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

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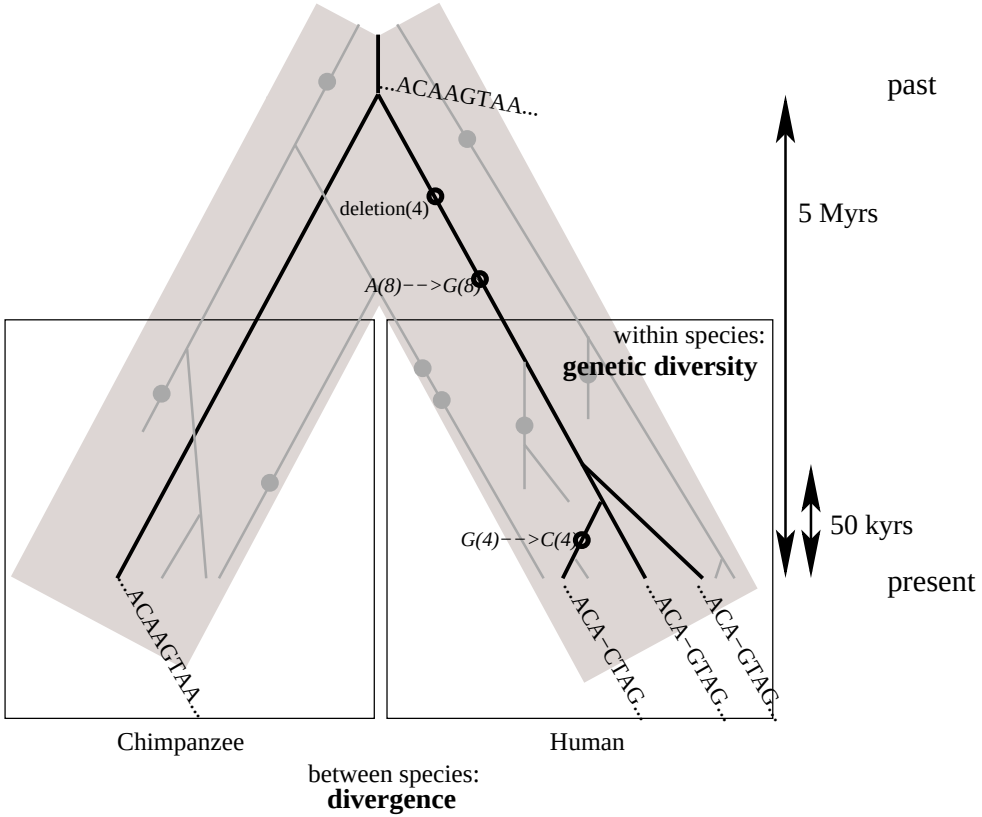
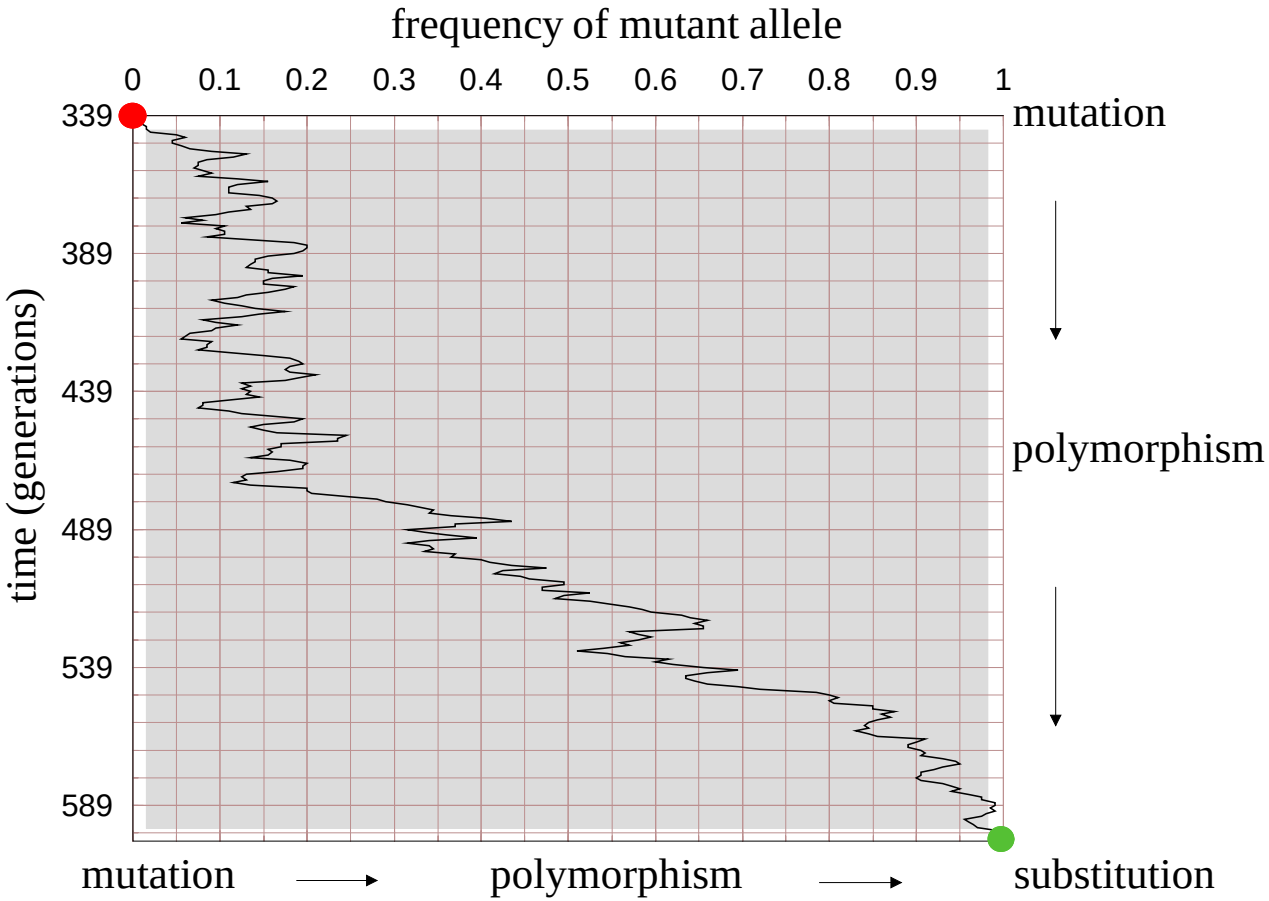
Outline

