Supplementary File S3.

MLEs, HPD intervals, and coefficients of variation for the six demographic parameters under various simulation conditions. For MLE/HPD graphs, black shapes are average MLEs for the five simulated datasets for each condition, and grey shapes are average $HPD90_{Hi}$ and $HPD90_{Lo}$ values. The thin black line on each graph represents the true value for each parameter (or the pre-sweep/neutral value for selective sweep simulations). For each of the following eight sets simulation conditions, there are five graphs in the following order: current effective population size MLEs/HPDs, ancestral effective population size MLEs/HPDs, divergence time MLEs/HPDs, gene flow MLEs/HPDs, and coefficients of variation for all parameters.

A) Infinite sites vs. HKY vs. GTR evolution. Each set of simulations is labeled by the substitution model used for simulation (simulation program in parentheses) followed by the substitution model used for IMA analysis. (Graphs 1-5)

B) Recombination, full HKY datasets. (Graphs 6-10)

C) Recombination, HKY non-recombining blocks. (Graphs 11-15)

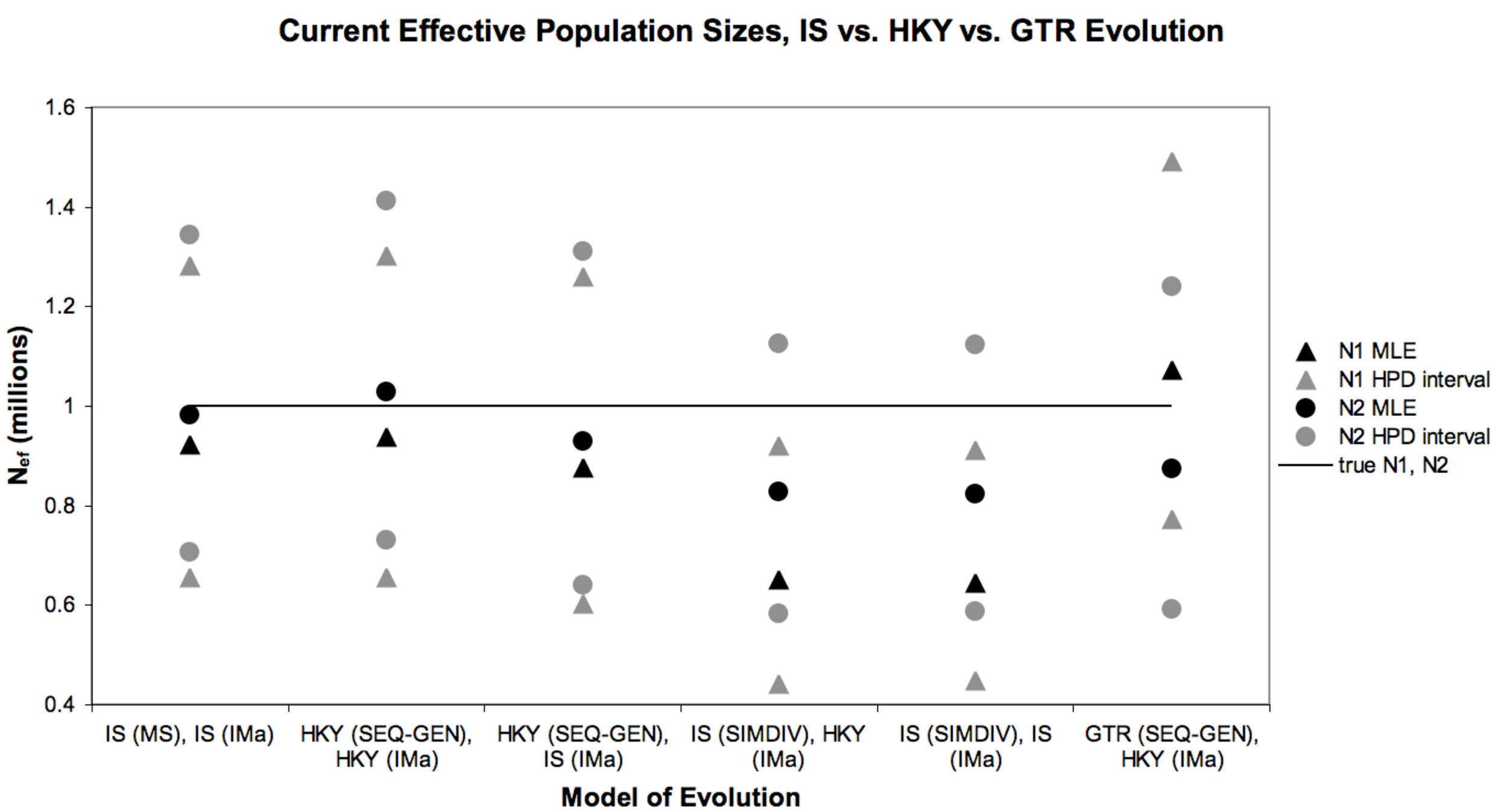
D) Gene flow between first focal species and third unsampled species. (Graphs 16-20)

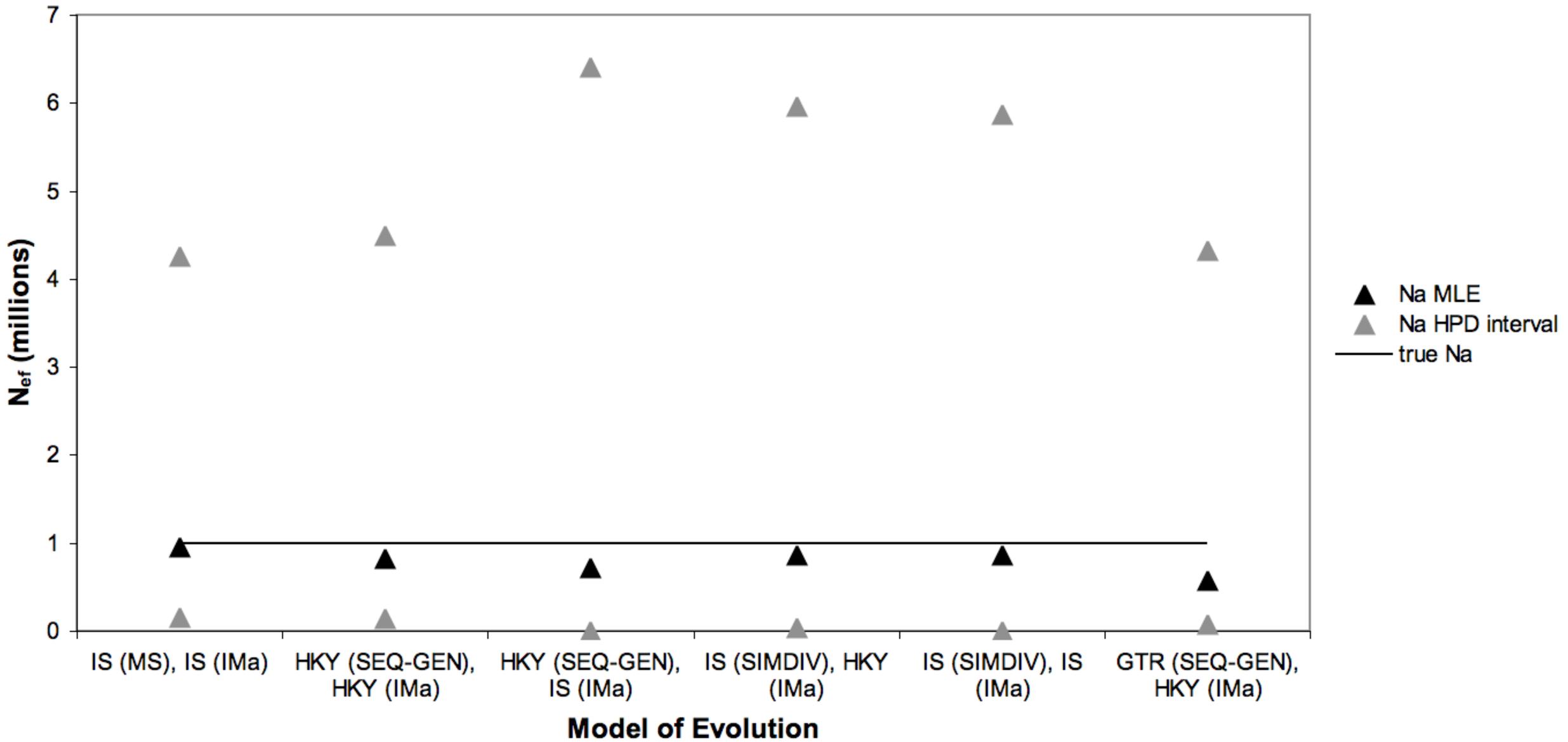
E) Population structure within species. (Graphs 21-25)

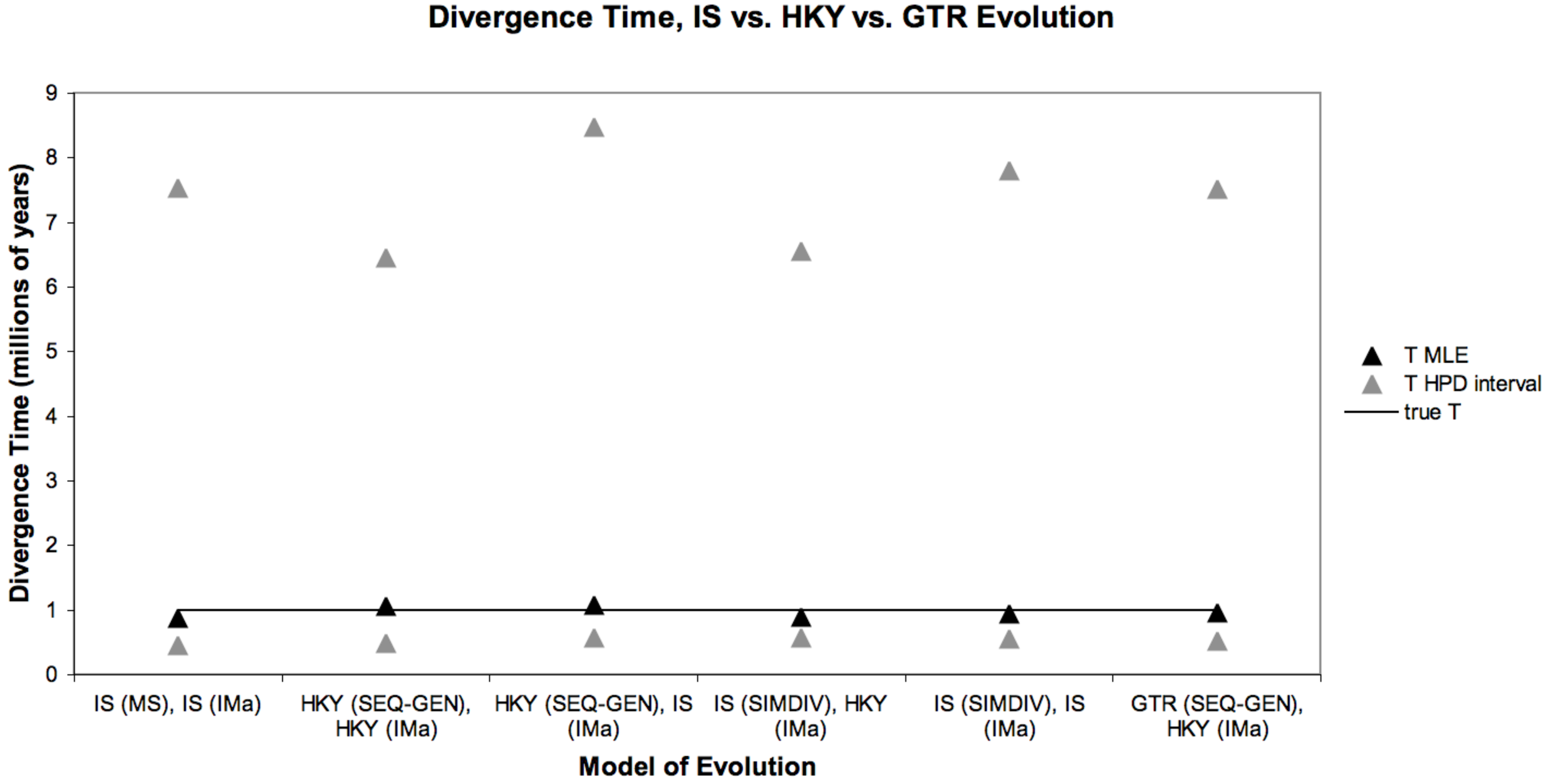
F) Linkage among loci. (Graphs 26-30)

