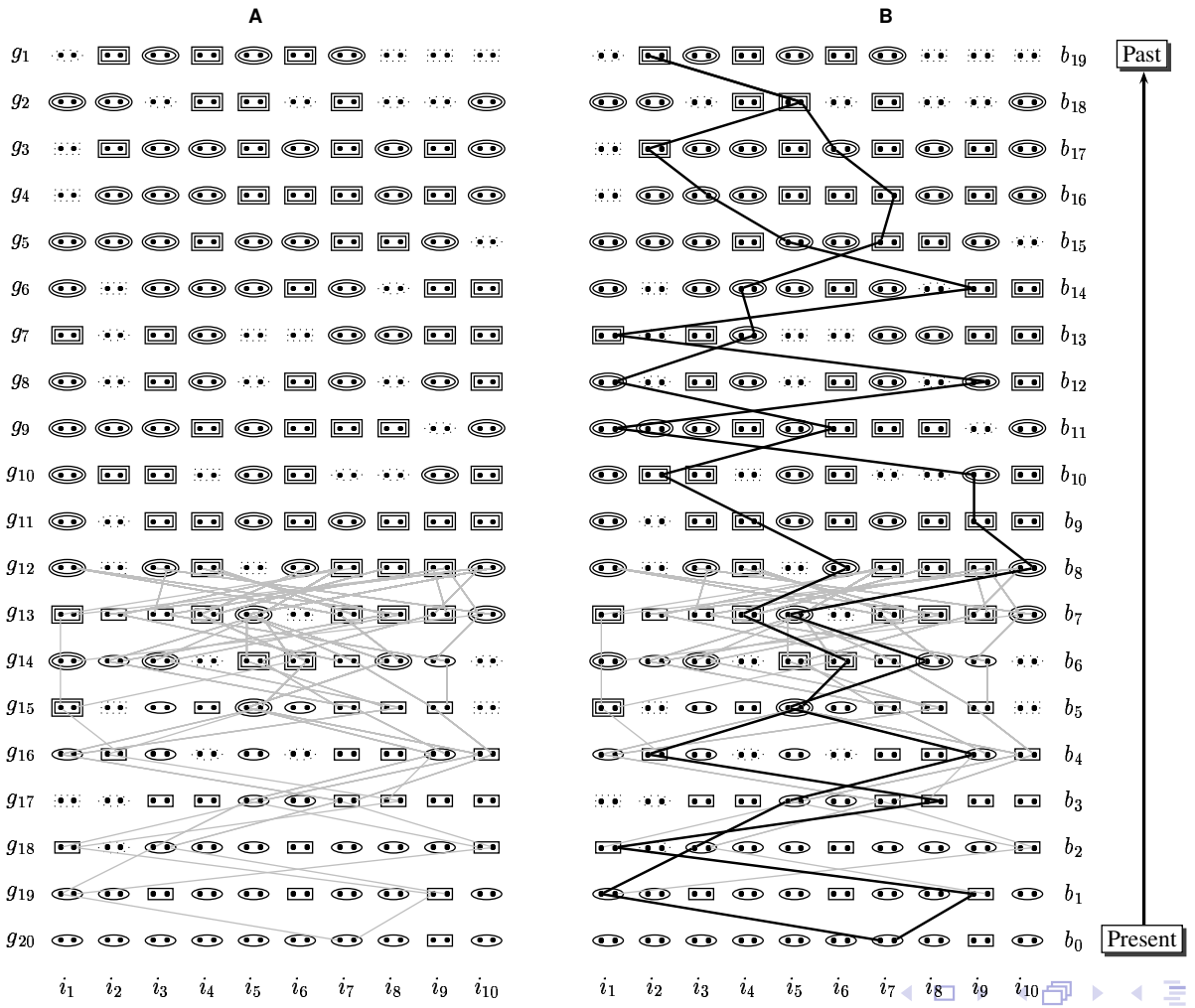
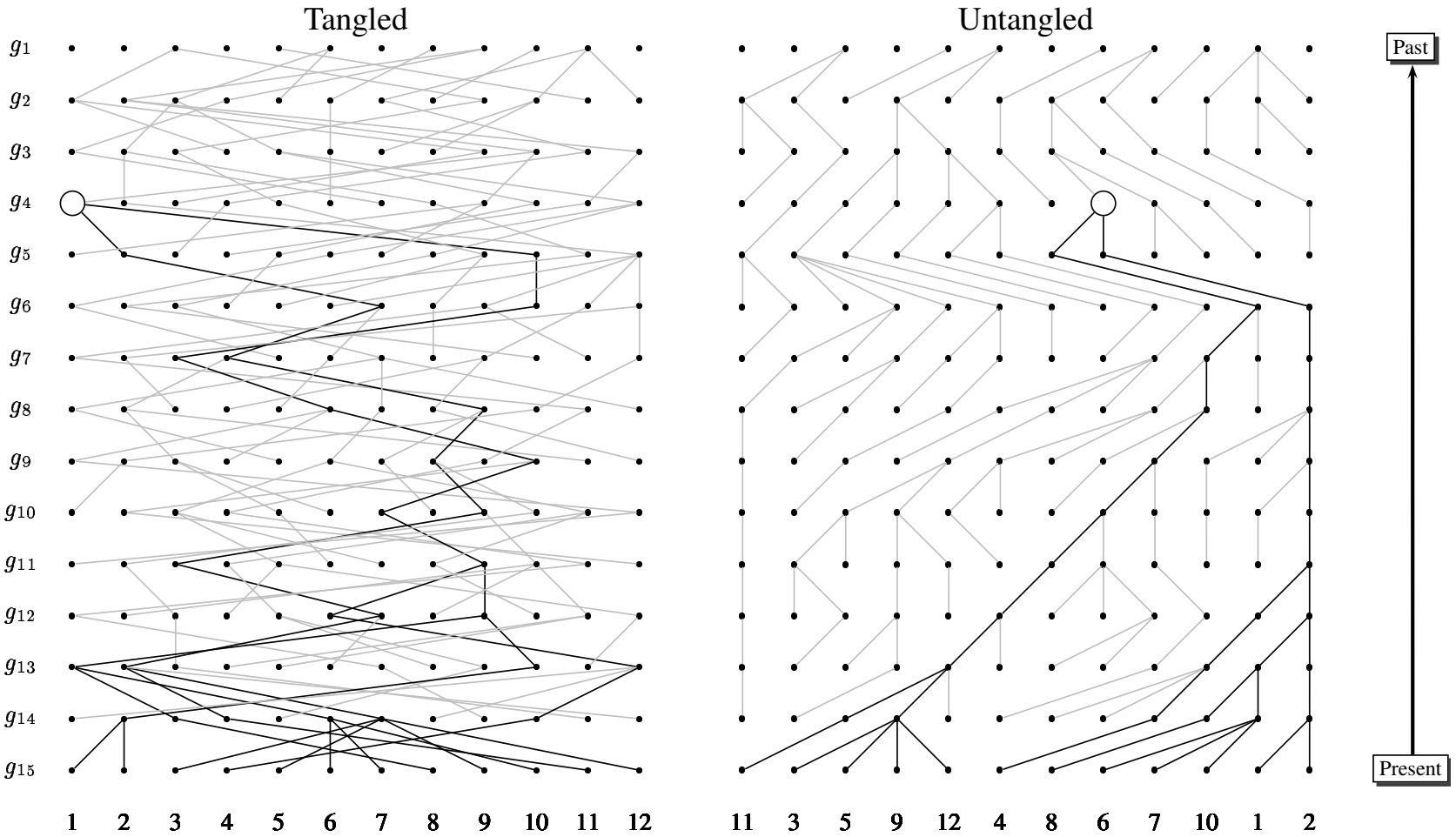
Introduction to Computational Biology; An Evolutionary Approach: Genes in Populations: Backward in Time