Genealogy of DNA Sequences



Polymorphisms & Substitutions



Types of Polymorphism

A

single nucleotide polymorphism:

```
indiv.1   ...ACGTTCGT....
indiv.2   ...ACATTCGT....
```

small−tandem−repeat polymorphism:

```
indiv.1   ...ACGGAGAGAGAGAGATTCGT....
indiv.2   ...ACGGAGAGAGATTCGT....
```

B

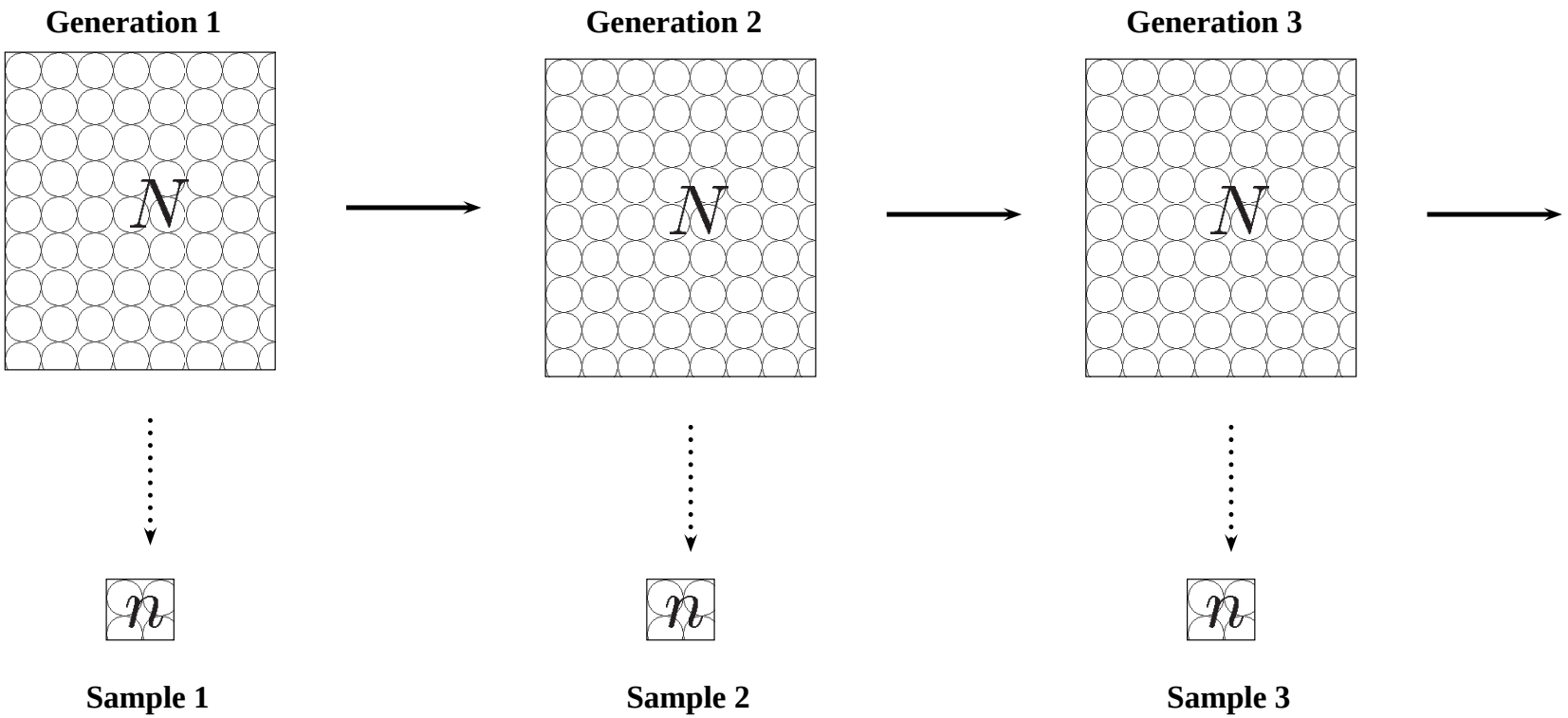
```
Chimp1   ...TCAGTAA...
Chimp2   ...ACACTAA...
Human1   ...ACAGTAG...
Human2   ...ACACTAG...
Human3   ...ACAGTAG...
```