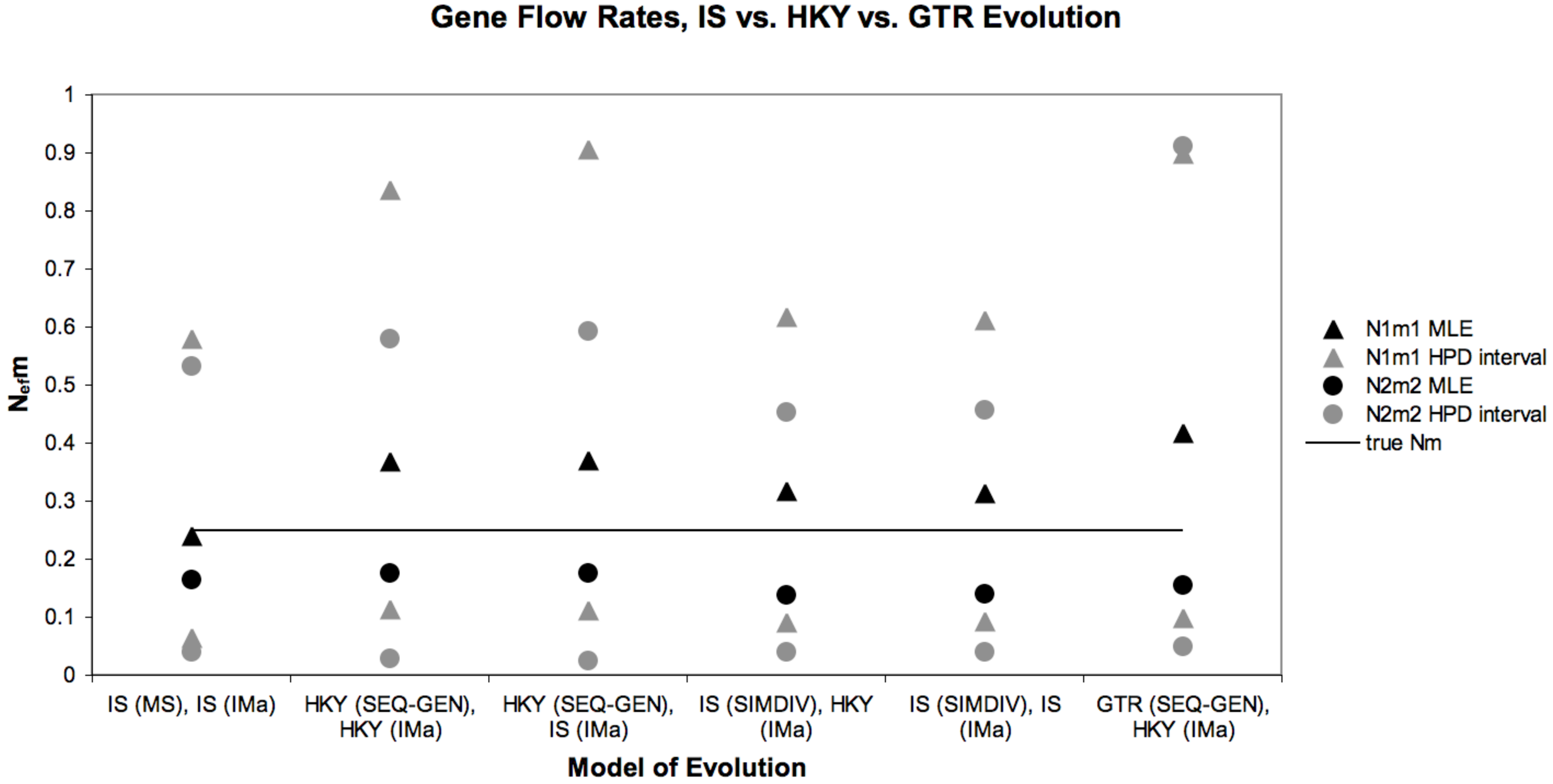
G) Divergent selective sweeps. (Graphs 31-35)

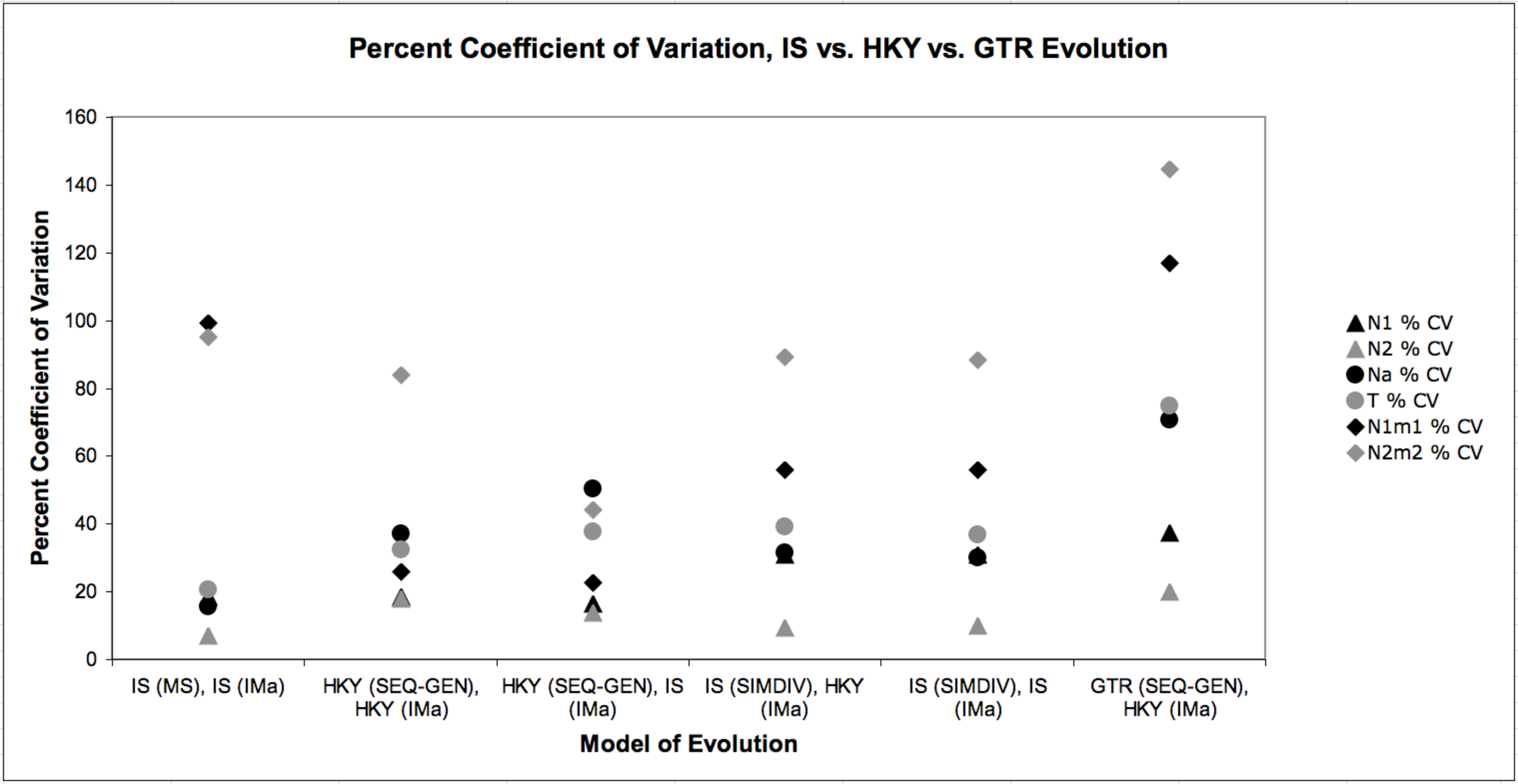
H) Complex demography. (Graphs 36-40)

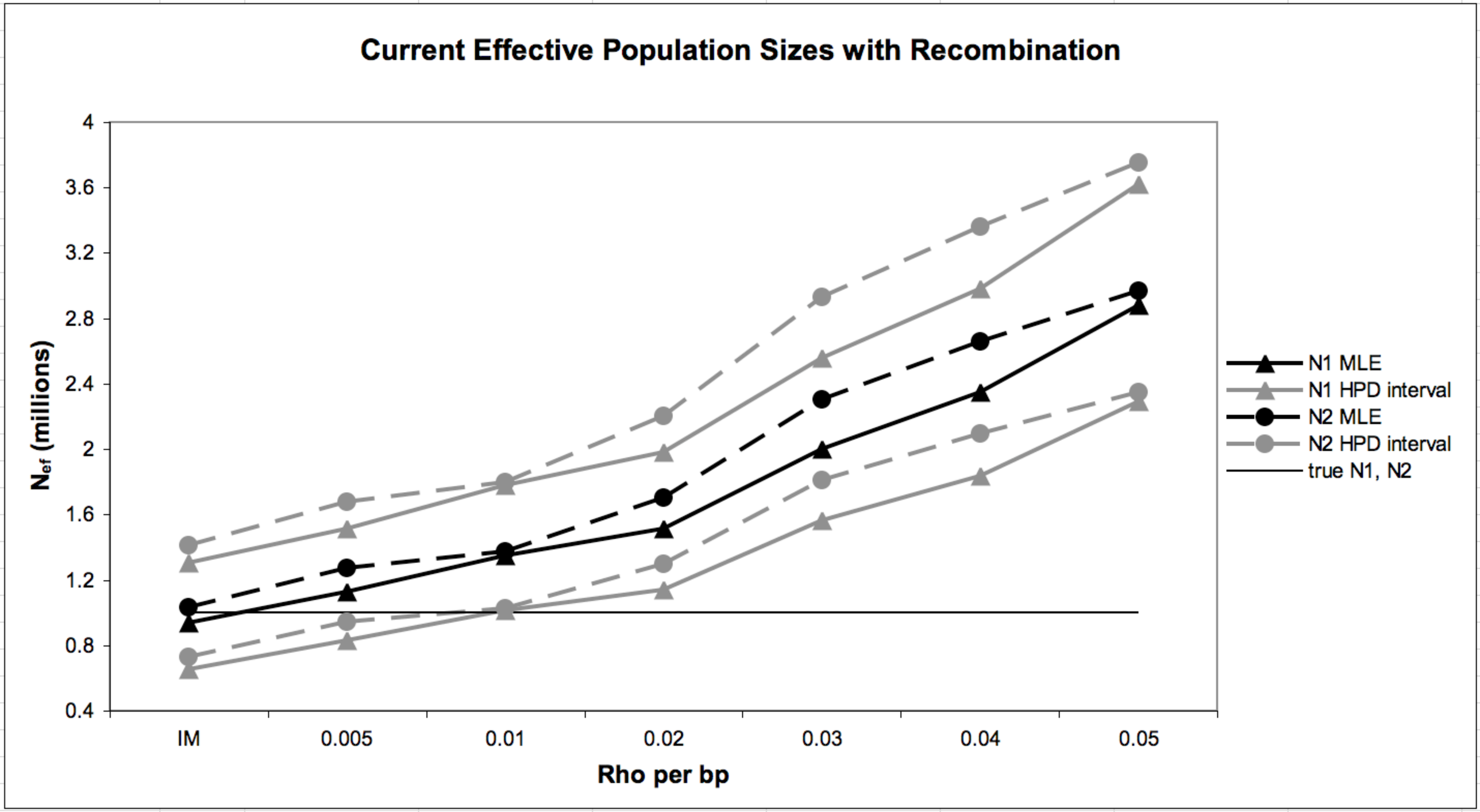

Current Effective Population Sizes, IS vs. HKY vs. GTR Evolution
1.6
1.4
1.2
1
0.8
0.6
0.4
Nef (millions)
IS (MS), IS (IMa)
HKY (SEQ-GEN), HKY (IMa)
HKY (SEQ-GEN), IS (IMa)
IS (SIMDIV), HKY (IMa)
IS (SIMDIV), IS (IMa)
GTR (SEQ-GEN), HKY (IMa)
Model of Evolution
N1 MLE
N1 HPD interval
N2 MLE
N2 HPD interval
true N1, N2

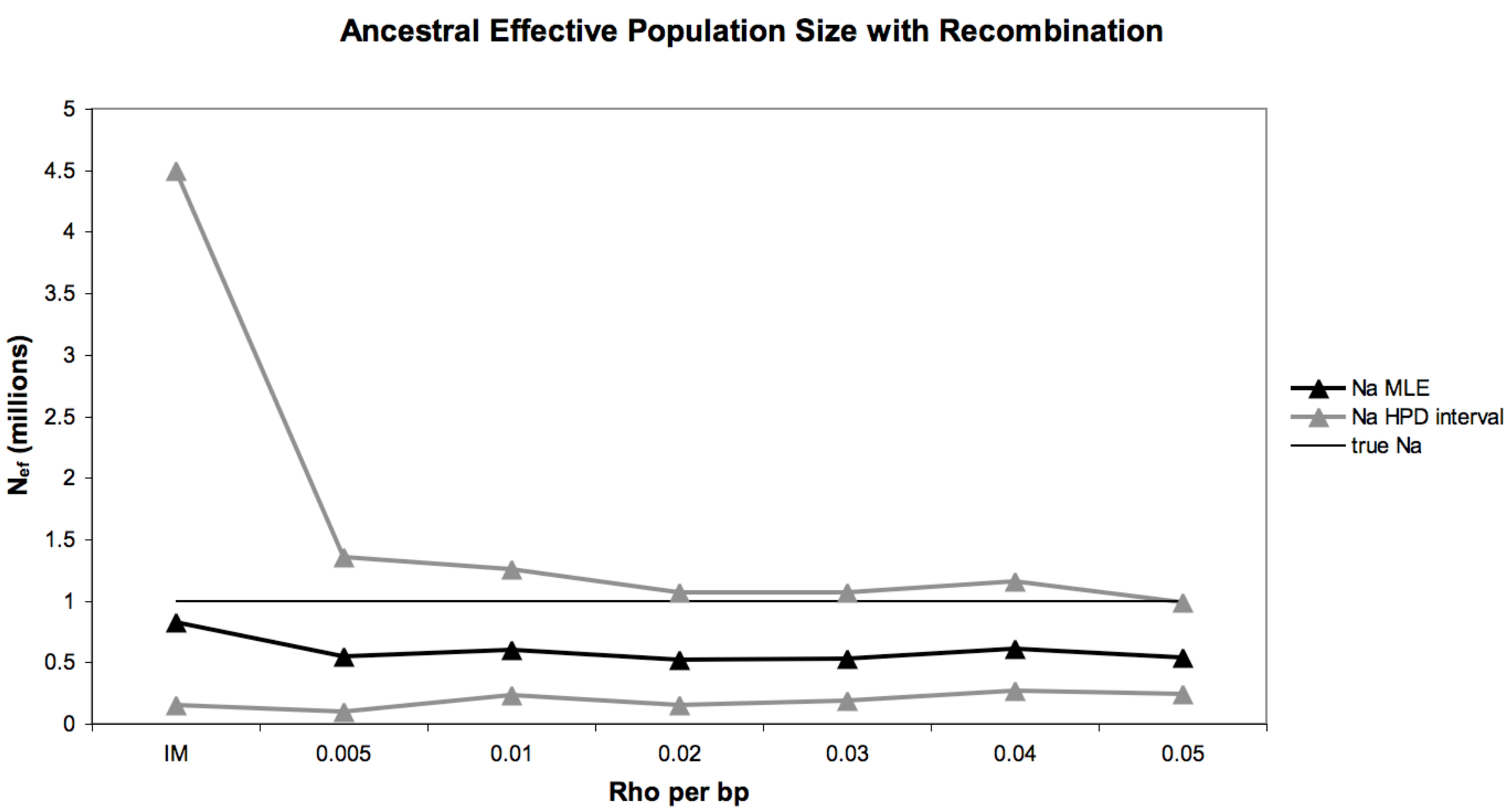

Ancestral Effective Population Size, IS vs. HKY vs. GTR Evolution
7
6
5
4
3
2
1
0
Nef (millions)
IS (MS), IS (IMa)
HKY (SEQ-GEN), HKY (IMa)
HKY (SEQ-GEN), IS (IMa)
IS (SIMDIV), HKY (IMa)
IS (SIMDIV), IS (IMa)
GTR (SEQ-GEN), HKY (IMa)
Model of Evolution
Na MLE
Na HPD interval
true Na

