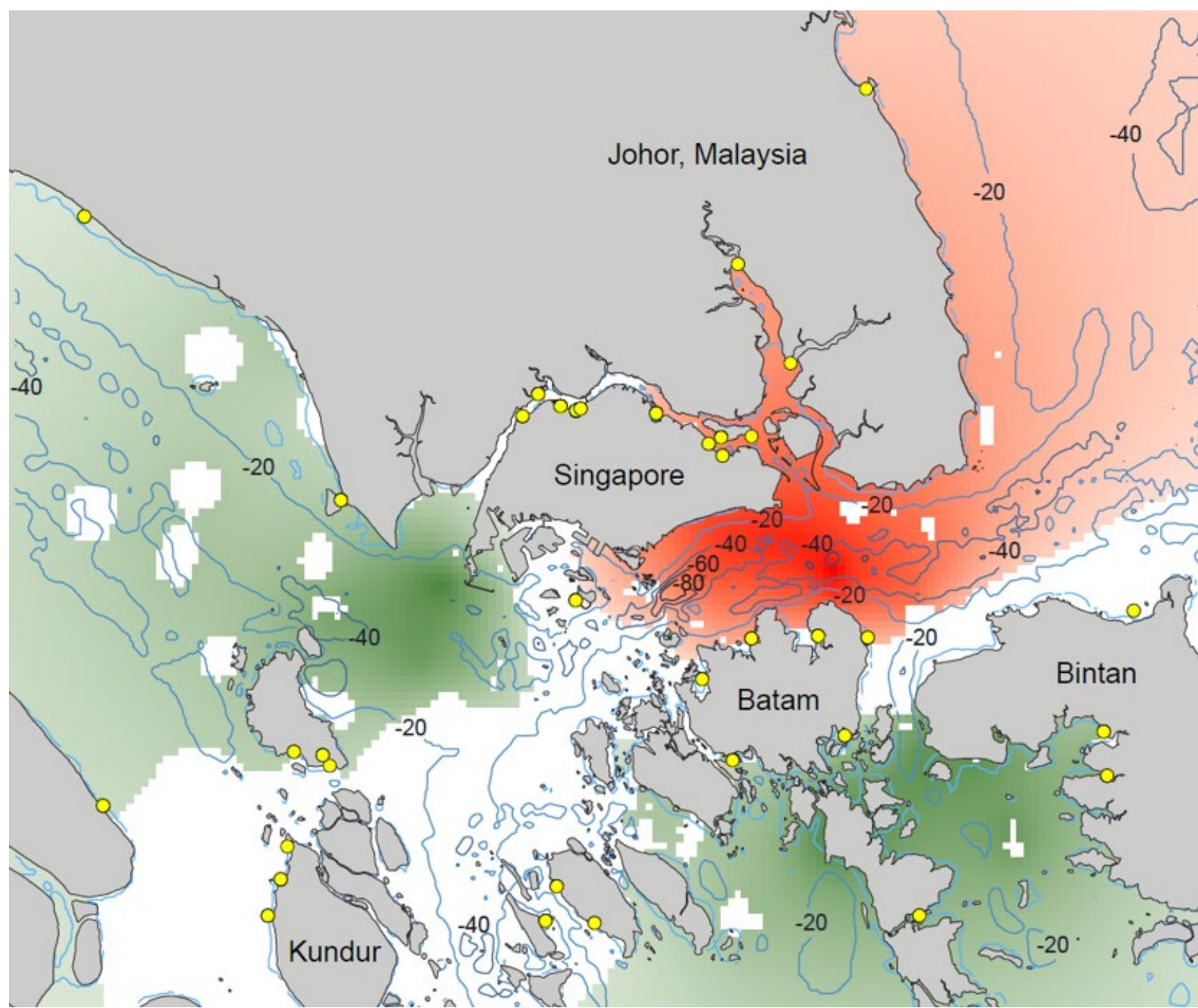
Preferred habitats:
Sandy beaches



Different dispersal capability

Mapping of resistance to dispersal ($DResD^2$) indicates depth-limited dispersal of CR

No significant resistance to dispersal of TG (data not displayed)