private shared fixed

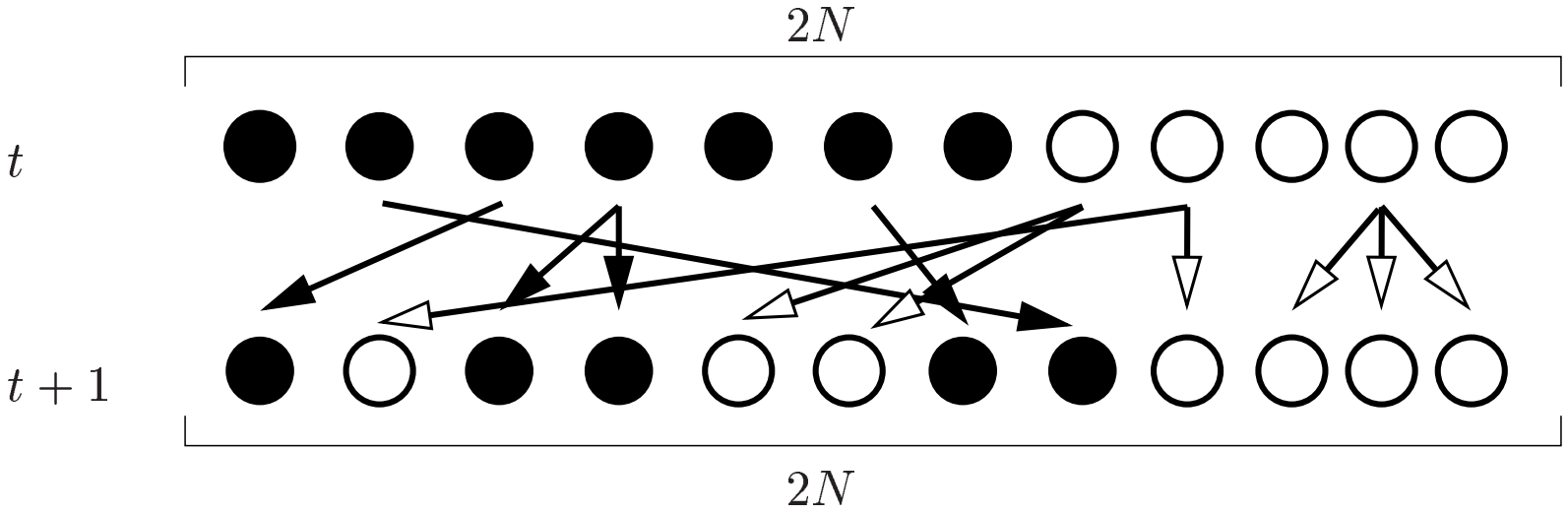
Adh of *D. melanogaster*

Strain	5' Flanking	Exon 1	Intron 1	Exon 2	Intron 2	Exon 3	Intron 3	Exon 4, translated	3' Untranslated	3' Flanking
	CCG		CAATATGGG∇_1C∇_2GC	T	AC	CCCC	GGAAT	CTCCACTAG	A∇_3C	AGC∇_4C∇_5TΔ_6
Wa-S	...		.....AT.....	.	..	TT.A	CA.TA	AC.....	...	.....Δ
Fl-1S	..C		.....	.	..	TT.A	CA.TA	AC.....	...	.....Δ
Af-S	...		.....	.	..	....	.....	.....A	...	..T∇.1A.
Fr-S	...		.....	.	GT	....	.....	.....A	.-1.	TA.....
Fl-2S	...		AG...A.TC....A	G	GT	....	.....	.....	C3.	.....
Ja-S	..C		.....	G	..	....	.....	...T.T.CA	C4.	....T...
Fl-F	..C		.....	G	..	....	.....	..GTCTCC.	C4.	.....
Fr-F	TGC		AG...A.TC∇G∇..	G	..	....	.....	..GTCTCC.	C4G	.....
Wa-F	TGC		AG...A.TC∇G∇..	G	..	....	.....	..GTCTCC.	C4G	.....
Af-F	TGC		AG...A.TC∇G∇..	G	..	....	.....	..GTCTCC.	C5G	.....
Ja-F	TGC		AGGGGA...∇..T.	G	..	..A.	..G..	..GTCTCC.	C4.	.....-1..
Polym. Sites	3	0	12	1	2	4	5	9	2	5
Nucleotides[1]	63	87	690	99	65	405	70	264	178	767
% polymorphic	4.7	0	1.7	1.0	3.1	1.0	7.1	3.5	1.1	0.6