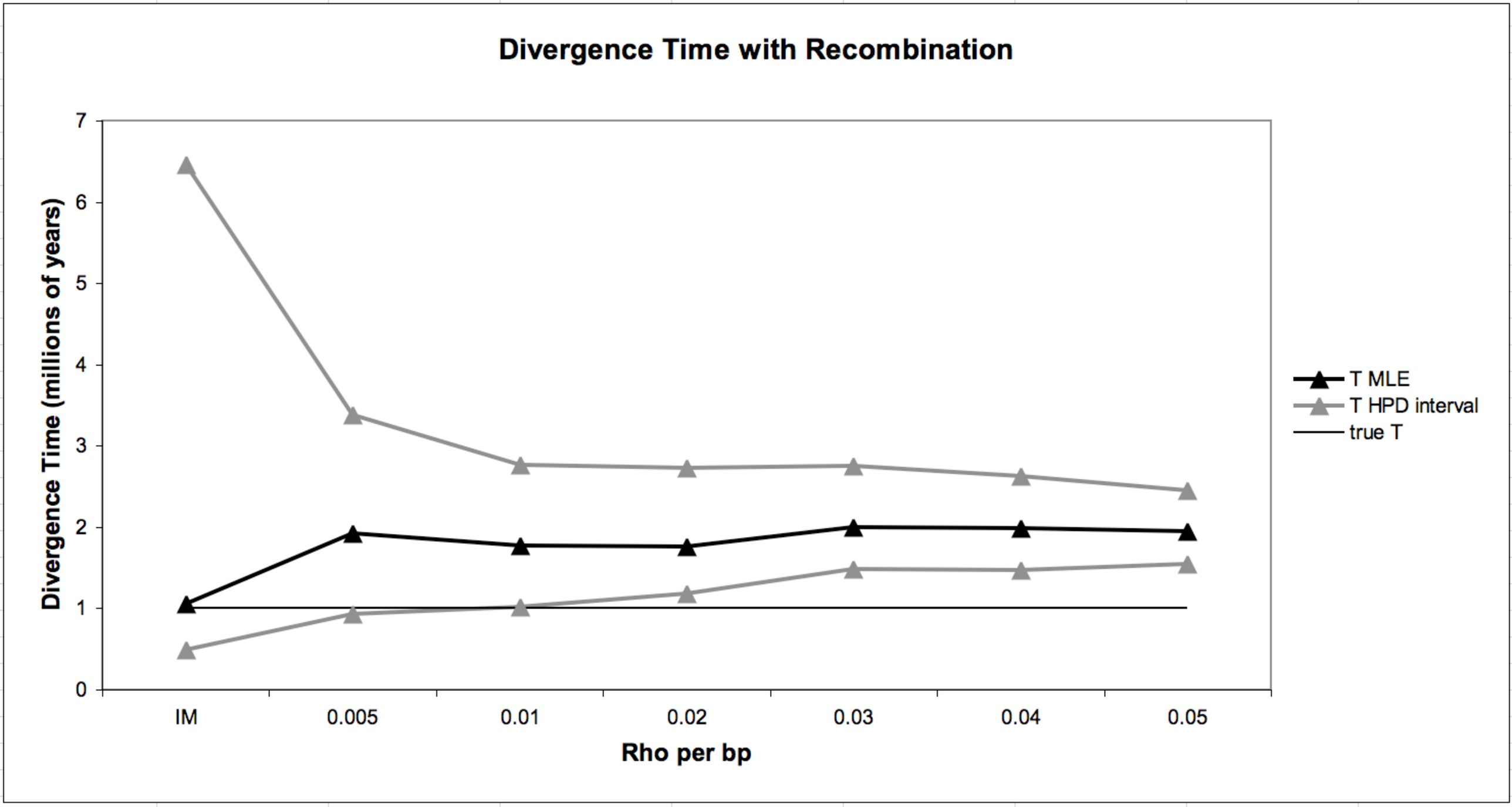

Divergence Time, IS vs. HKY vs. GTR Evolution
Divergence Time (millions of years)
0
1
2
3
4
5
6
7
8
9
IS (MS), IS (IMa)
HKY (SEQ-GEN), HKY (IMa)
HKY (SEQ-GEN), IS (IMa)
IS (SIMDIV), HKY (IMa)
IS (SIMDIV), IS (IMa)
GTR (SEQ-GEN), HKY (IMa)
Model of Evolution
T MLE
T HPD interval
true T

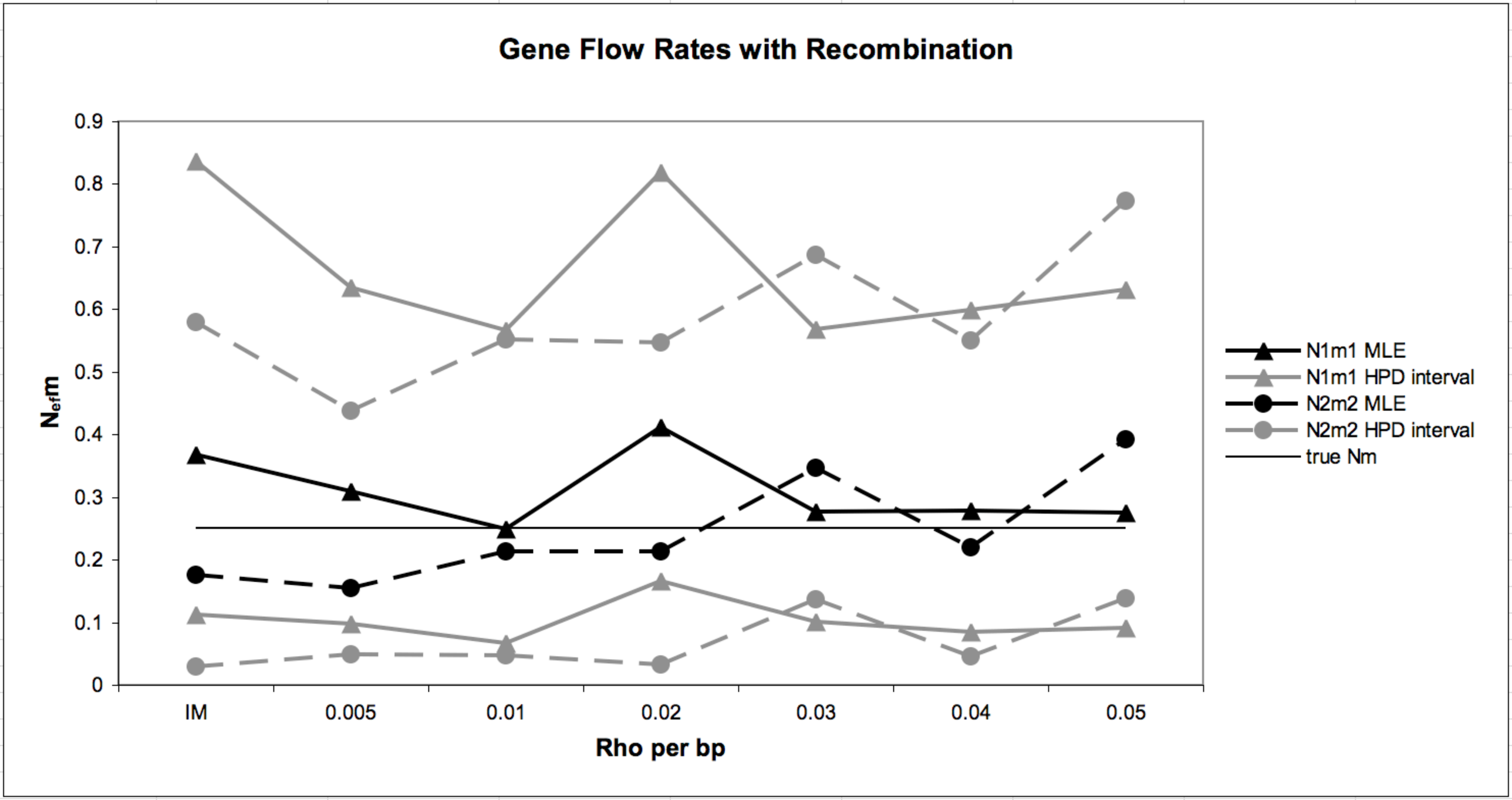

Gene Flow Rates, IS vs. HKY vs. GTR Evolution
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Nefm
IS (MS), IS (IMa)
HKY (SEQ-GEN), HKY (IMa)
HKY (SEQ-GEN), IS (IMa)
IS (SIMDIV), HKY (IMa)
IS (SIMDIV), IS (IMa)
GTR (SEQ-GEN), HKY (IMa)
Model of Evolution
N1m1 MLE
N1m1 HPD interval
N2m2 MLE
N2m2 HPD interval
true Nm

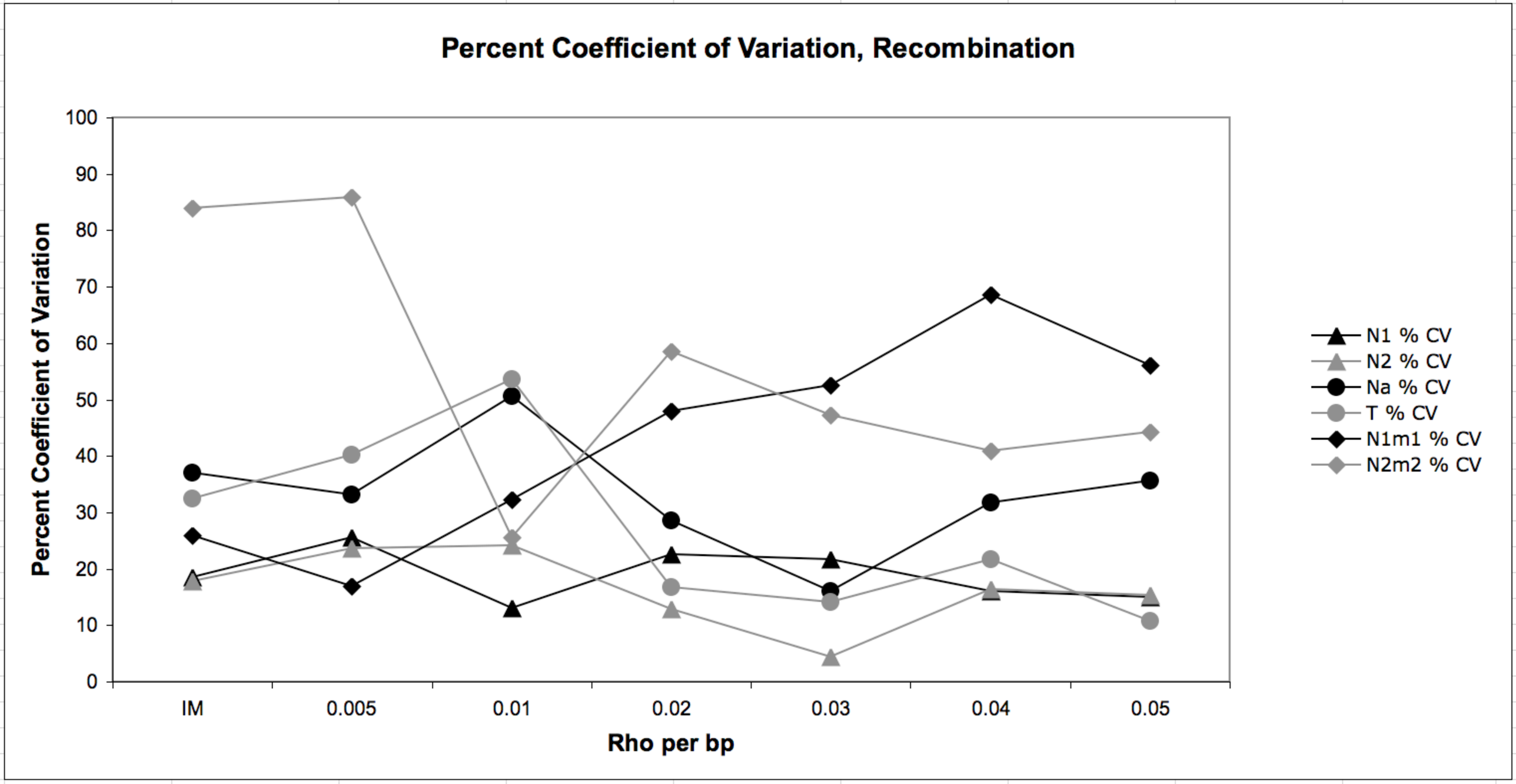

Percent Coefficient of Variation, IS vs. HKY vs. GTR Evolution
Percent Coefficient of Variation
160
140
120
100
80
60
40
20
0
IS (MS), IS (IMa)
HKY (SEQ-GEN), HKY (IMa)
HKY (SEQ-GEN), IS (IMa)
IS (SIMDIV), HKY (IMa)
IS (SIMDIV), IS (IMa)
GTR (SEQ-GEN), HKY (IMa)
Model of Evolution
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV

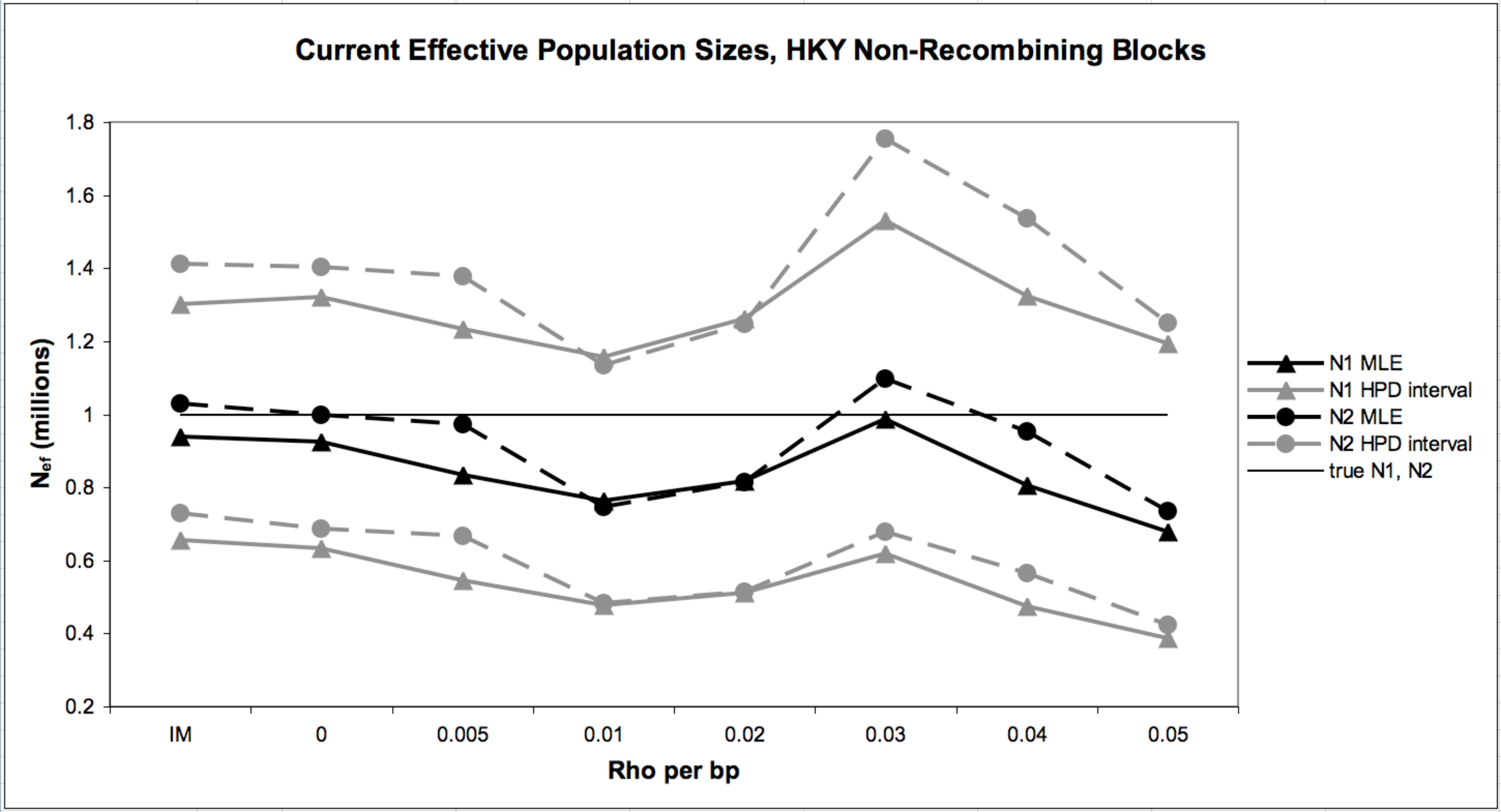

Current Effective Population Sizes with Recombination
N_{ef} (millions)
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
IM
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
N1 MLE
N1 HPD interval
N2 MLE
N2 HPD interval
true N1, N2

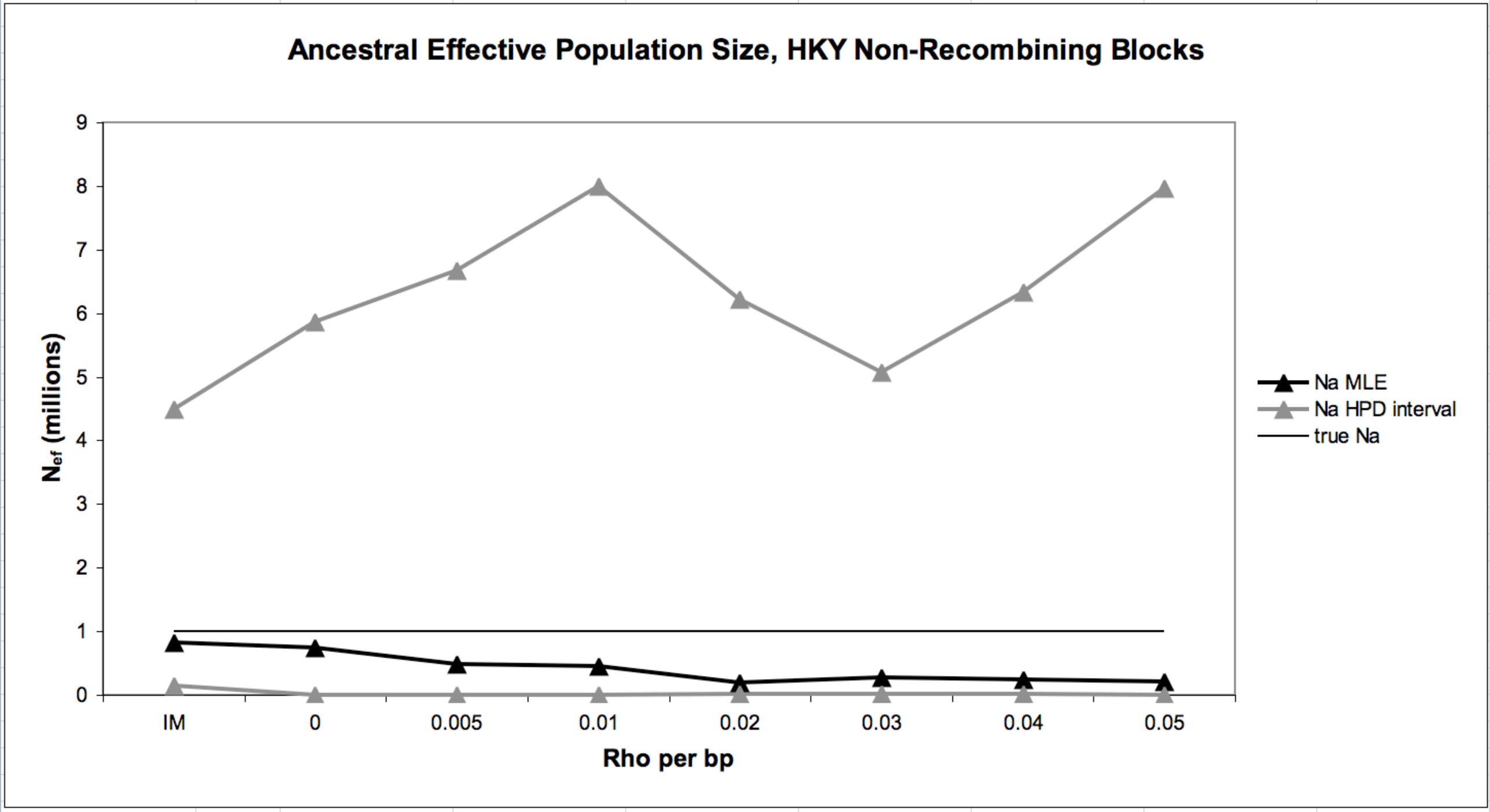

Ancestral Effective Population Size with Recombination
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Nef (millions)
IM
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
Na MLE
Na HPD interval
true Na

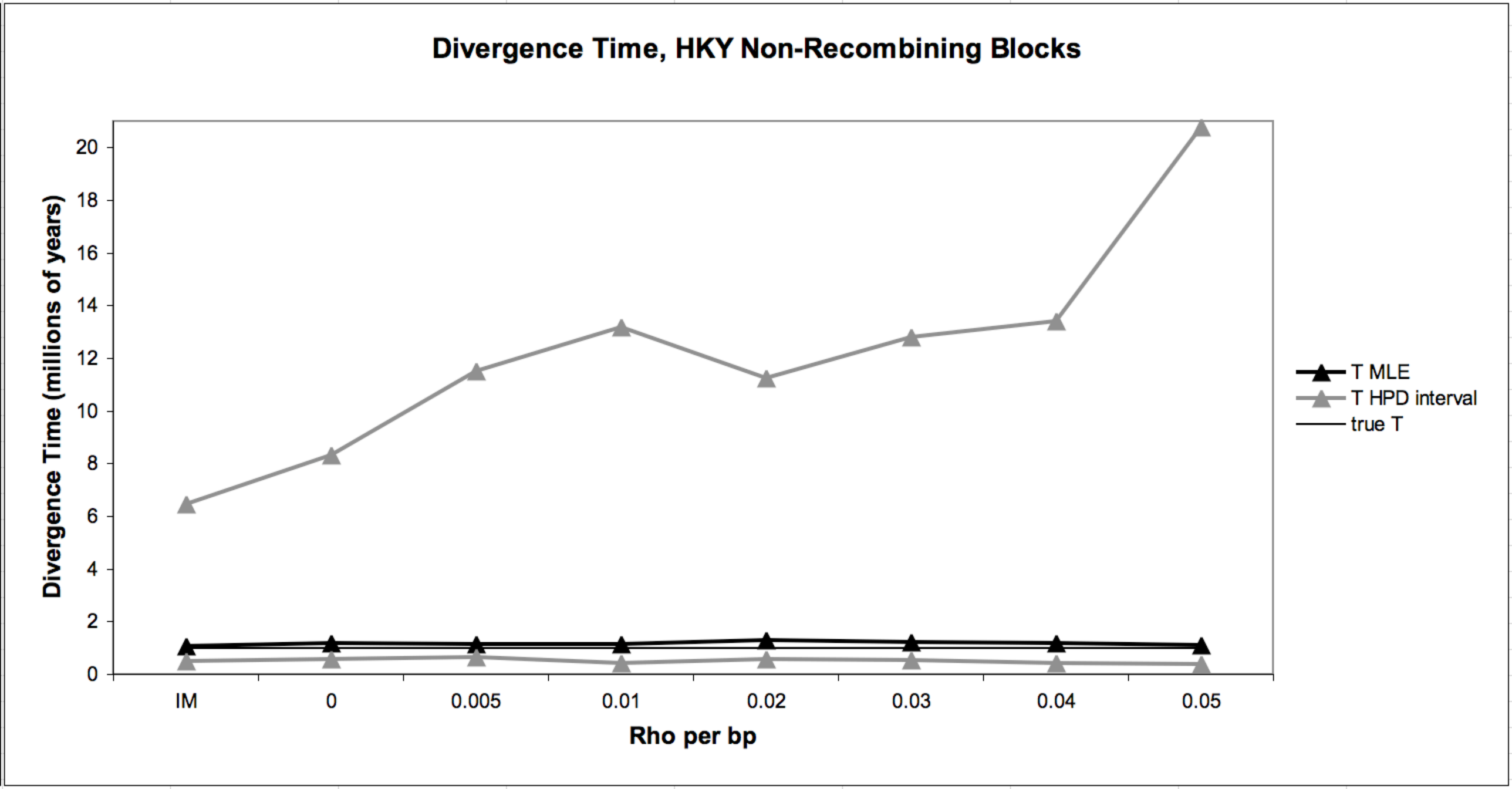

Divergence Time with Recombination
Divergence Time (millions of years)
0
1
2
3
4
5
6
7
IM
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
T MLE
T HPD interval
true T

