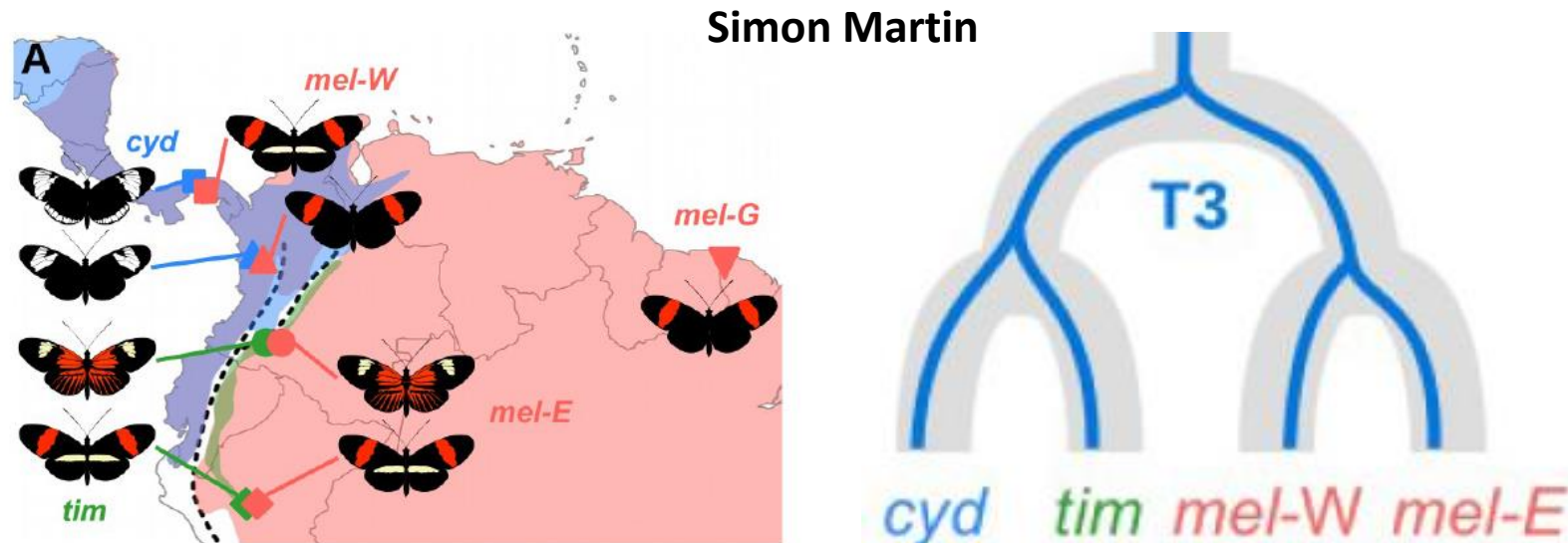


Detecting regions under divergent selection / barriers to gene flow

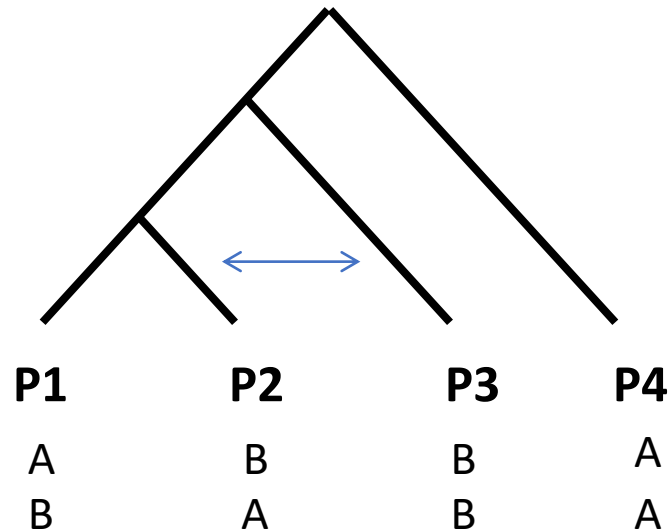
- If rates of gene flow between the two taxa/populations/species compared is high, F_{ST} is a good measure for detecting regions under divergent selection or barrier loci
- If the taxa are divergent enough, d_{xy} may work best, particularly if levels of gene flow are not very high and in cases of secondary contact
- If the taxa are very young and gene flow is not very high, f_d might help



Sliding window introgression statistics

f_d can be applied to smaller number of ABBA and BABA sites than D and is thus ideal for sliding windows.