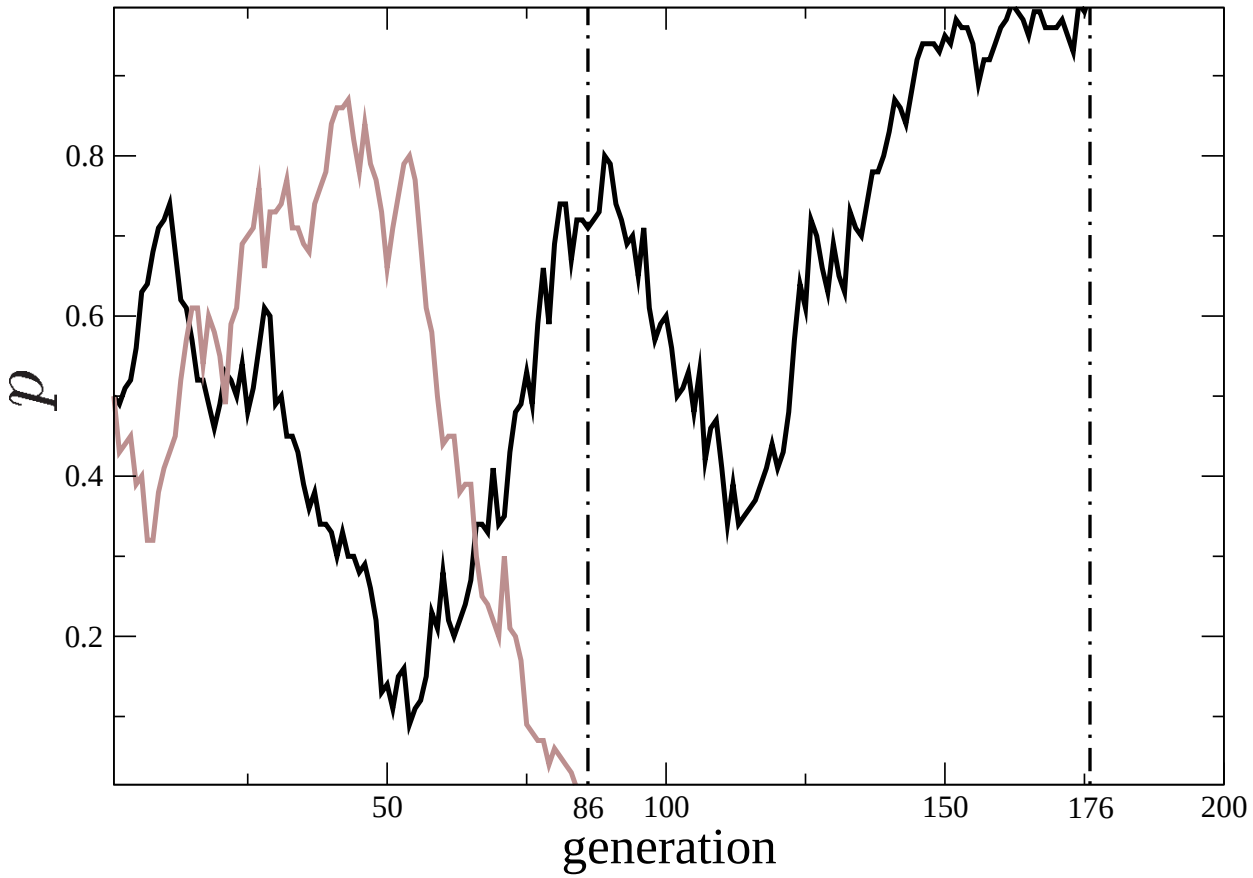
Evolution Forward in Time



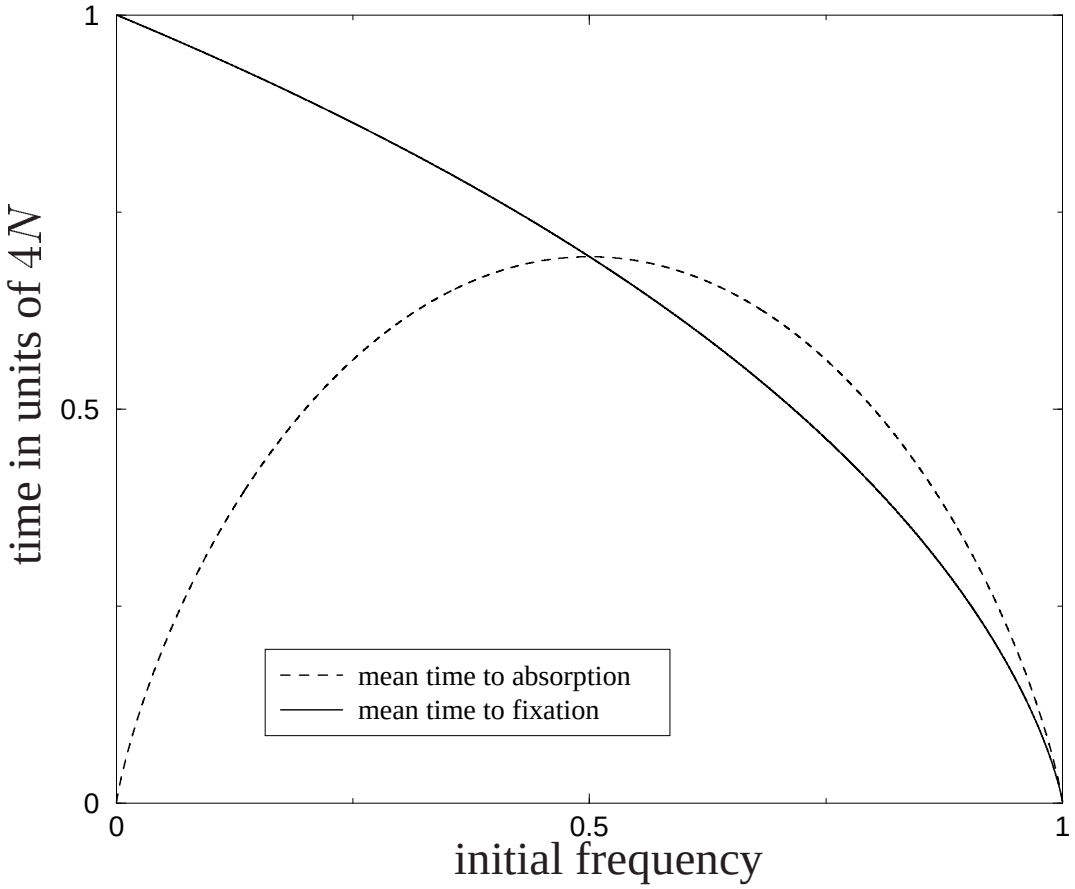
Evolution in two Generations