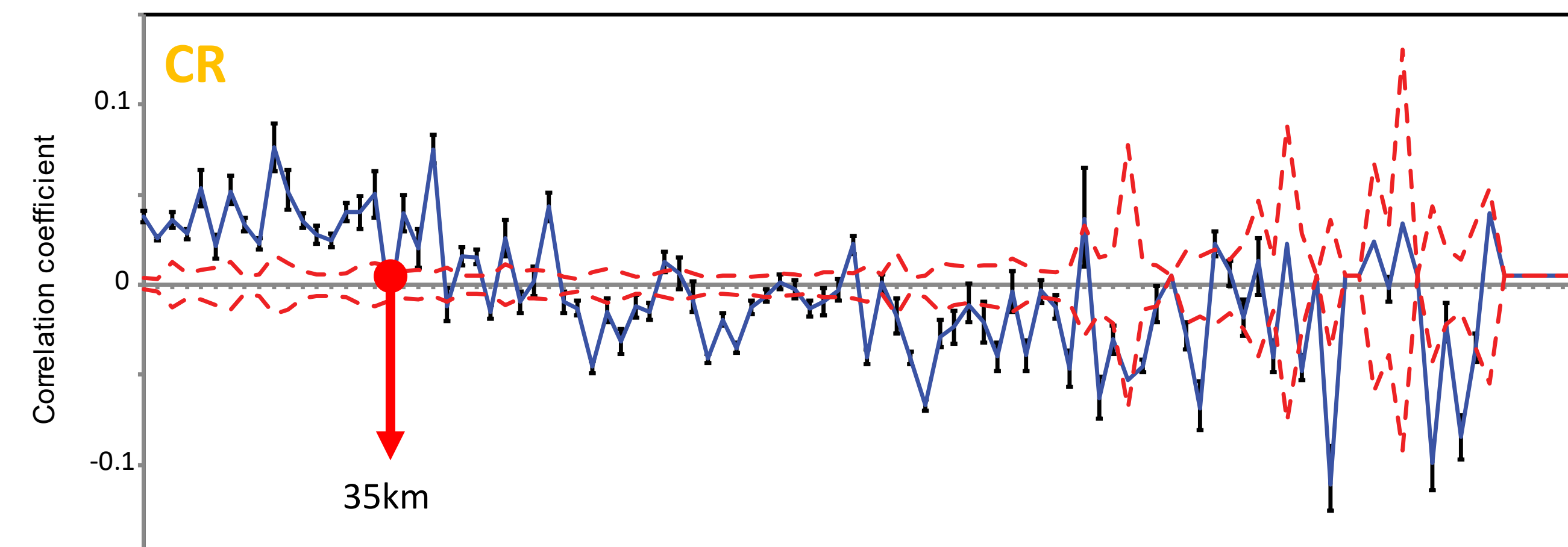
Methods

~300 individuals across the Singapore Strait (SS)