ABBA and BABA patterns are computed from allele frequencies and the f test of the four populations is standardized by the maximum value it could get which would be the scenario of complete mixing between P2 and P3. P2 and P3 are thus both set to PD which is the taxon with higher derived allele frequency of P2 and P3.



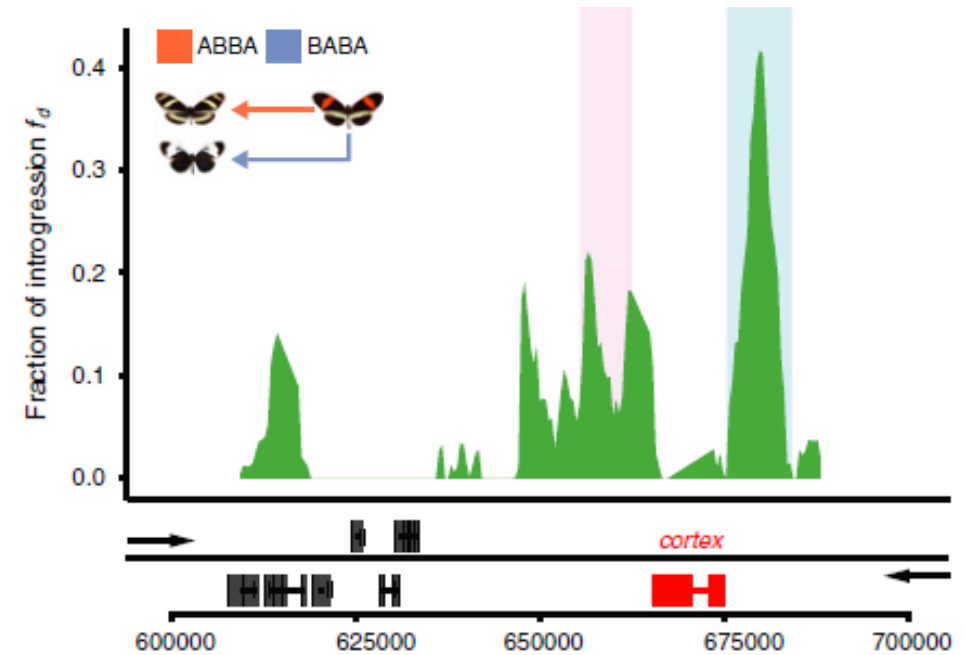
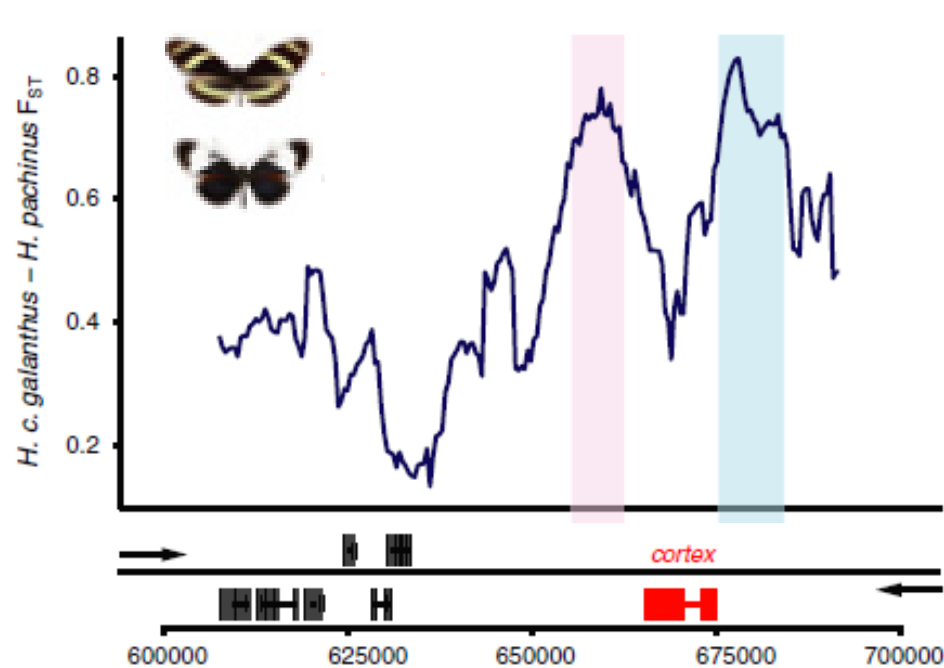
$$C_{ABBA}(i) = (1 - \hat{p}_{i1})\hat{p}_{i2}\hat{p}_{i3}(1 - \hat{p}_{i4})$$