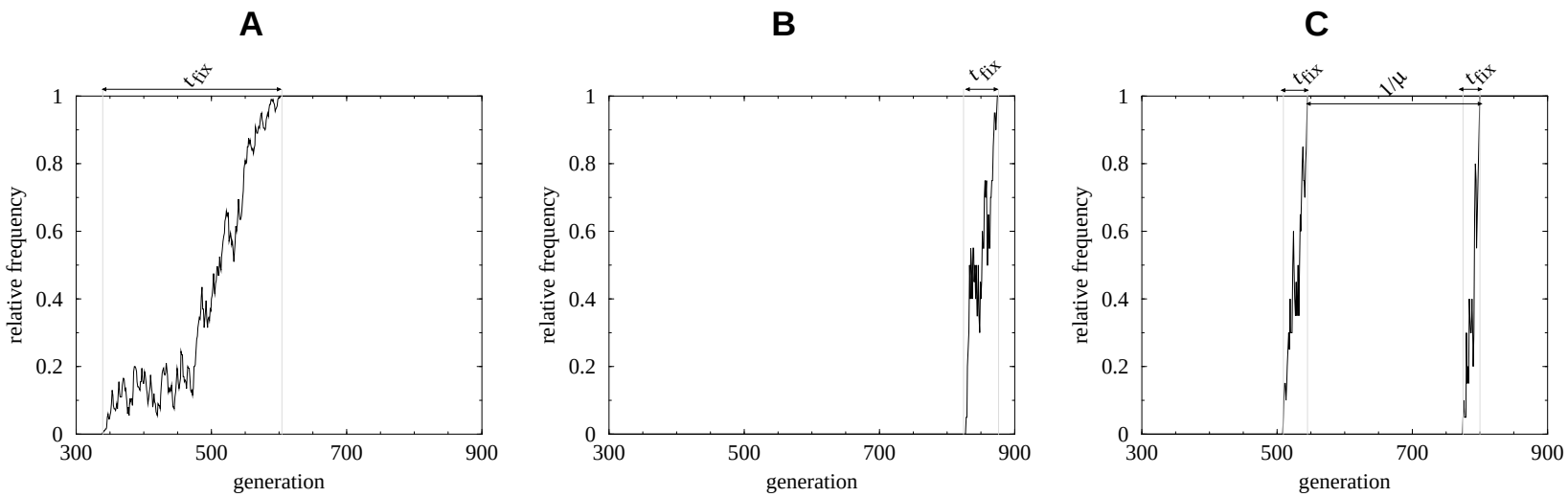
Evolution under Drift



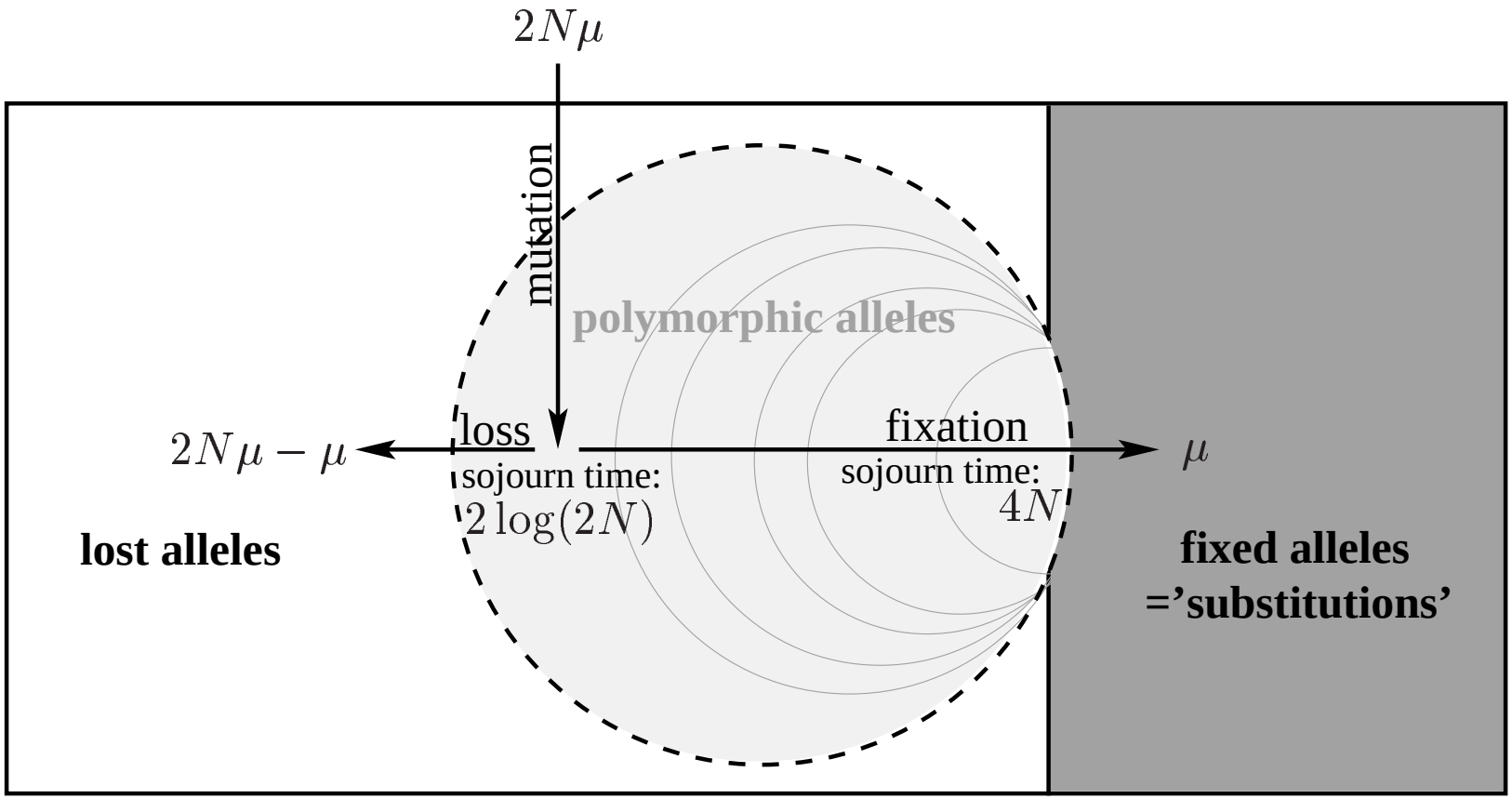
Absorption & Fixation



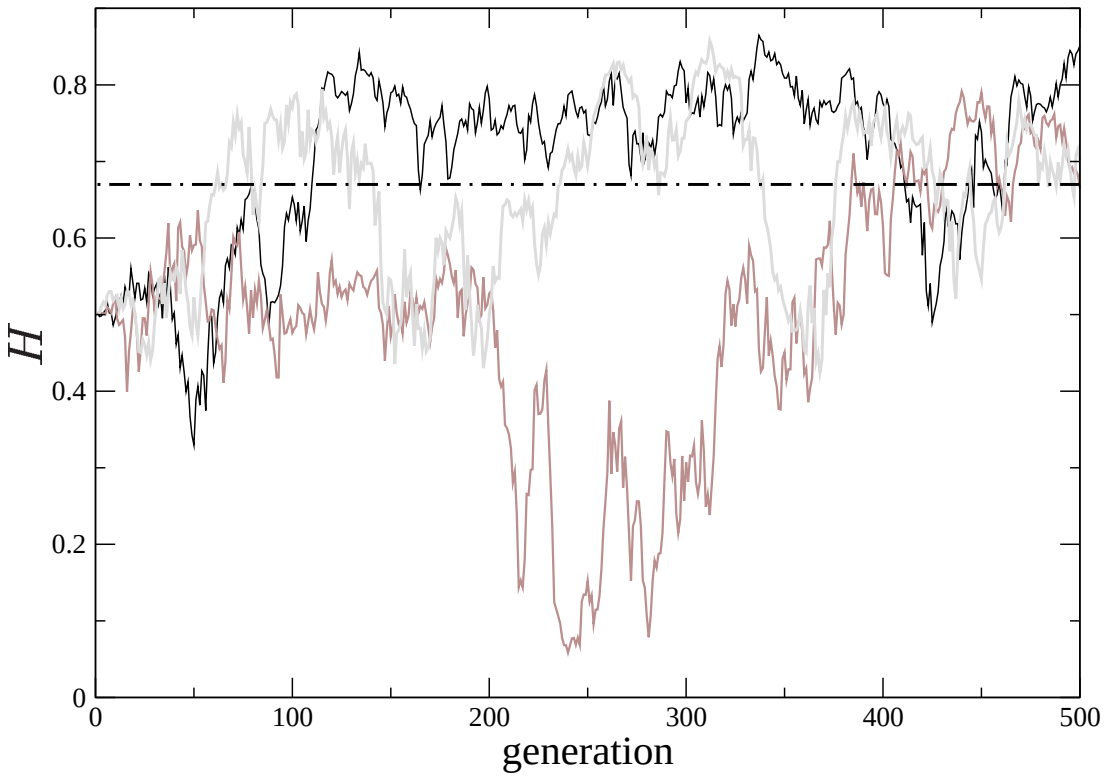