Hundreds of thousand genomic SNPs using double-digest RADseq

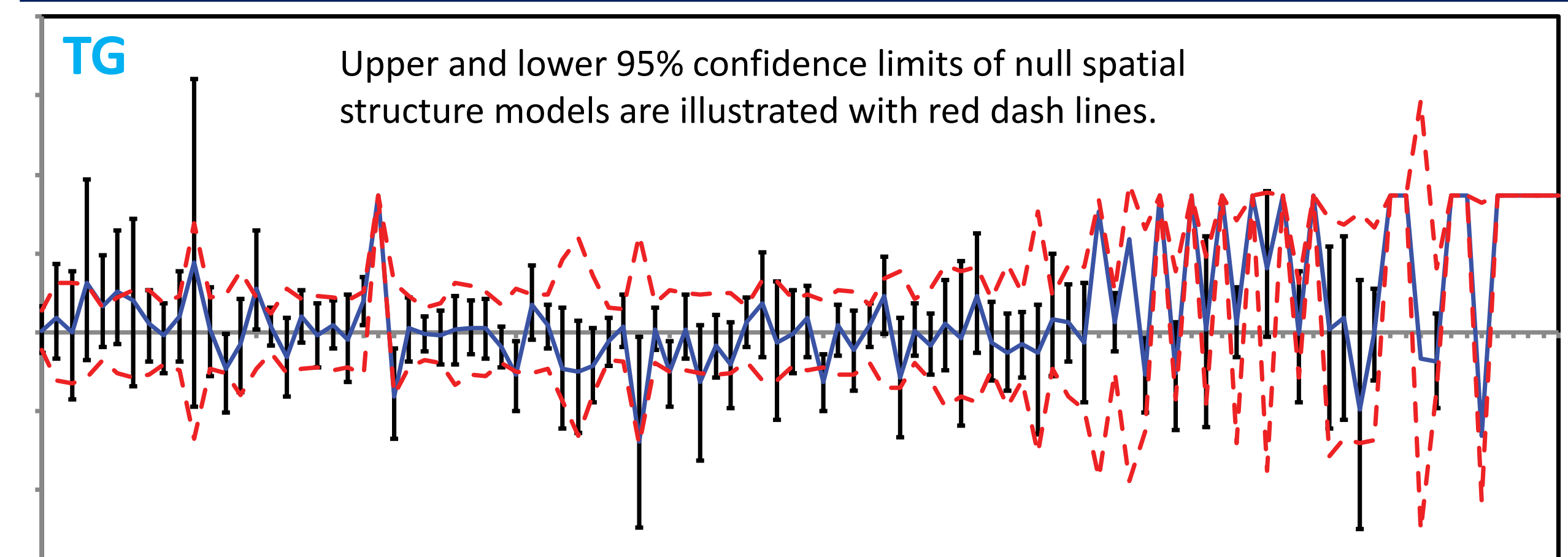
Dispersal capability was examined using spatial autocorrelation and resistance mapping.

Genetic diversity was examined by calculating heterozygosity and effective population size