$$C_{BABA}(i) = \hat{p}_{i1}(1 - \hat{p}_{i2})\hat{p}_{i3}(1 - \hat{p}_{i4})$$

$$\hat{f}_d = \frac{S(P_1, P_2, P_3, O)}{S(P_1, P_D, P_D, O)}$$

PD=P2 or P3
(taxon with higher
derived allele frequency)

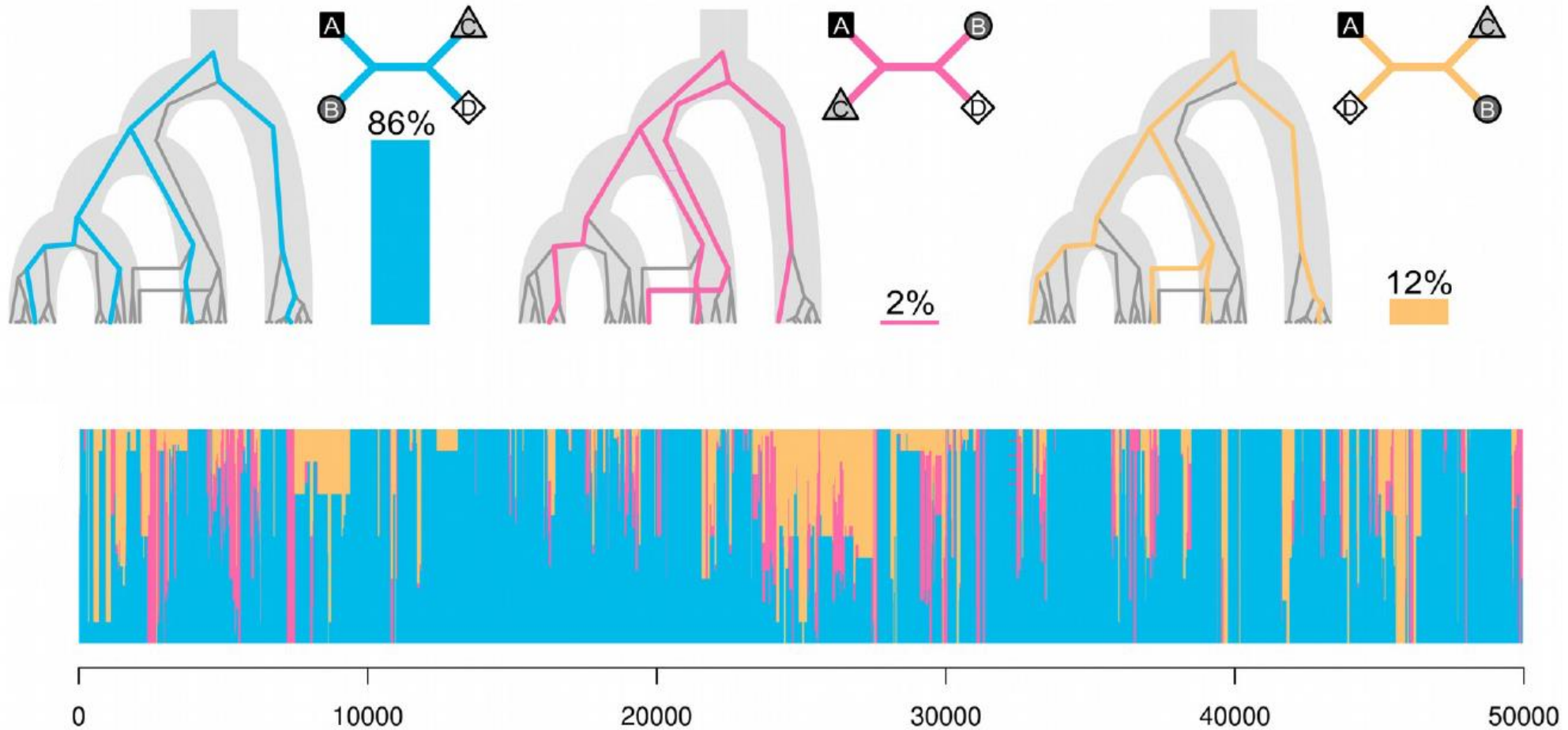
f_d can be used to find regions of adaptive introgression