Bernhard Haubold & Thomas Wiehe

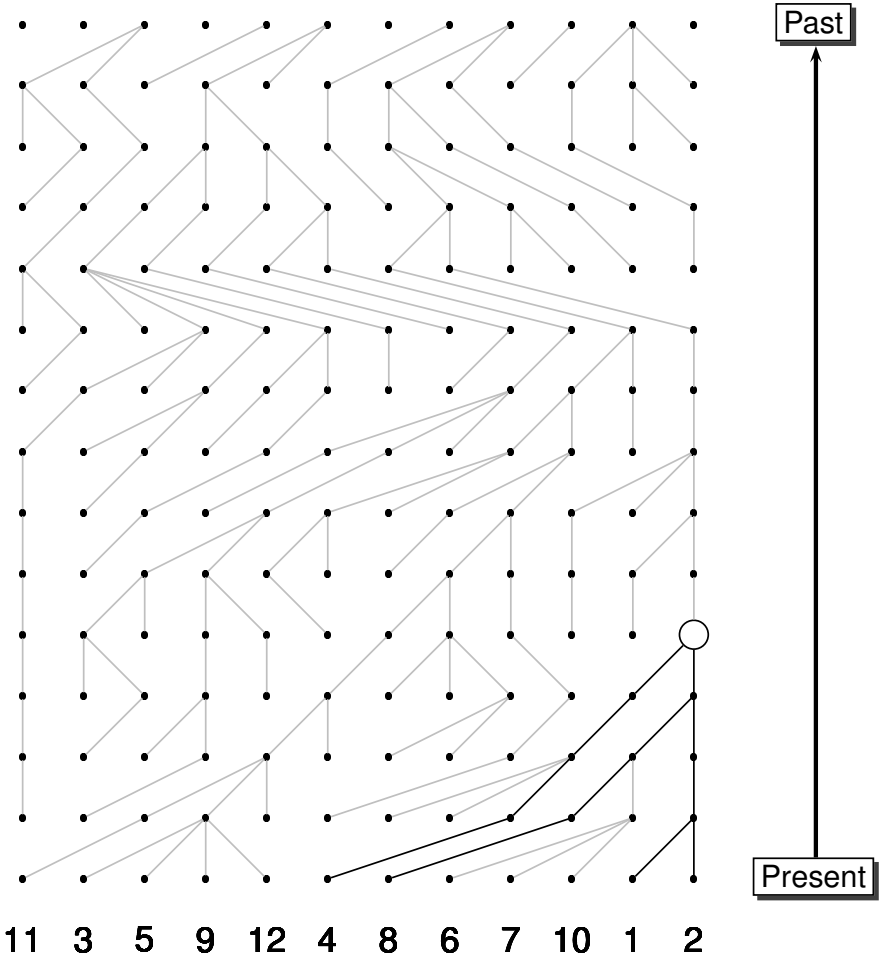
Genealogy of Individuals



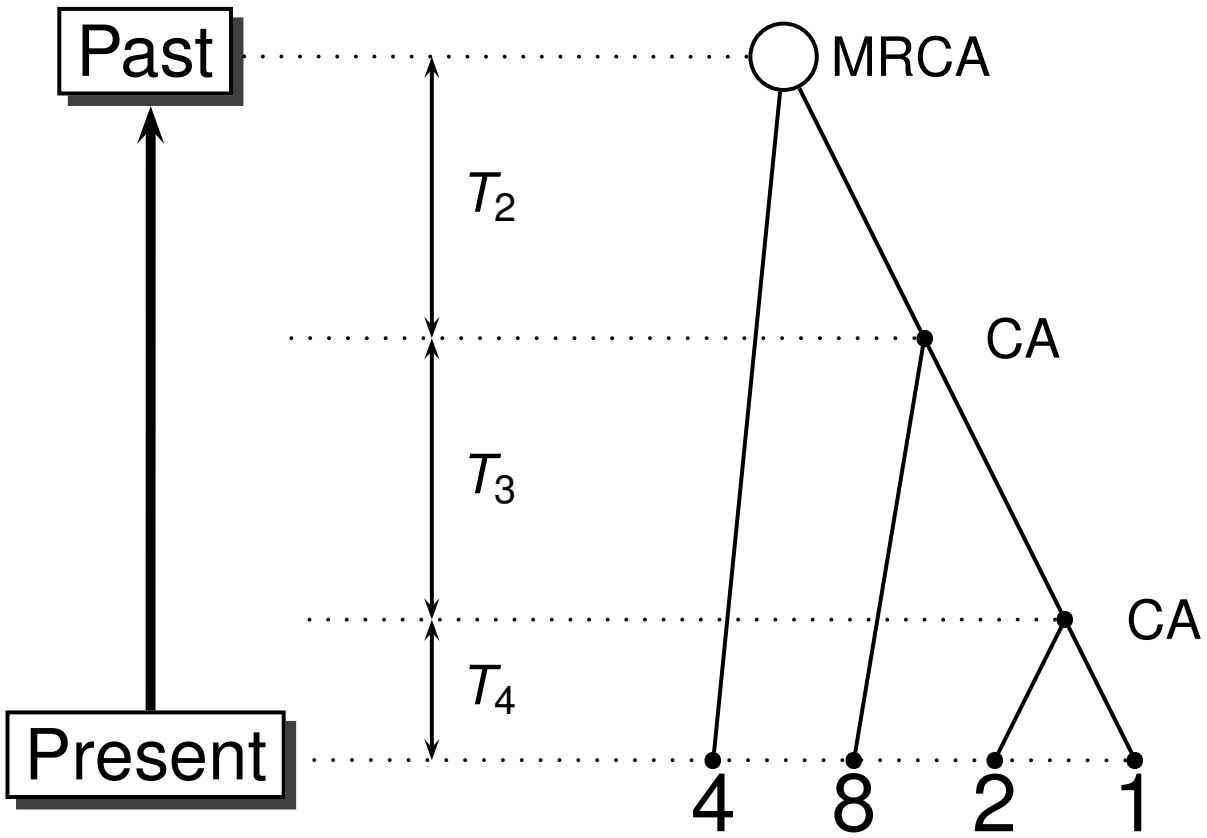
Genealogy of Genes



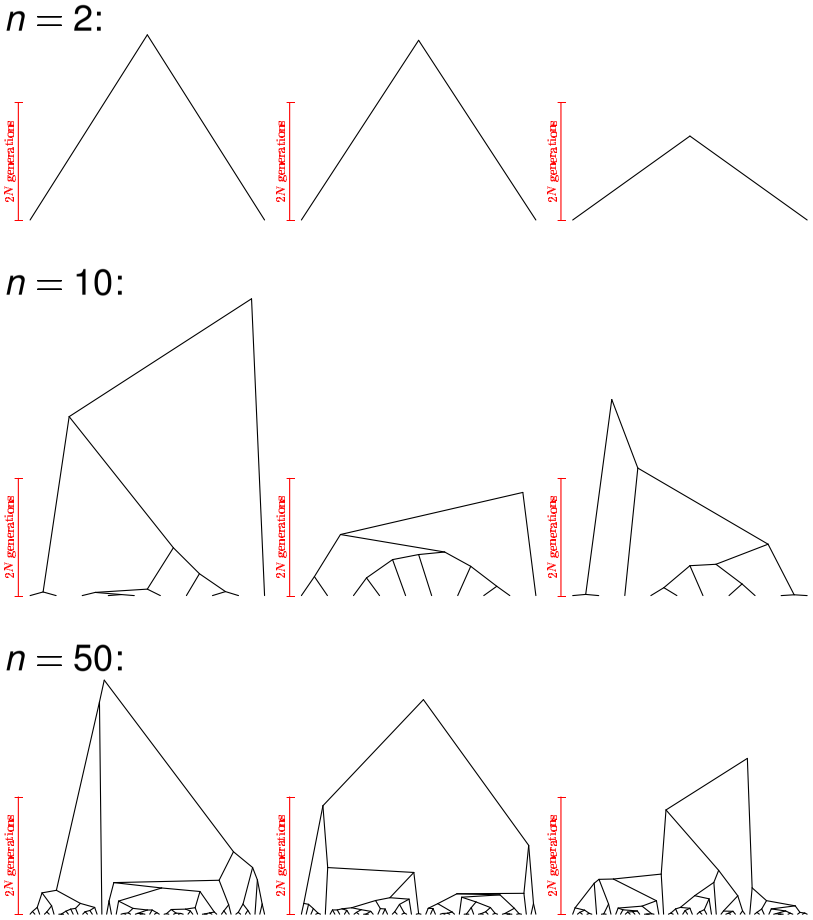
Sample Genealogy



The Coalescent