Mutation Drift Balance



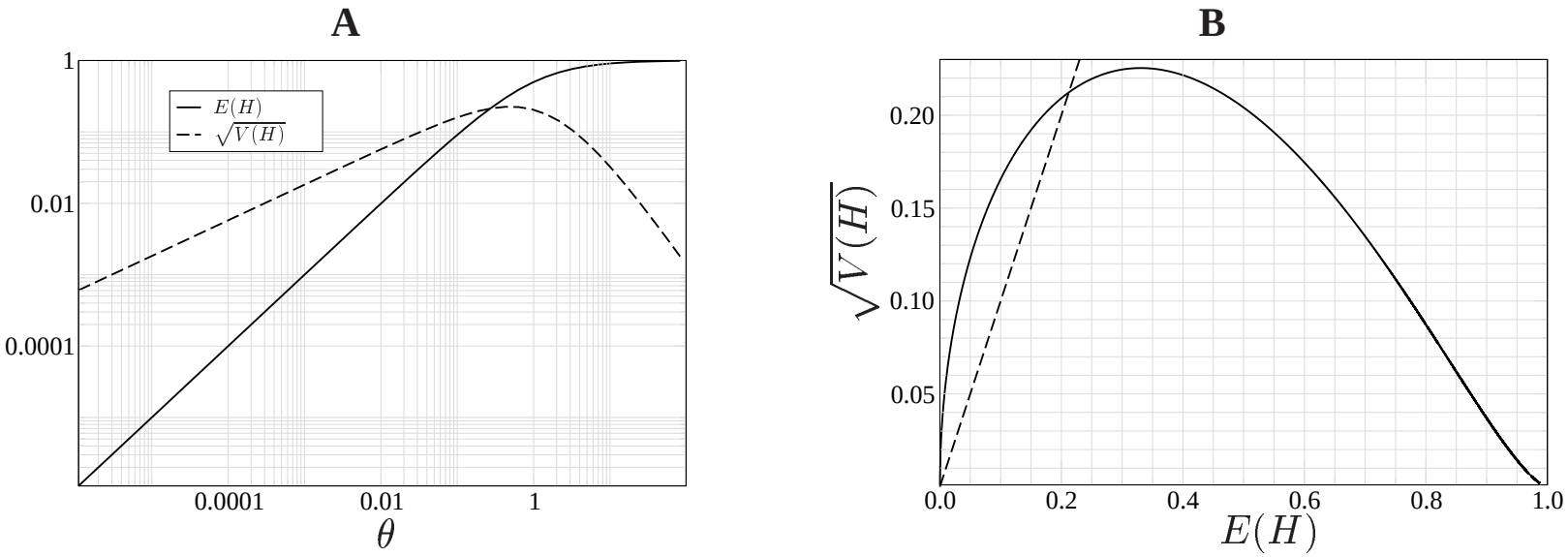
Mutation Drift Balance



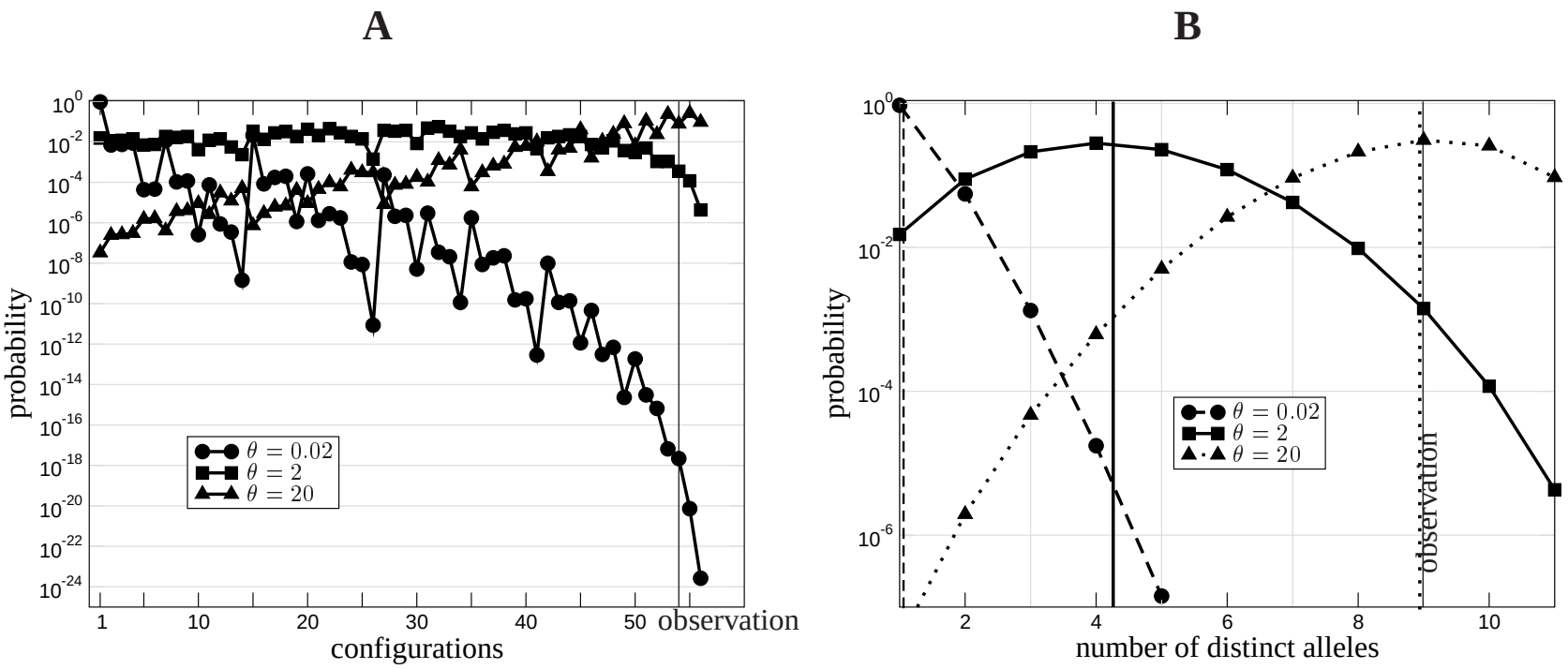
Simulation of Heterozygosity



Heterozygosity and Mutation Rate



Sample Configurations



Expectations

θ	$\underline{\kappa}$†	$E(\mathcal{K}_{11})$	$V(\mathcal{K}_{11})$	S‡	$E(C_1(11))$
0.02	1.020	1.058	0.057	0.586	0.022
2.00	3.000	4.206	1.947	5.858	1.833
6.12	7.120	6.629	2.234	17.925	4.176
20.0	21.00	8.945	1.550	58.579	7.333