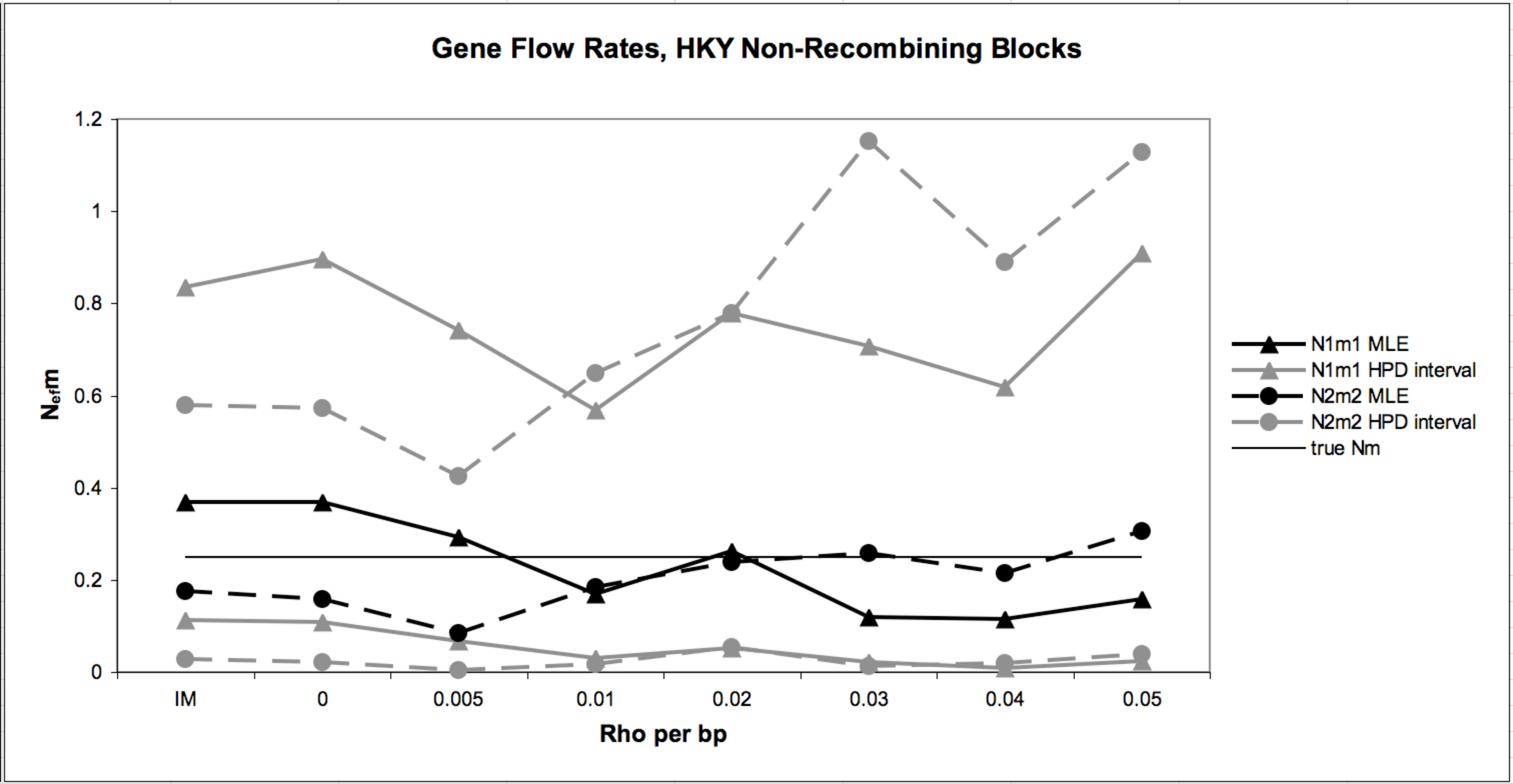

Gene Flow Rates with Recombination
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$N_{ef}m$
IM
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
N1m1 MLE
N1m1 HPD interval
N2m2 MLE
N2m2 HPD interval
true Nm

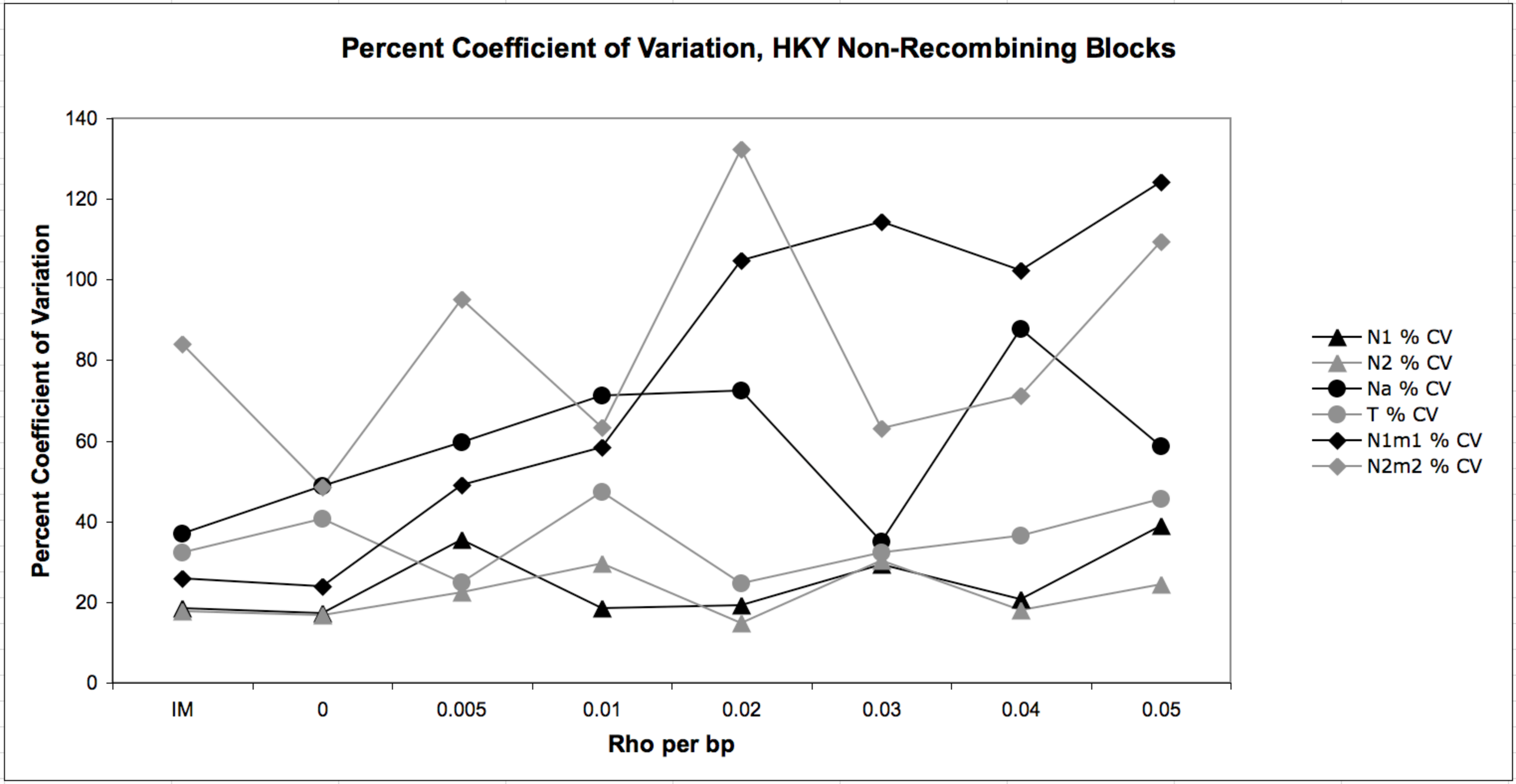

Percent Coefficient of Variation, Recombination
Percent Coefficient of Variation
100
90
80
70
60
50
40
30
20
10
0
IM
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV

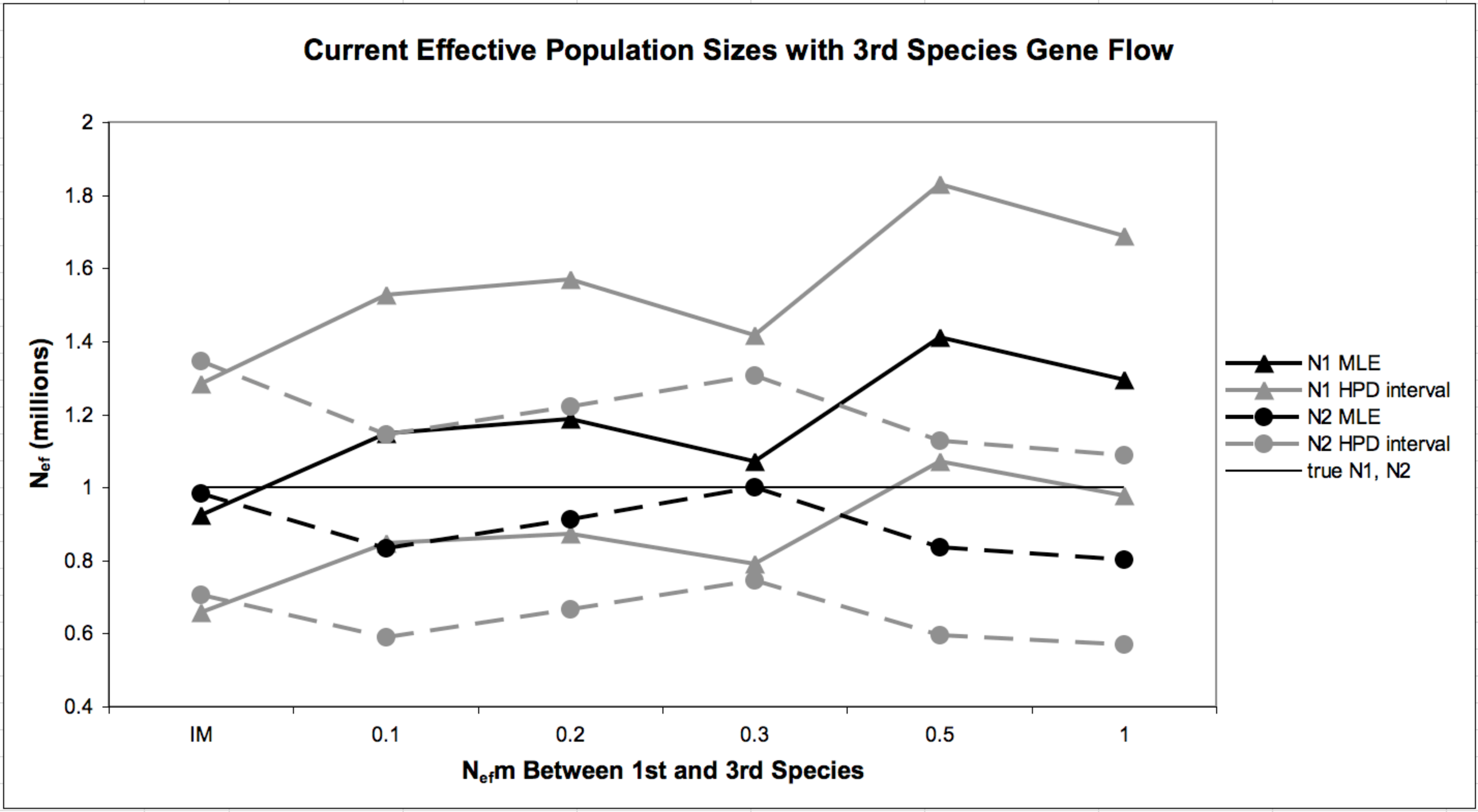

Current Effective Population Sizes, HKY Non-Recombining Blocks
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
Nef (millions)
IM
0
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
N1 MLE
N1 HPD interval
N2 MLE
N2 HPD interval
true N1, N2

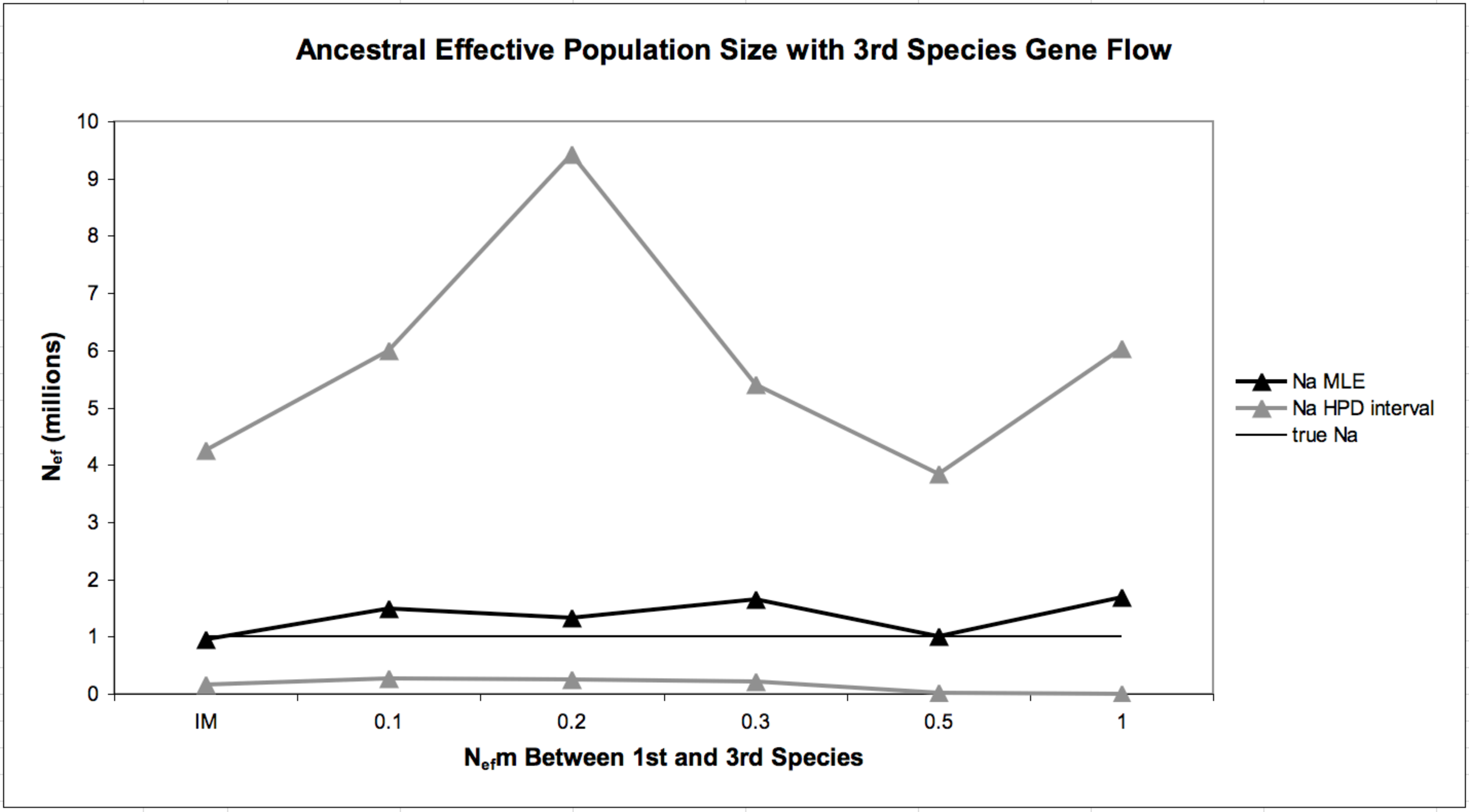

Ancestral Effective Population Size, HKY Non-Recombining Blocks
N_{ef} (millions)
9
8
7
6
5
4
3
2
1
0
IM
0
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
Na MLE
Na HPD interval
true Na