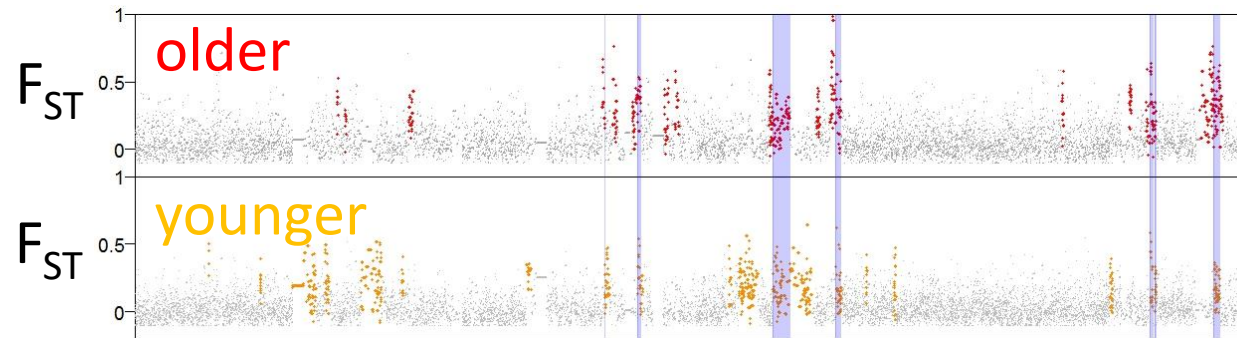
Detecting regions under divergent selection / barriers to gene flow

- F_{st}
- d_{xy}
- Tajima's D (low if under selection)
- Long-range haplotype statistics (iHS, XP-EHH, requires phasing)
- π ($\Delta \pi$)
- f_d
- TWISST
- recombination rates

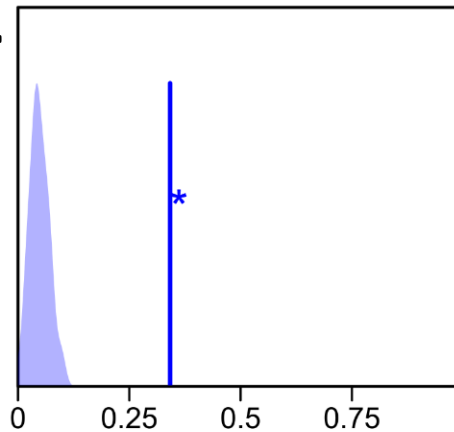
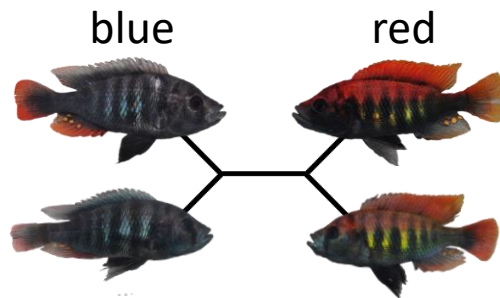
TWISST: Visualizing gene trees across the genome