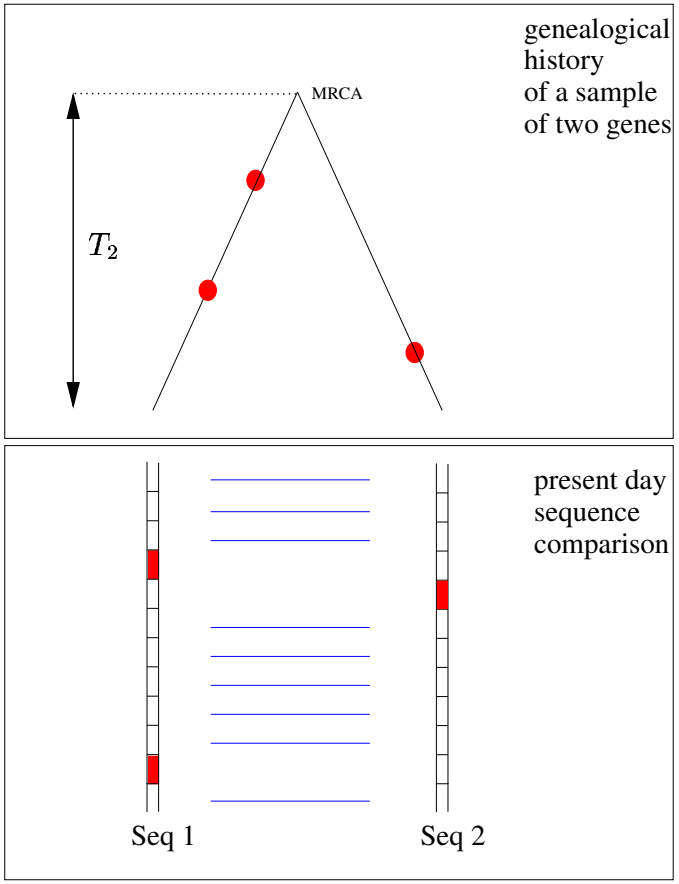
Coalescent Trees



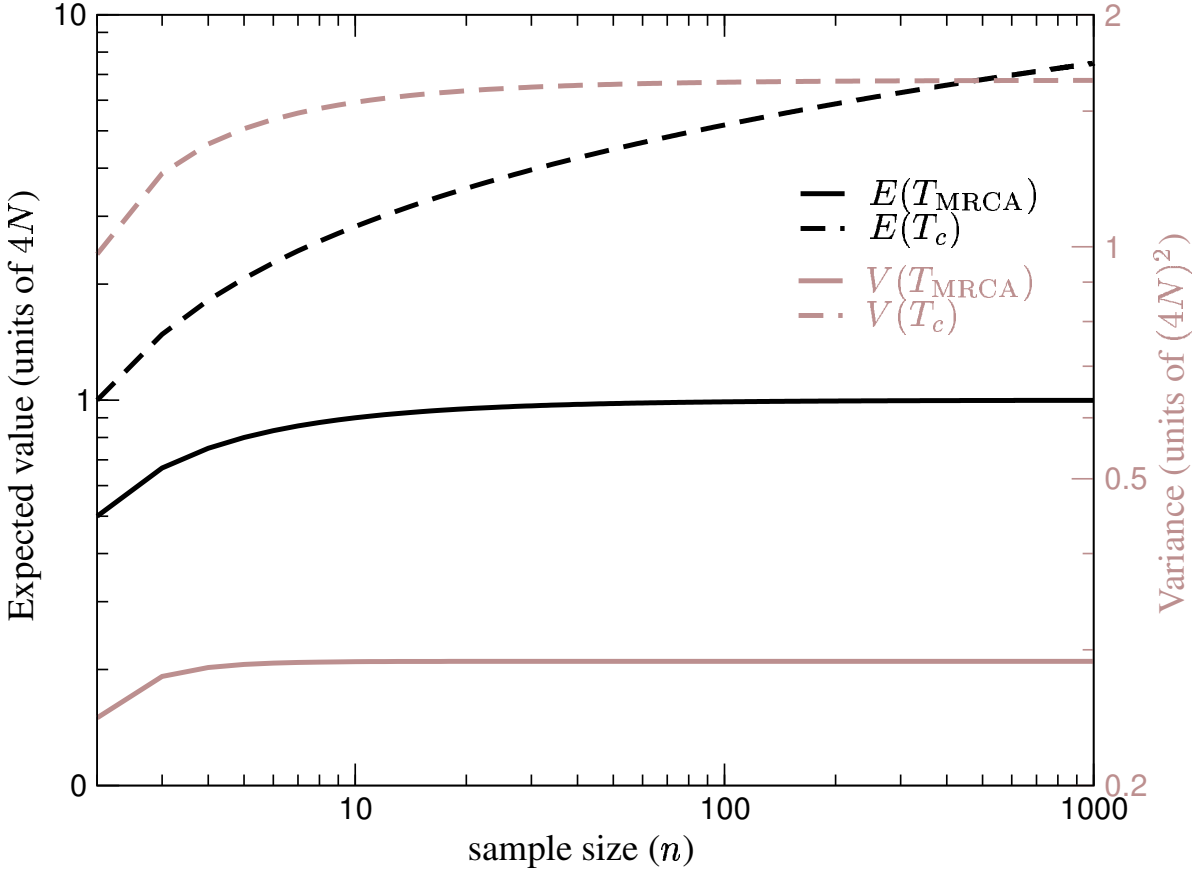
Coalescent *vs.* Phylogeny

Feature	Phylogeny	Coalescent
Level of comparison	Inter-species gene history	Intra-species gene history
Purpose	Reconstruct the true species history	Simulate sets of potential gene histories
Observation of interest	Tree topology	Frequency spectrum and distribution of segregating sites
Data source	Comparative data	Model parameters
Multiplicity	Single	Many