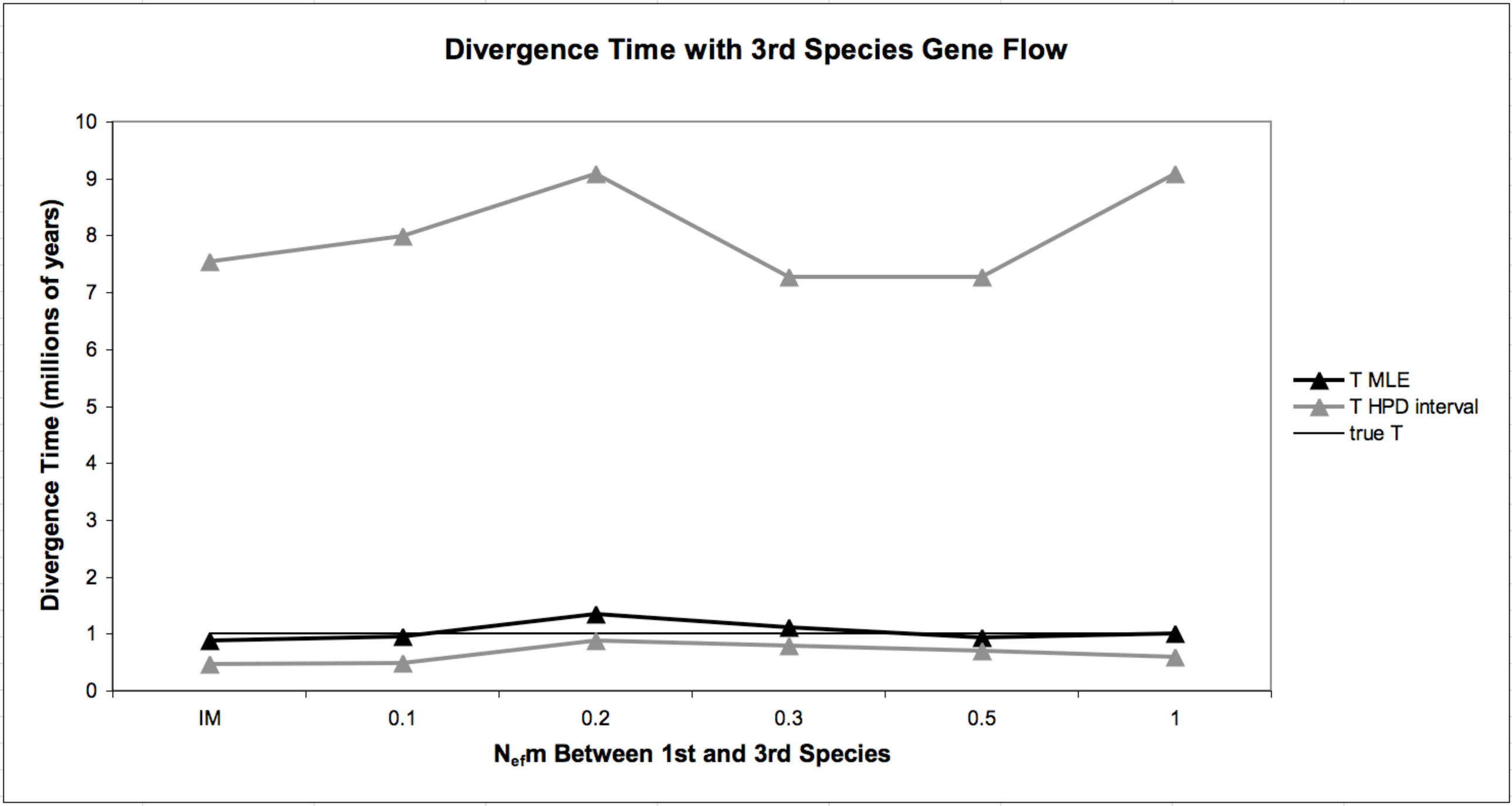

Divergence Time, HKY Non-Recombining Blocks
Divergence Time (millions of years)
0
2
4
6
8
10
12
14
16
18
20
IM
0
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
T MLE
T HPD interval
true T

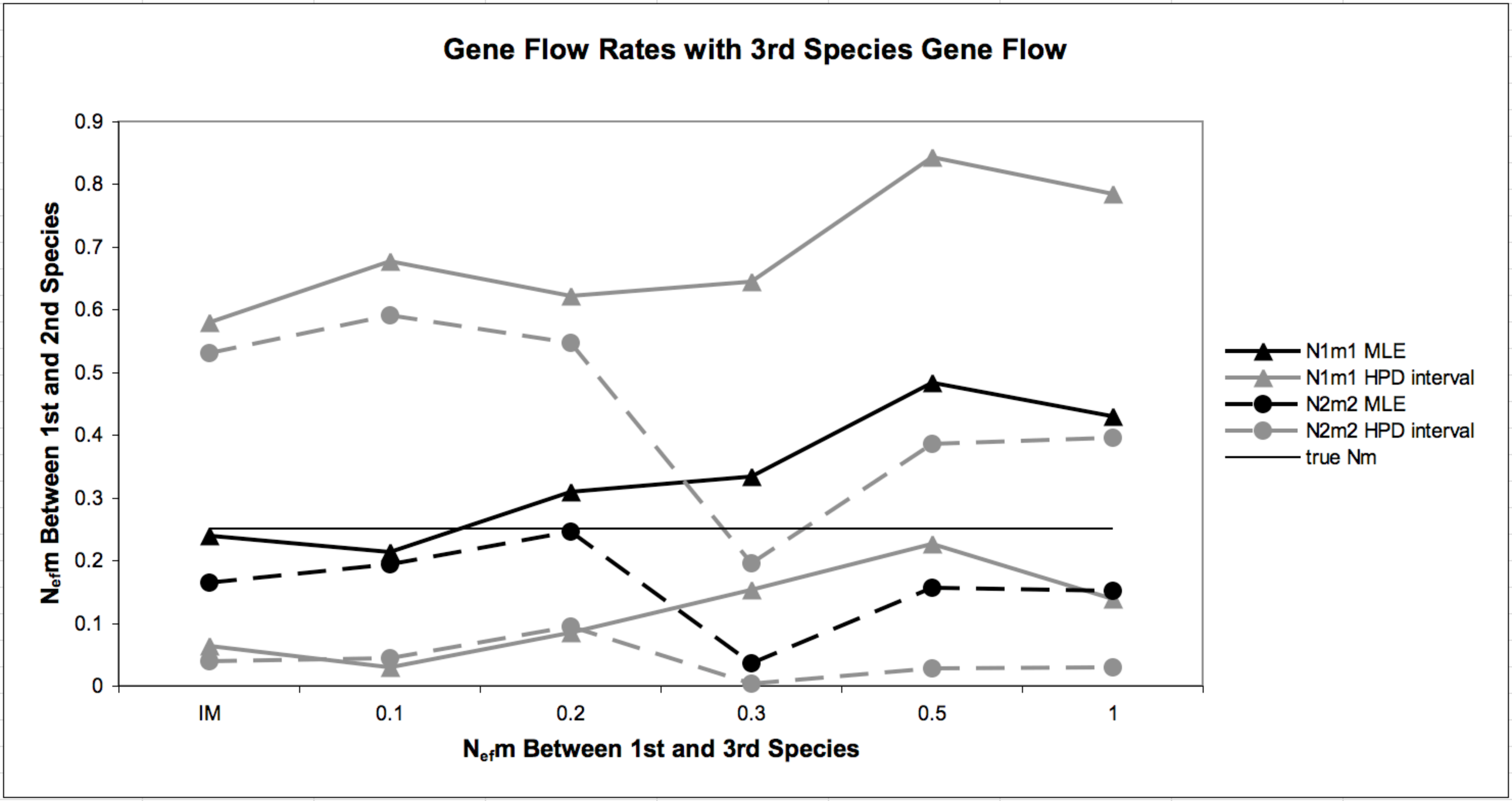

Gene Flow Rates, HKY Non-Recombining Blocks
1.2
1
0.8
0.6
0.4
0.2
0
$N_{ef}m$
IM
0
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
N1m1 MLE
N1m1 HPD interval
N2m2 MLE
N2m2 HPD interval
true Nm

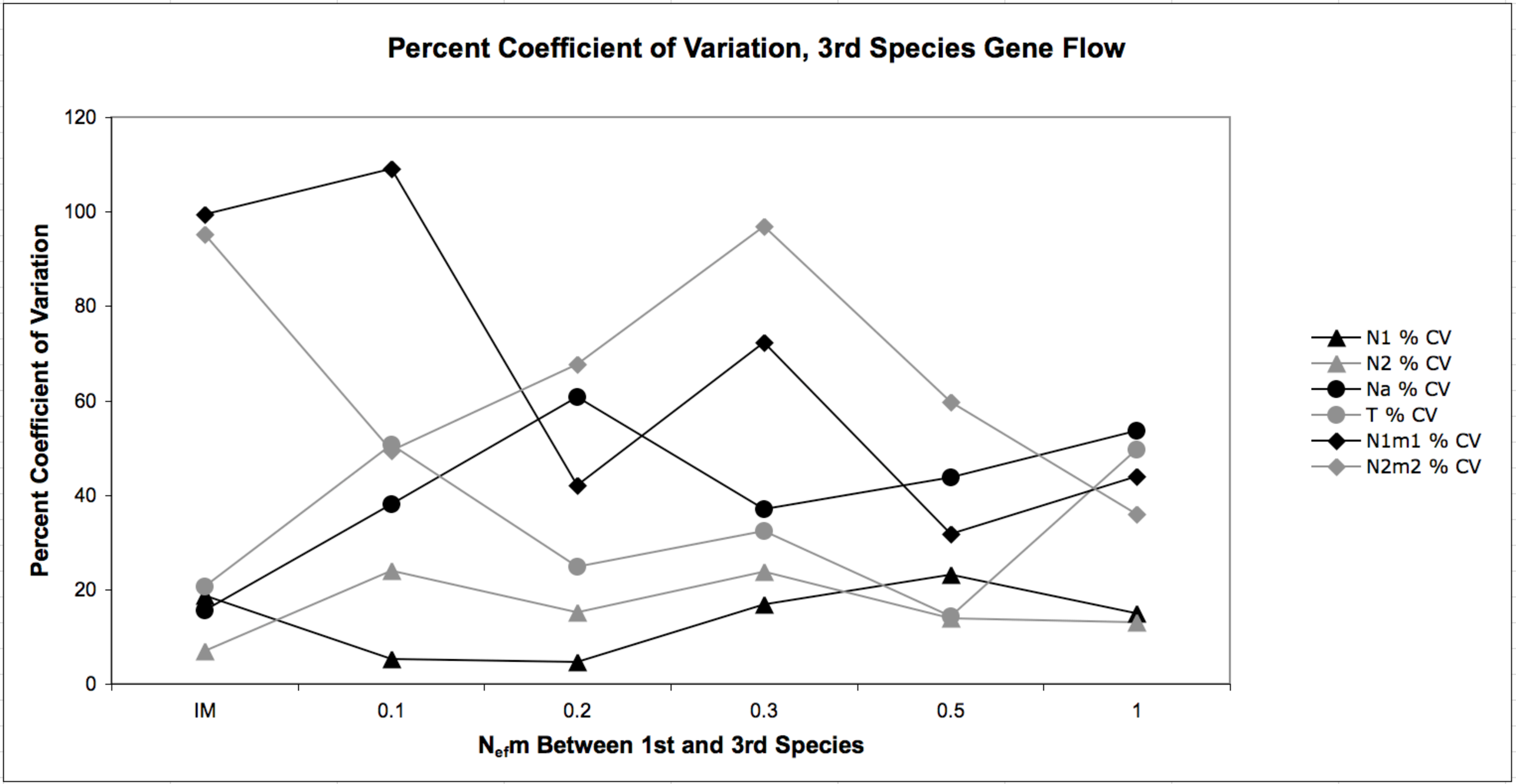

Percent Coefficient of Variation, HKY Non-Recombining Blocks
Percent Coefficient of Variation
140
120
100
80
60
40
20
0
IM
0
0.005
0.01
0.02
0.03
0.04
0.05
Rho per bp
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV

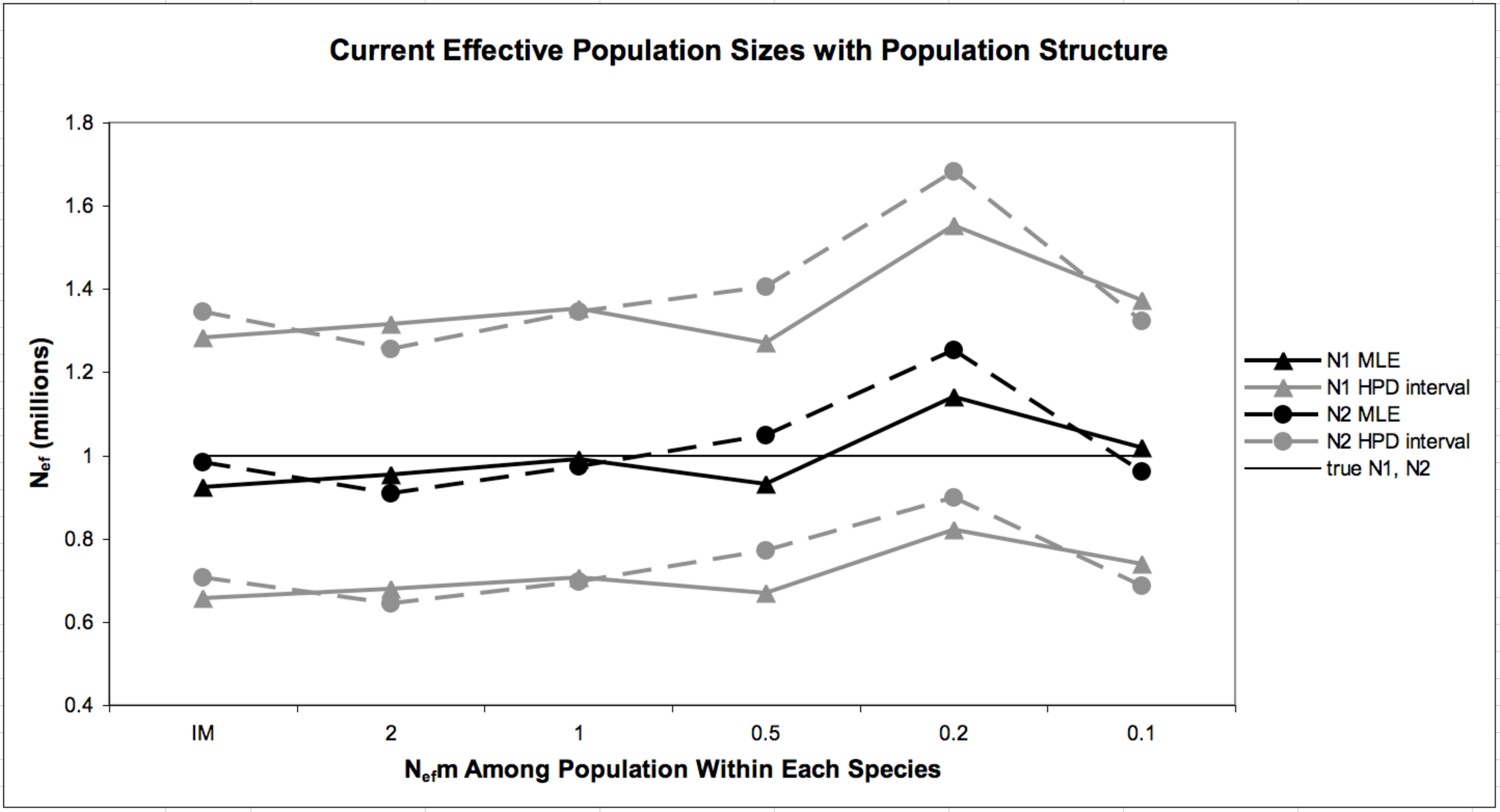

Current Effective Population Sizes with 3rd Species Gene Flow
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
Nef (millions)
IM
0.1
0.2
0.3
0.5
1
Nefm Between 1st and 3rd Species
N1 MLE
N1 HPD interval
N2 MLE
N2 HPD interval
true N1, N2

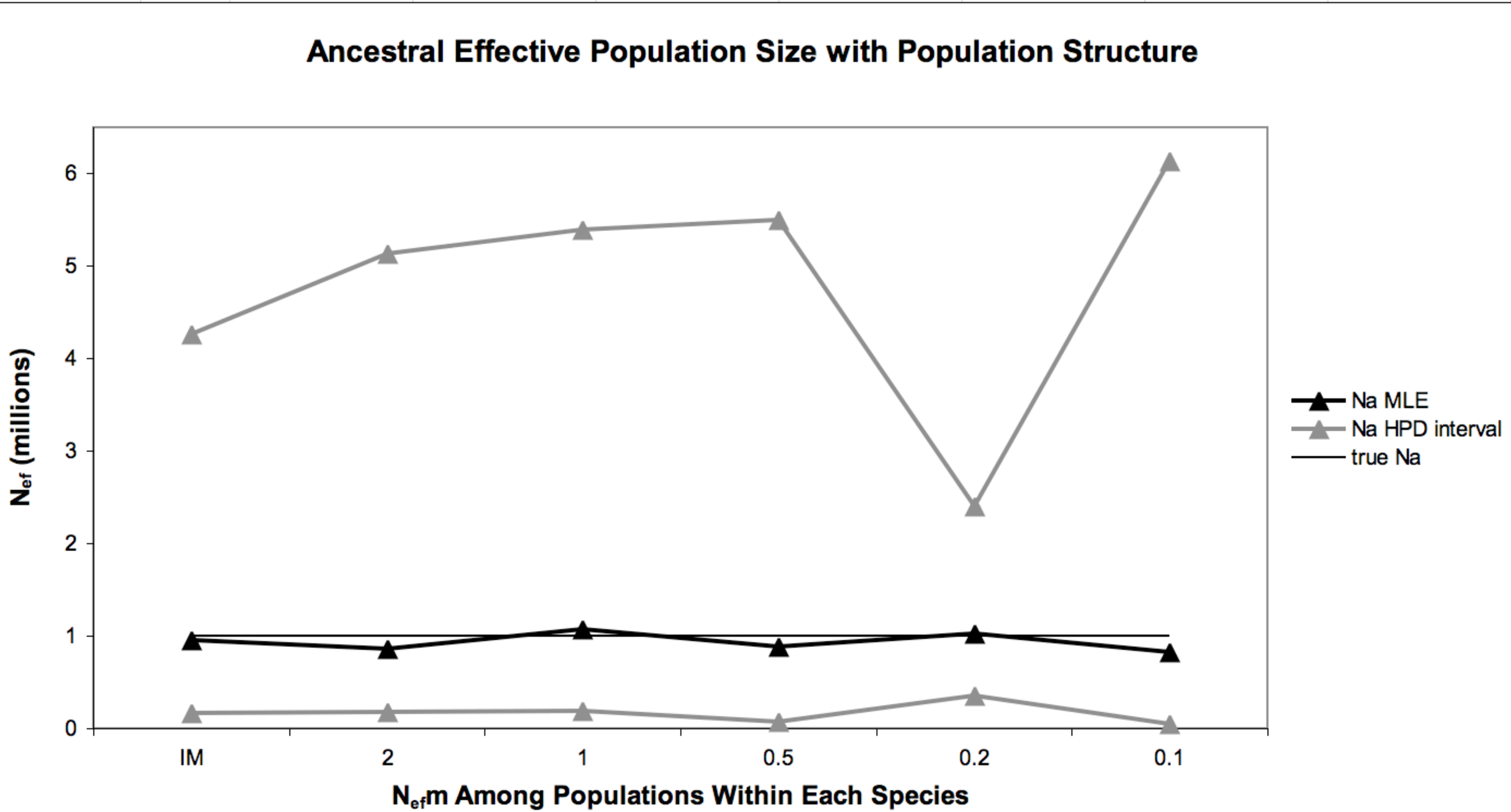

Ancestral Effective Population Size with 3rd Species Gene Flow
10
9
8
7
6
5
4
3
2
1
0
Nef (millions)
IM
0.1
0.2
0.3
0.5
1
Nefm Between 1st and 3rd Species
Na MLE
Na HPD interval
true Na

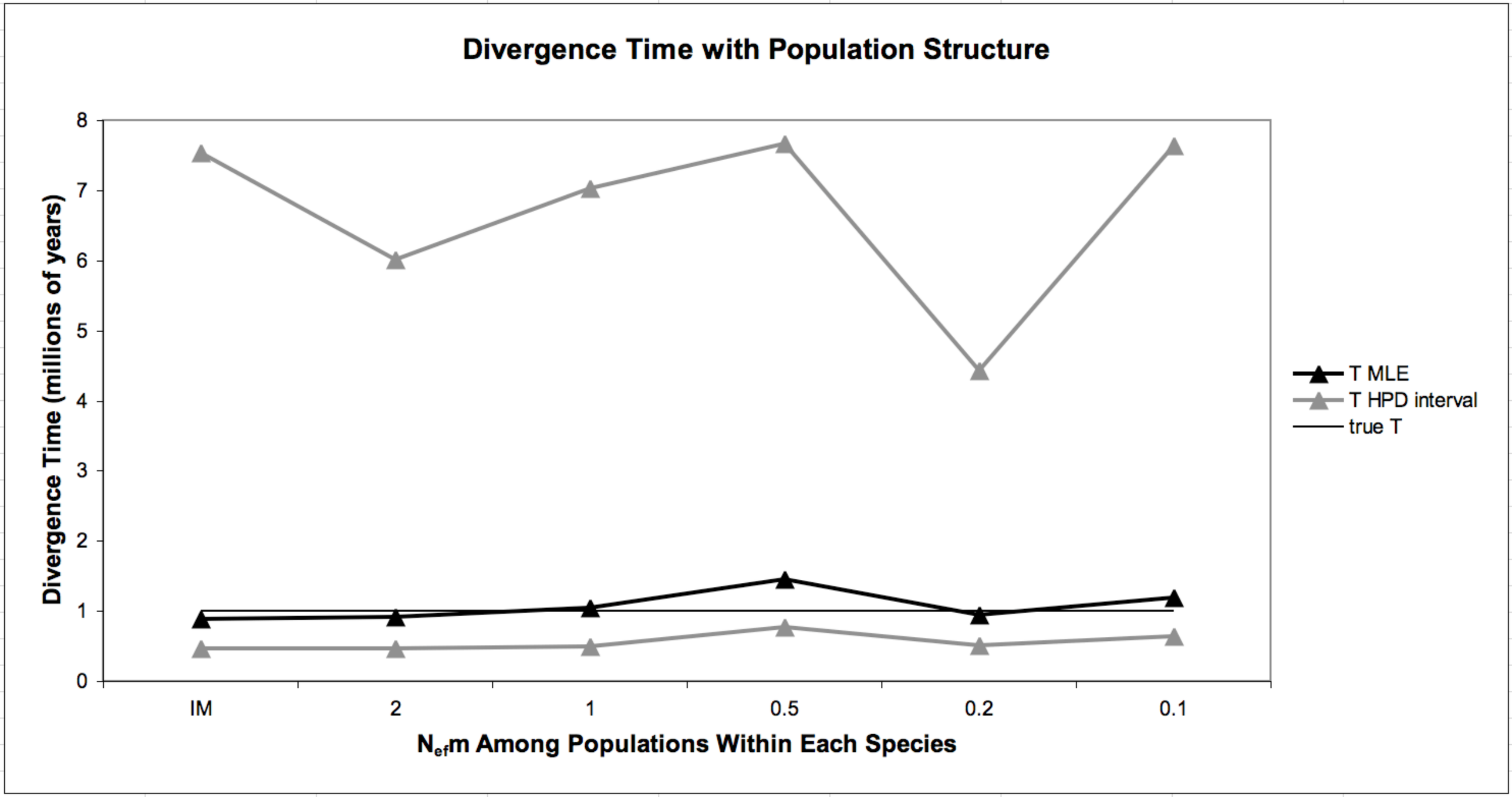

Divergence Time with 3rd Species Gene Flow
Divergence Time (millions of years)
10
9
8
7
6
5
4
3
2
1
0
IM
0.1
0.2
0.3
0.5
1
Nefm Between 1st and 3rd Species
T MLE
T HPD interval
true T

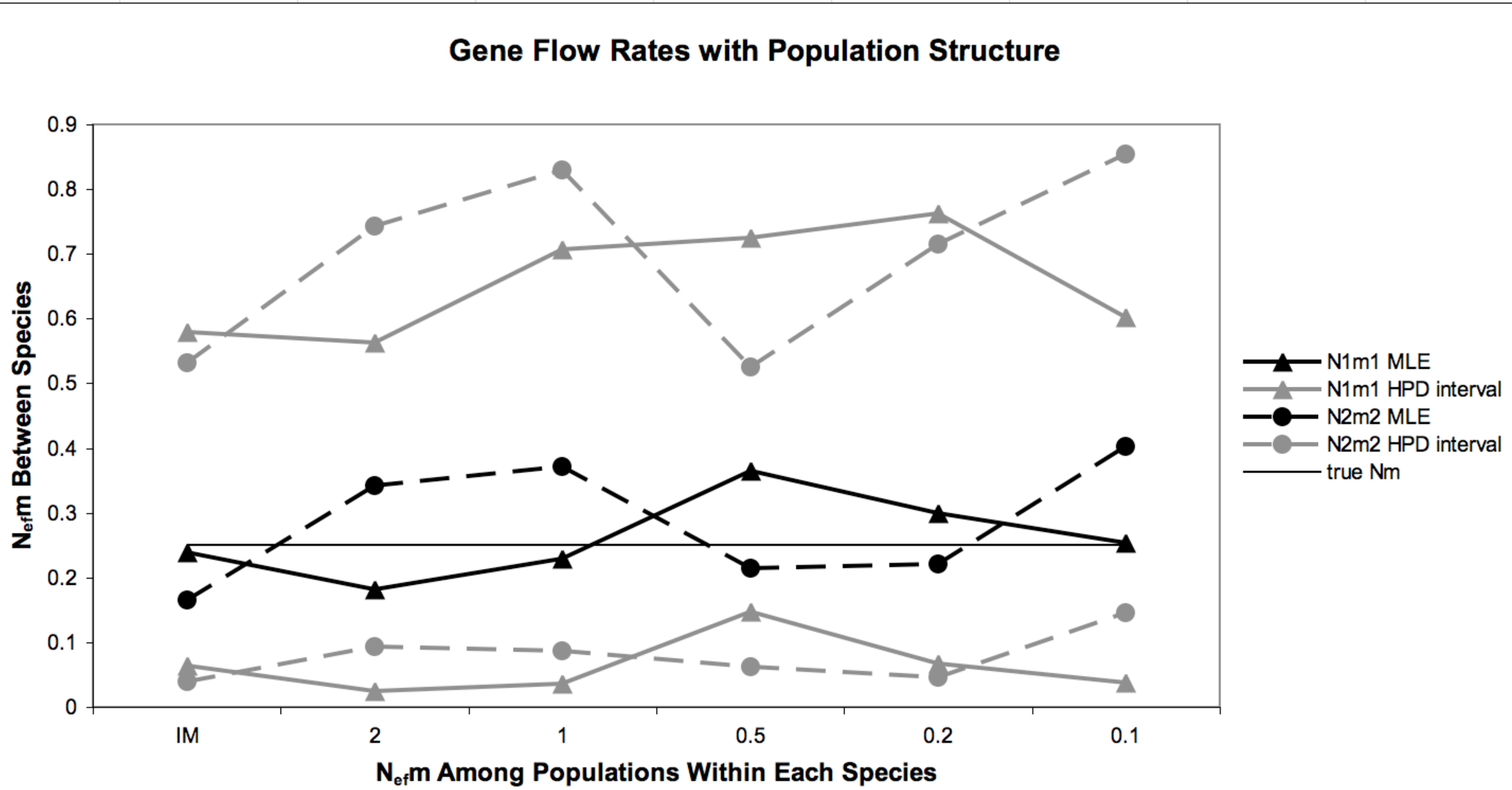

Gene Flow Rates with 3rd Species Gene Flow
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Nefm Between 1st and 2nd Species
IM
0.1
0.2
0.3
0.5
1
Nefm Between 1st and 3rd Species
N1m1 MLE
N1m1 HPD interval
N2m2 MLE
N2m2 HPD interval
true Nm