Example: Highly differentiated regions shared by both species pairs show parallel allele frequency differences



Species group by color



%shared HDRs with color topology

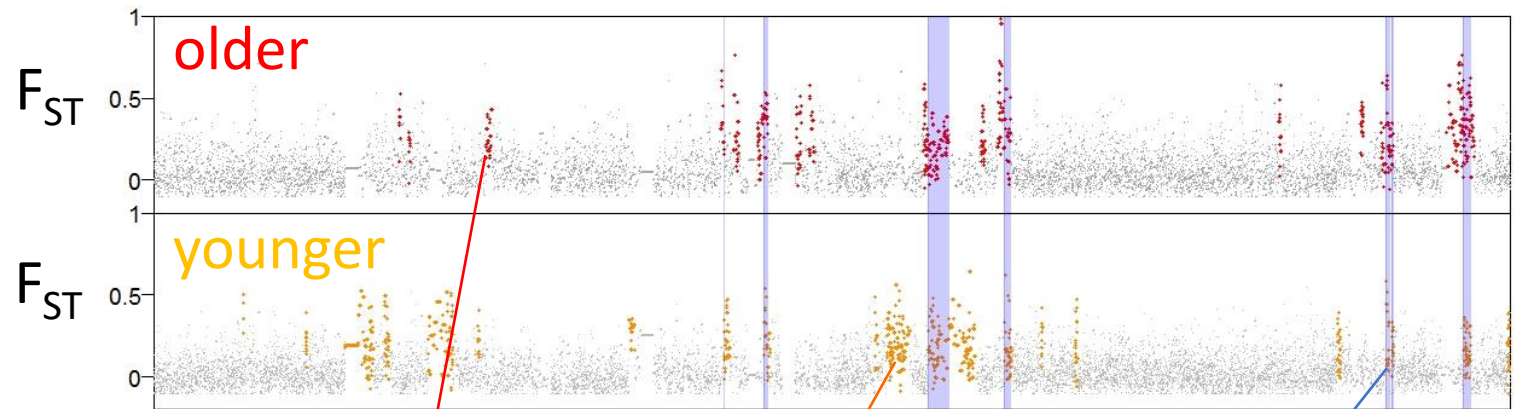
TWISST

(Martin & Van Belleghem, 2017)

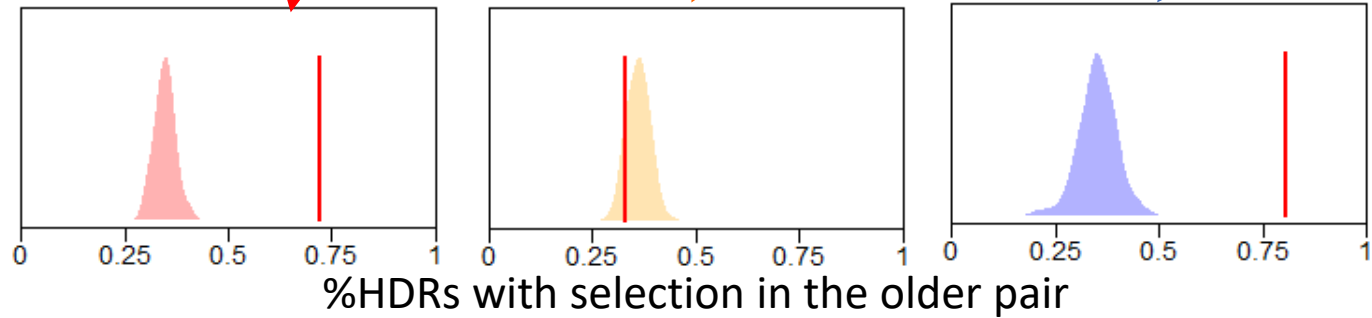
Enrichment of selection statistics support the action of selection

Selection statistics:

d_{xy}
Tajima's D
 $\Delta\pi$
XP-EHH
iHS



Selection in the older pair



Selection in the younger pair