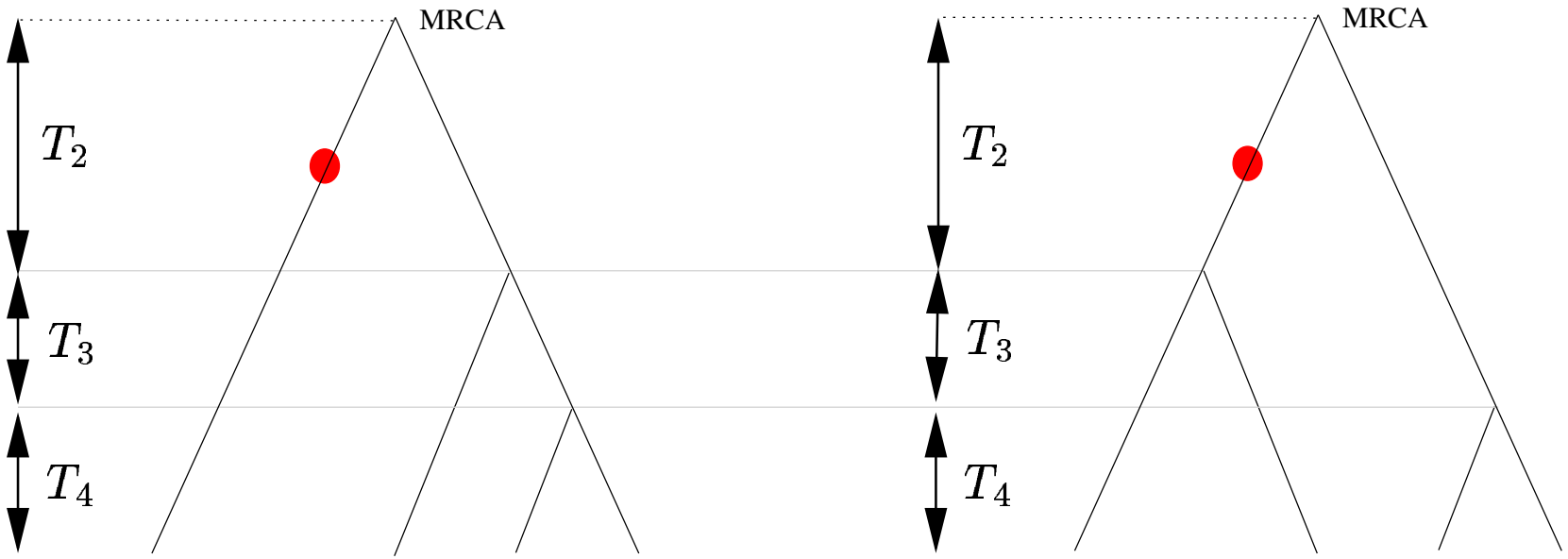
Genealogy & Polymorphisms



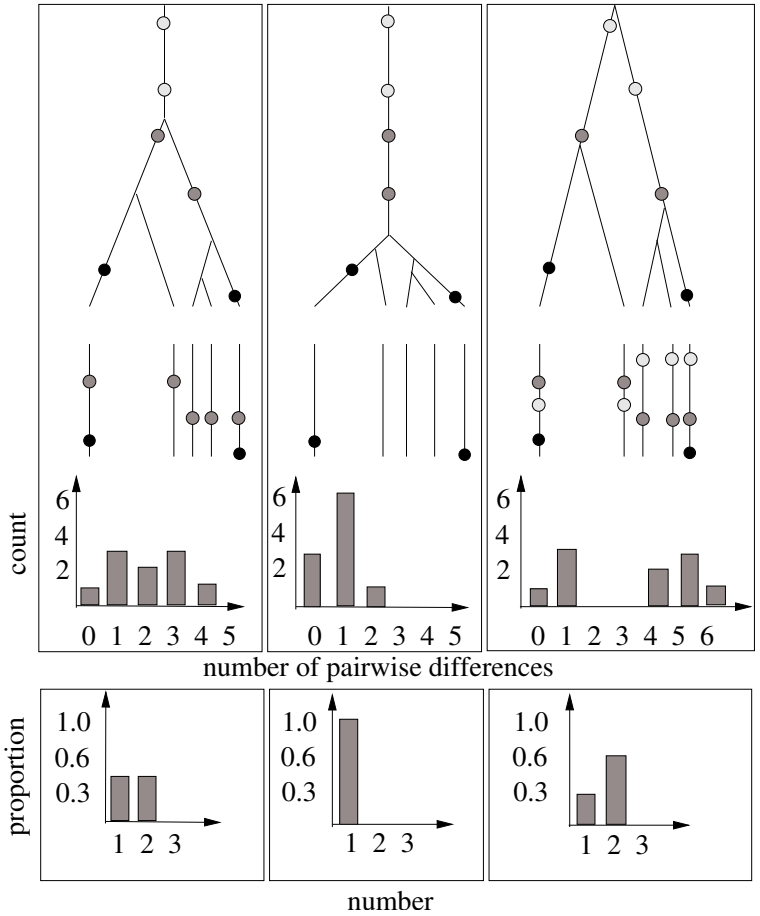
T_{MRCA}



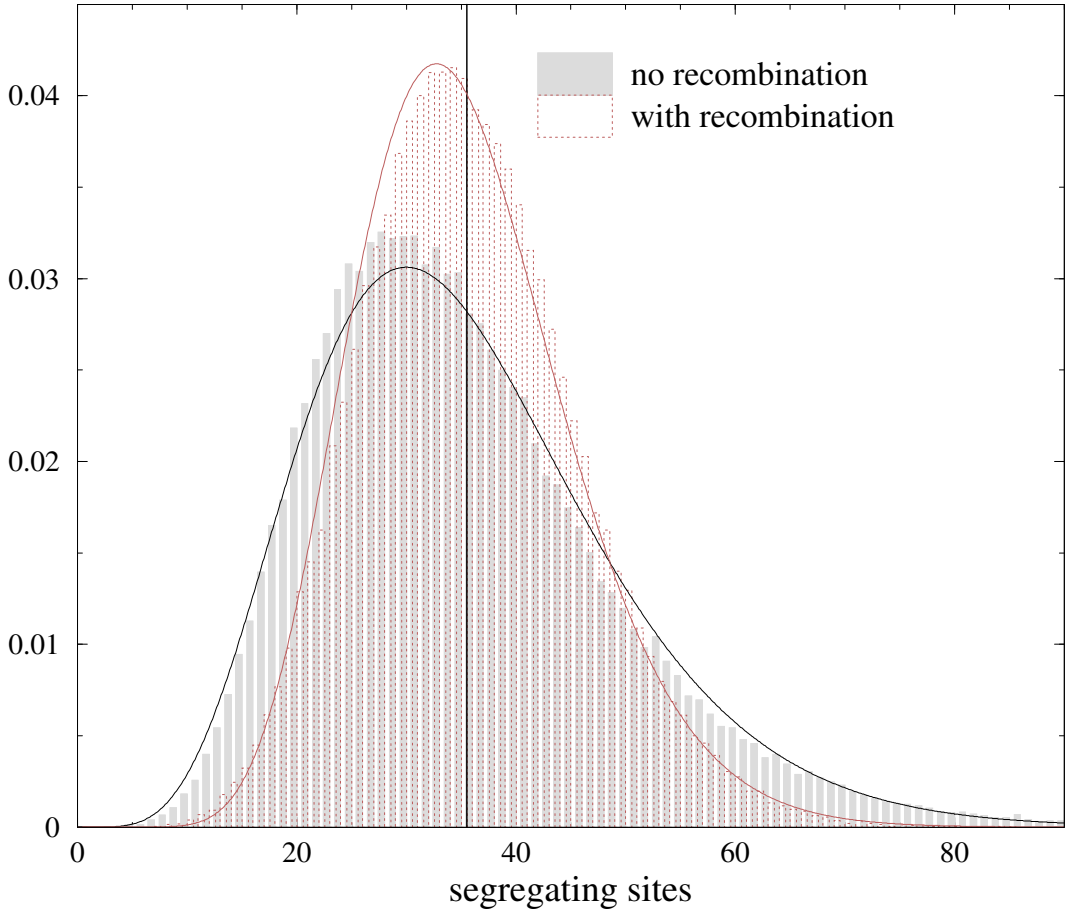
Topology & Frequency Spectrum



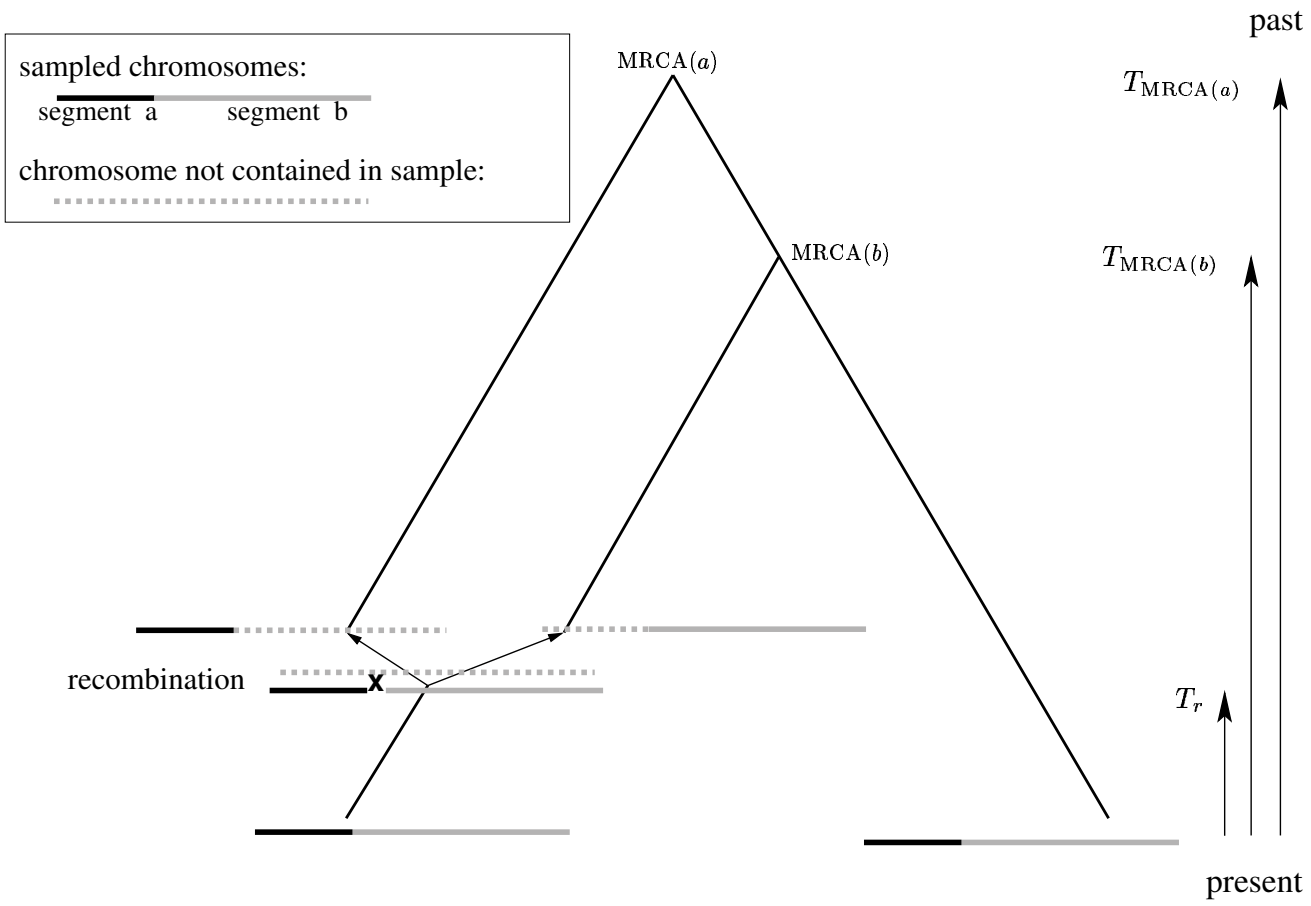
Coalescent and SNPs



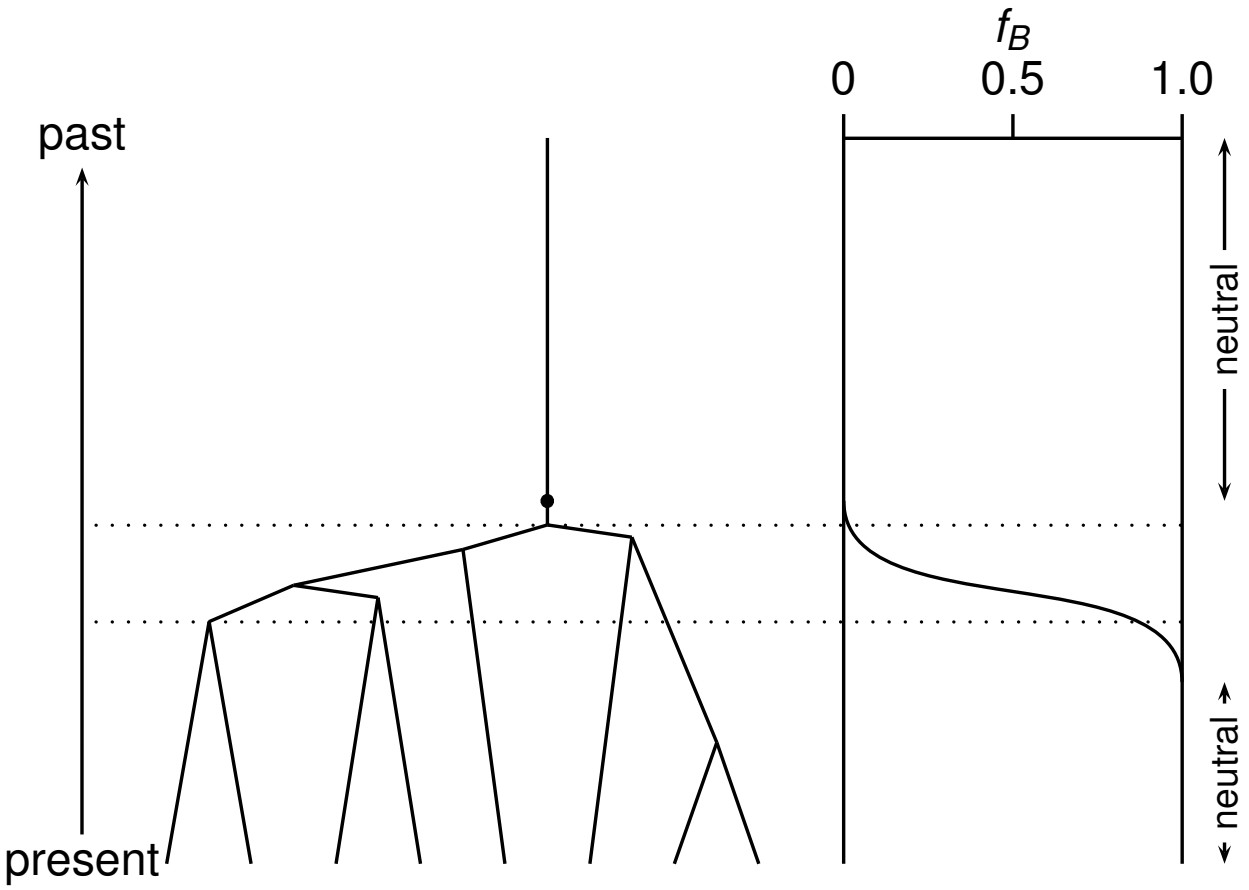