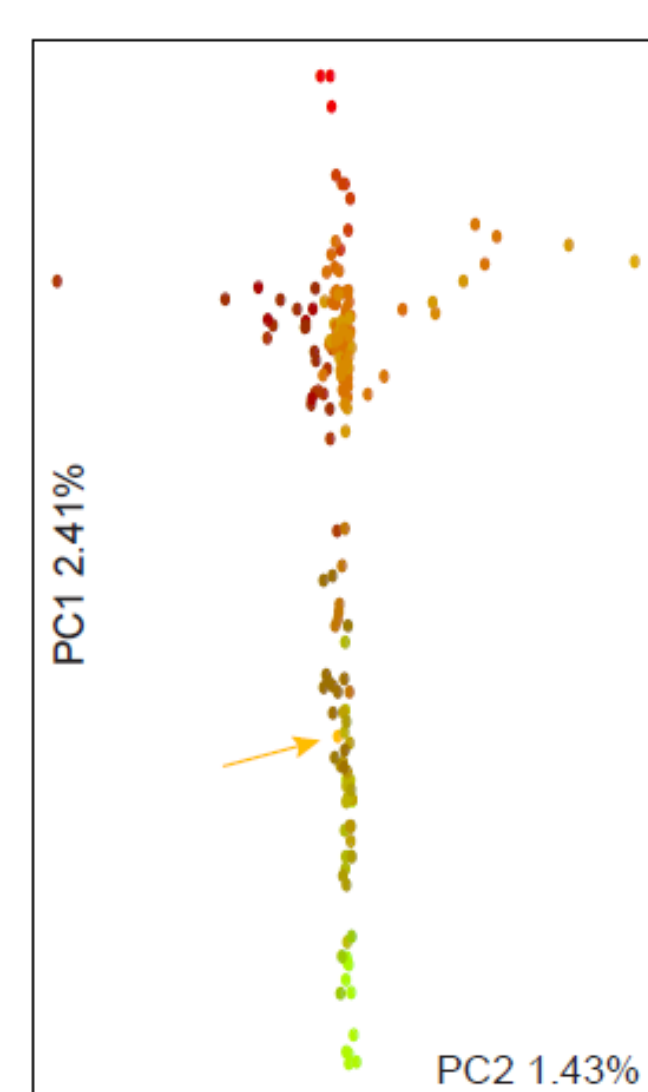
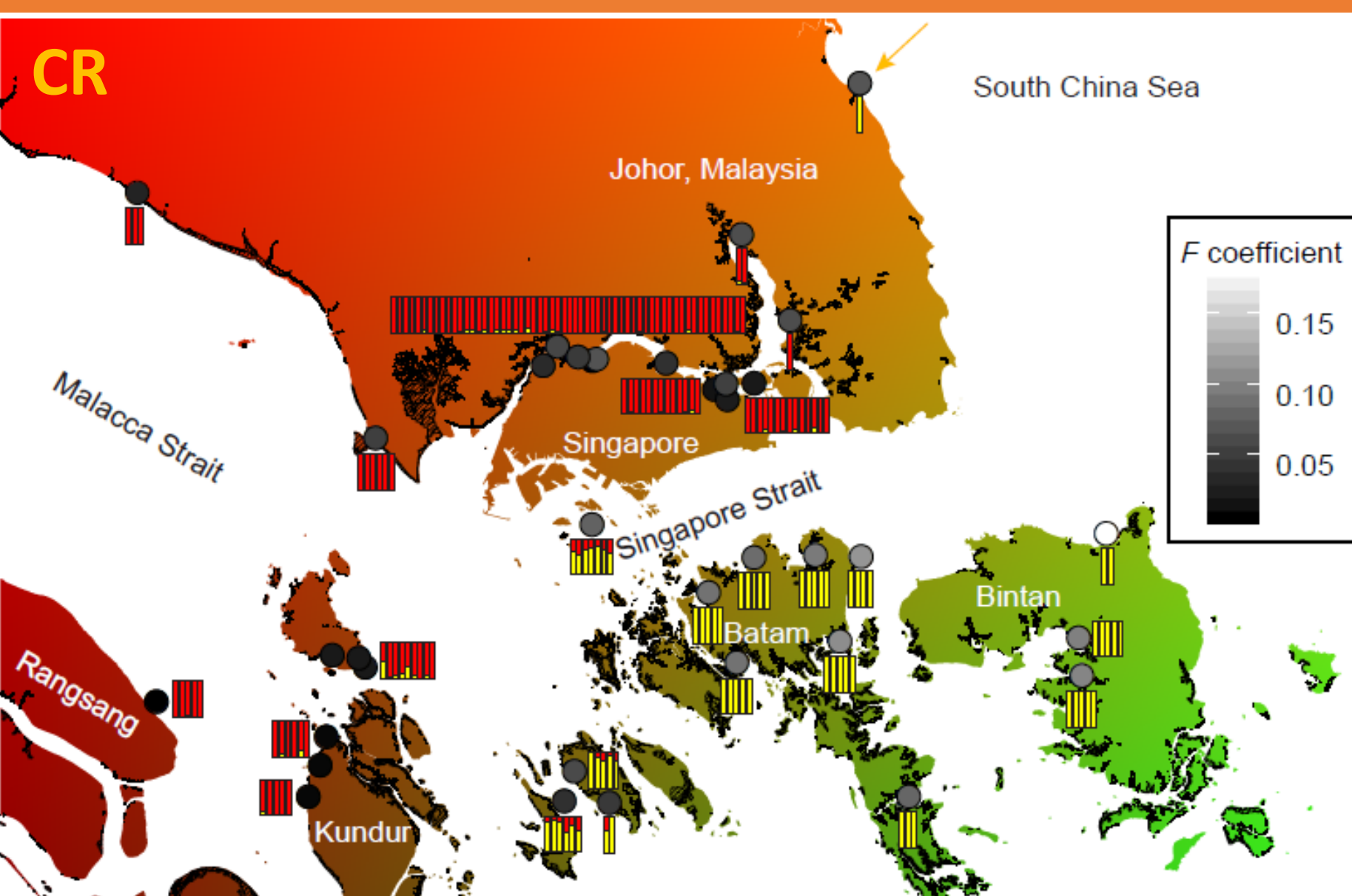


Spatial autocorrelation analysis ($GenAlEx^3$) within 200km:

CR disperses within 35km
TG disperses beyond study area



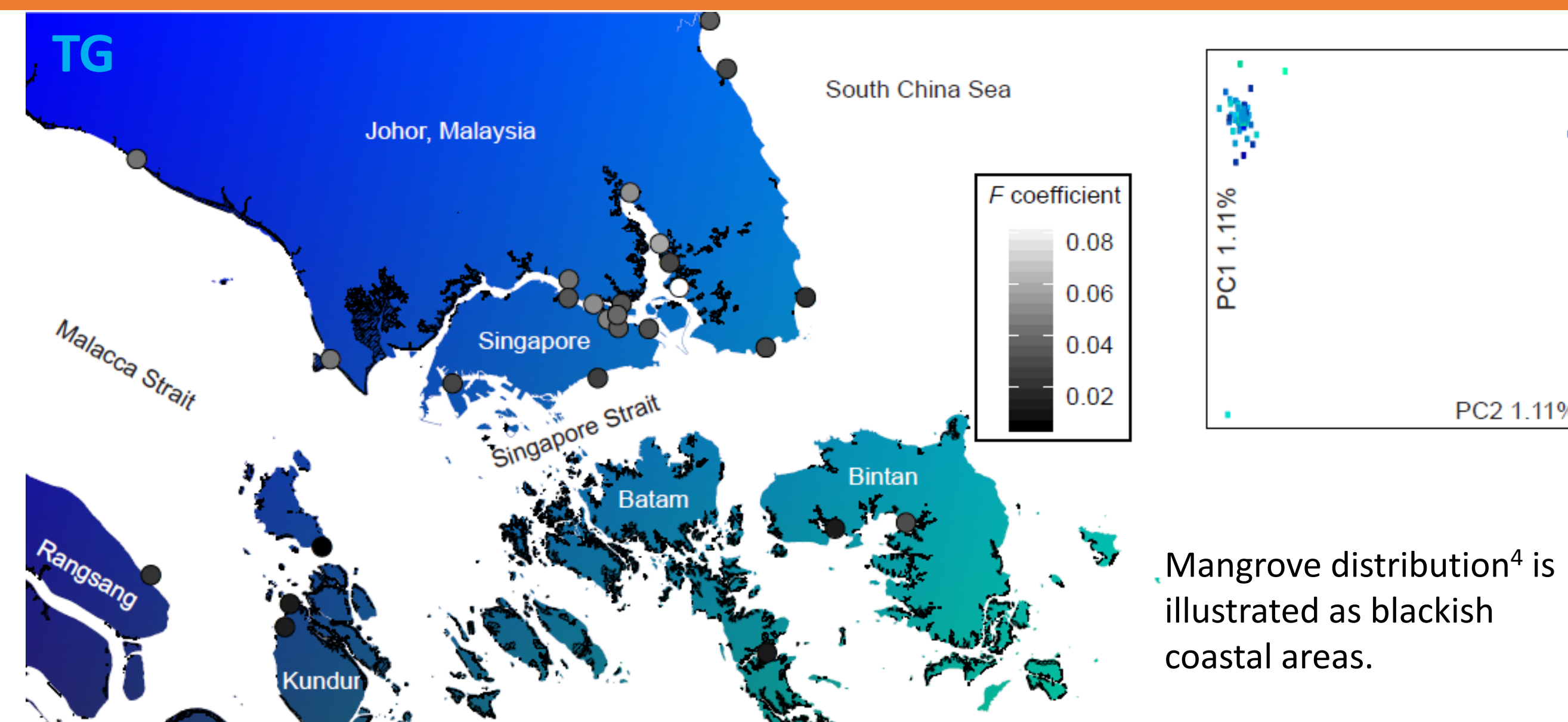
Different genetic diversity as evolutionary response



PCA plot:
Spatial-genetic correlation in CR
Panmixia in TG

ADMIXTURE⁴ bar plots:
Subdivision along the SS in CR

F coefficient:
Relatively low genetic diversity in CR, especially ones at south of SS