SNPs ± Recombination



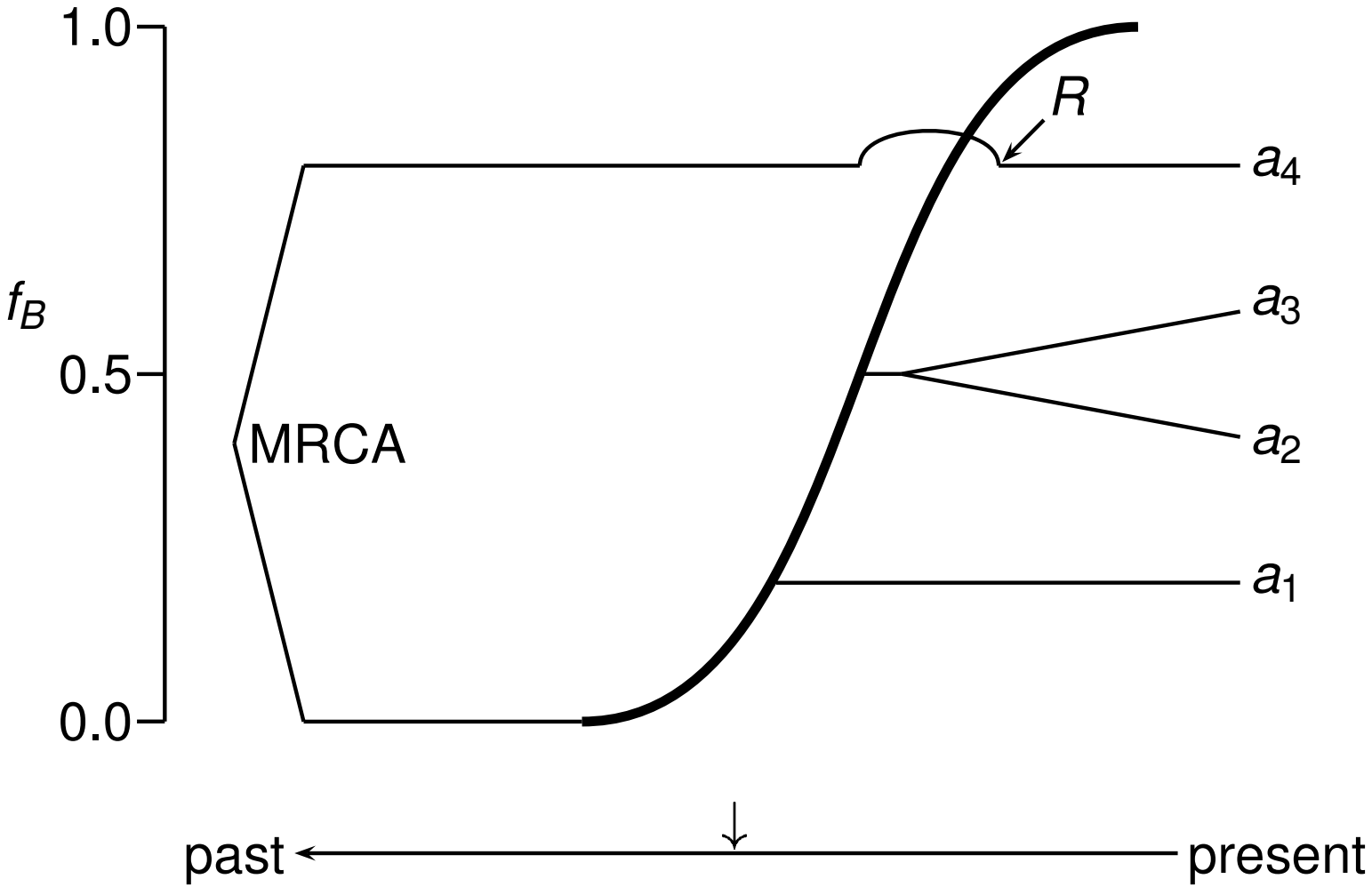
Coalescent with Recombination



Selective Sweep



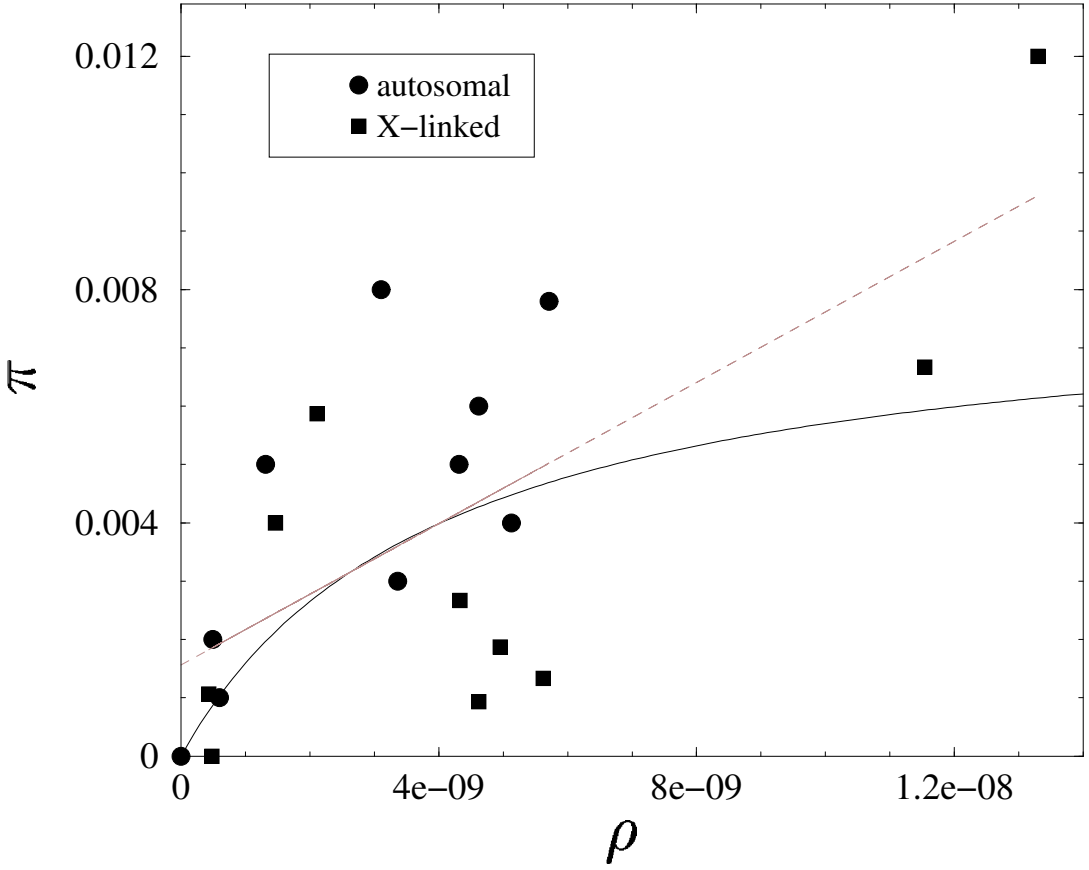
Recombination & Selection



Recombination & Genetic Diversity in *D. melanogaster*

locus	$\rho \times 10^{-9}$	π	reference
X-linked loci			
Yellow,Achaete	0.429	0.0008	[3]
Pgd	1.466	0.0030	[3]
Z,Tko	2.114	0.0044	[1]
Per	4.952	0.0014	[3]
White	13.30	0.0090	[13]
Notch	11.54	0.0050	[14]
Vermilion	5.619	0.0010	[4]
Forked	4.330	0.0020	[9]
Zw	4.619	0.0007	[6]
Su(F)	0.476	0.0000	[9]
autosomal loci			
Gpdh	5.714	0.0078	[15]
Adh	4.621	0.0060	[10]
Ddc	1.314	0.0050	[4]
Amy	3.107	0.0080	[11]
Pu	5.129	0.0040	[15]
Est6	4.314	0.0050	[7]
MtnA	0.593	0.0010	[8]
Hsp70A	0.493	0.0020	[12]
Ry	3.364	0.0030	[2]
Ci^D	0.000	0.0000	[5]

Quantifying Selection



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