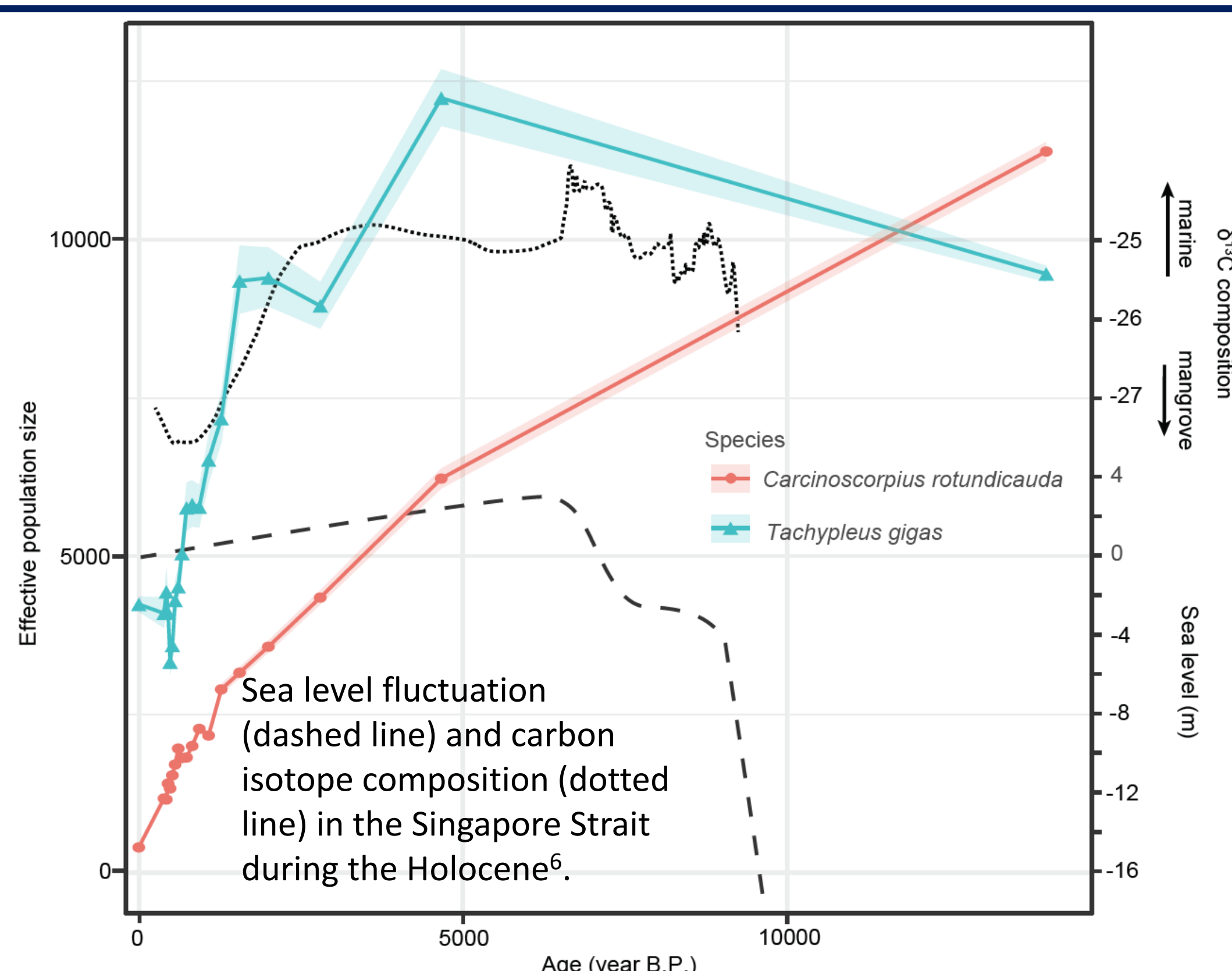


Effective population size ($LinkNe^5$) over Holocene indicates:

Sea level rise and maintain at high level → disconnection among habitats → CR decline

Rapid sea level rise → coastal area increase → TG increase

Sea level maintain → rapid mangrove formation in coastal area → TG decline



Conclusions

Capability of population genomic analyses at small spatio-temporal scale may redirect conservation measures.

Dispersal capability and habitat preference determine species' evolutionary response to climate change.

Further decline in CR with impending sea level rise, whereas TG may increase but subject to habitat dynamics and human disturbance.

References

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