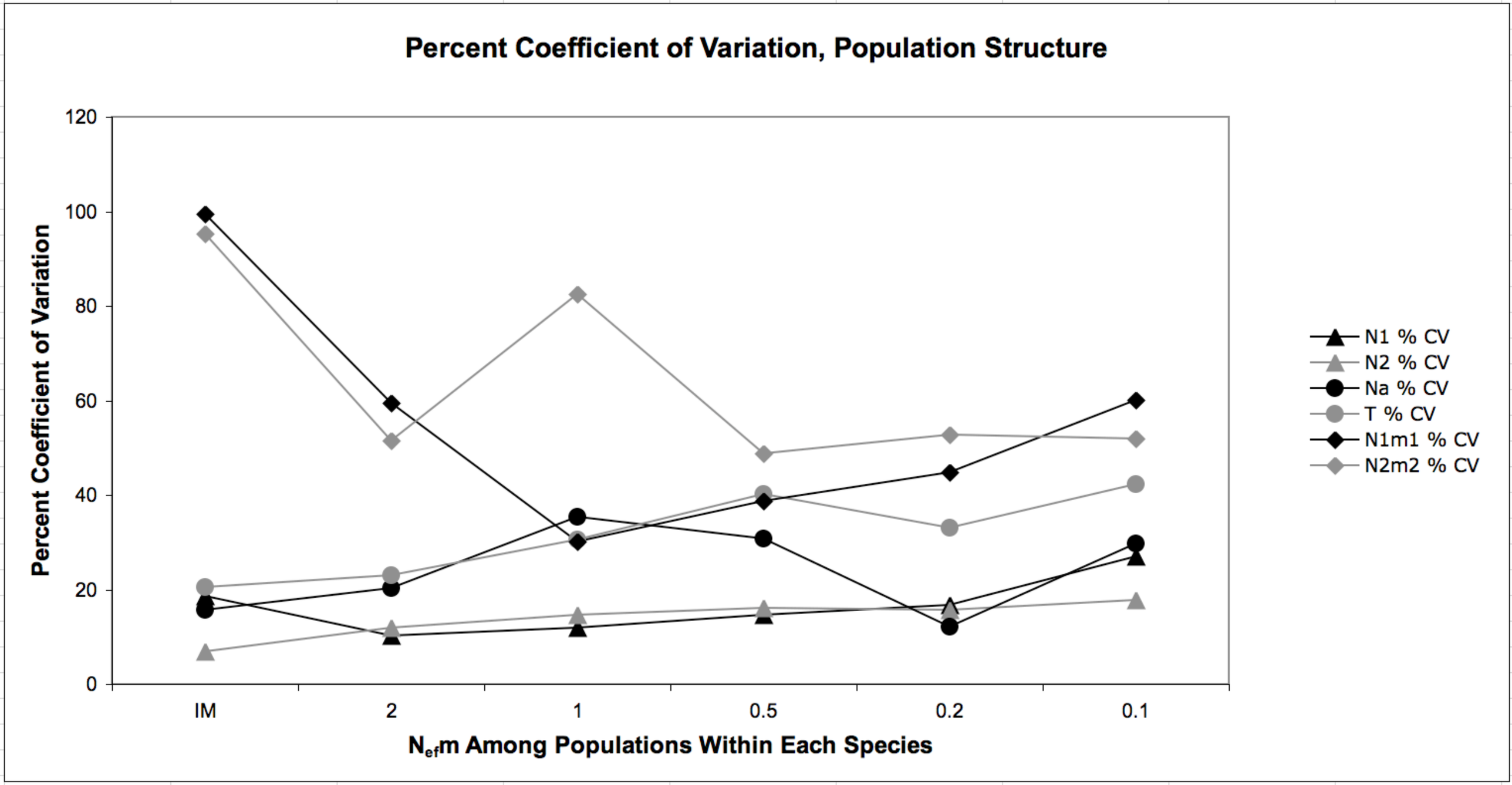

Percent Coefficient of Variation, 3rd Species Gene Flow
Percent Coefficient of Variation
120
100
80
60
40
20
0
IM
0.1
0.2
0.3
0.5
1
Nefm Between 1st and 3rd Species
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV

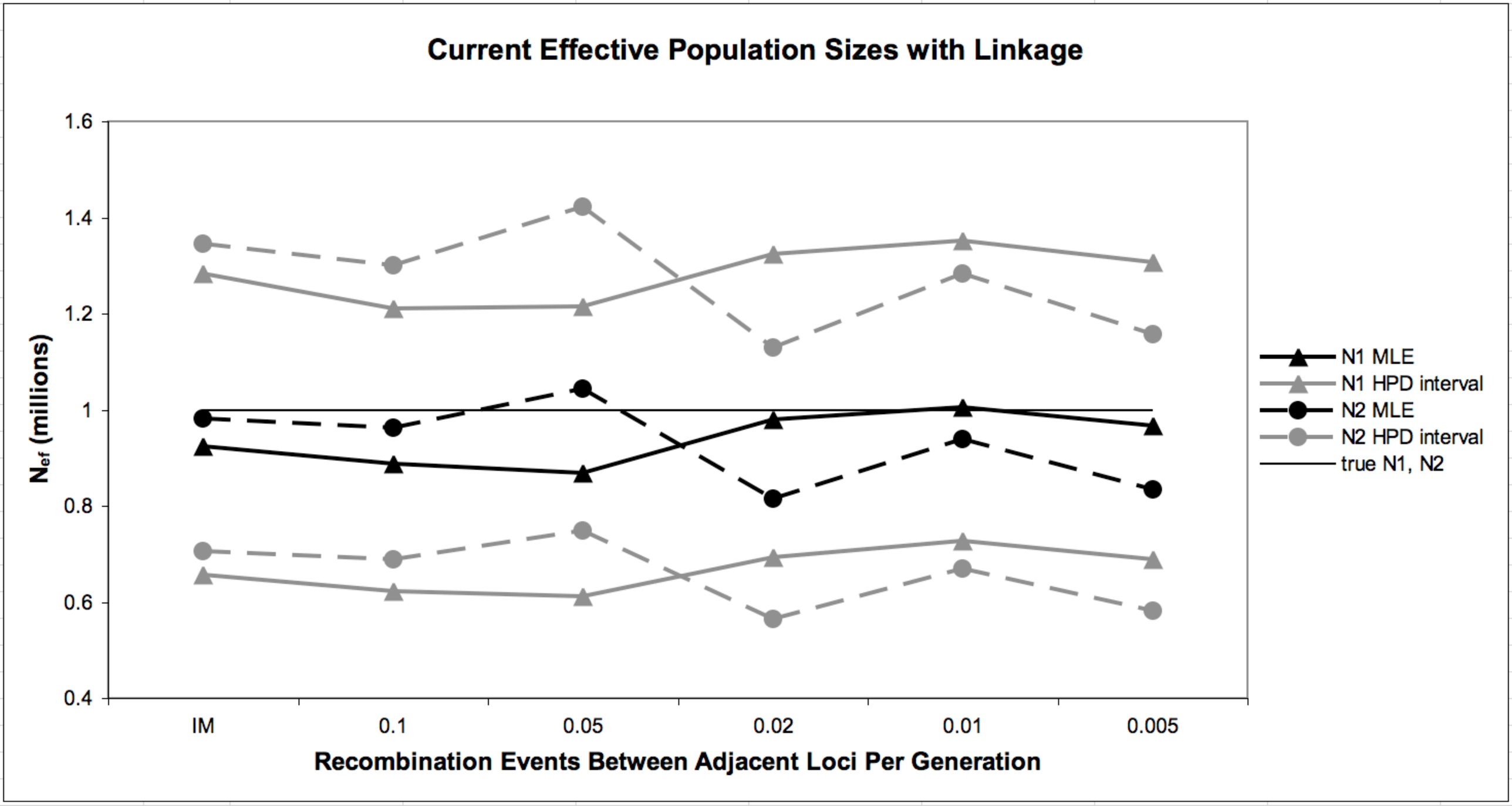

Current Effective Population Sizes with Population Structure
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
Nef (millions)
IM
2
1
0.5
0.2
0.1
Nefm Among Population Within Each Species
N1 MLE
N1 HPD interval
N2 MLE
N2 HPD interval
true N1, N2

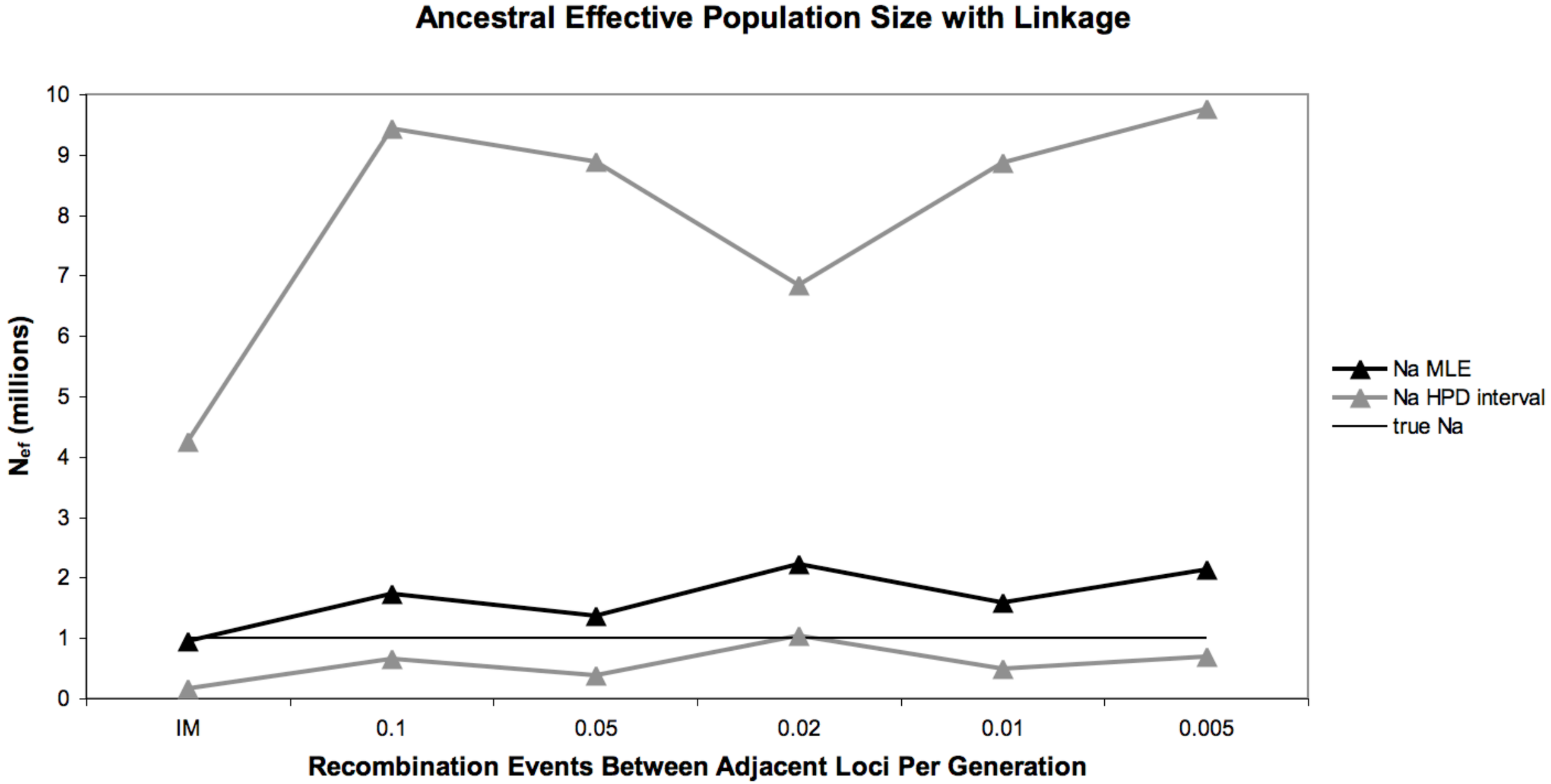

Ancestral Effective Population Size with Population Structure
N_{ef} (millions)
0
1
2
3
4
5
6
IM
2
1
0.5
0.2
0.1
N_{ef}m Among Populations Within Each Species
Na MLE
Na HPD interval
true Na

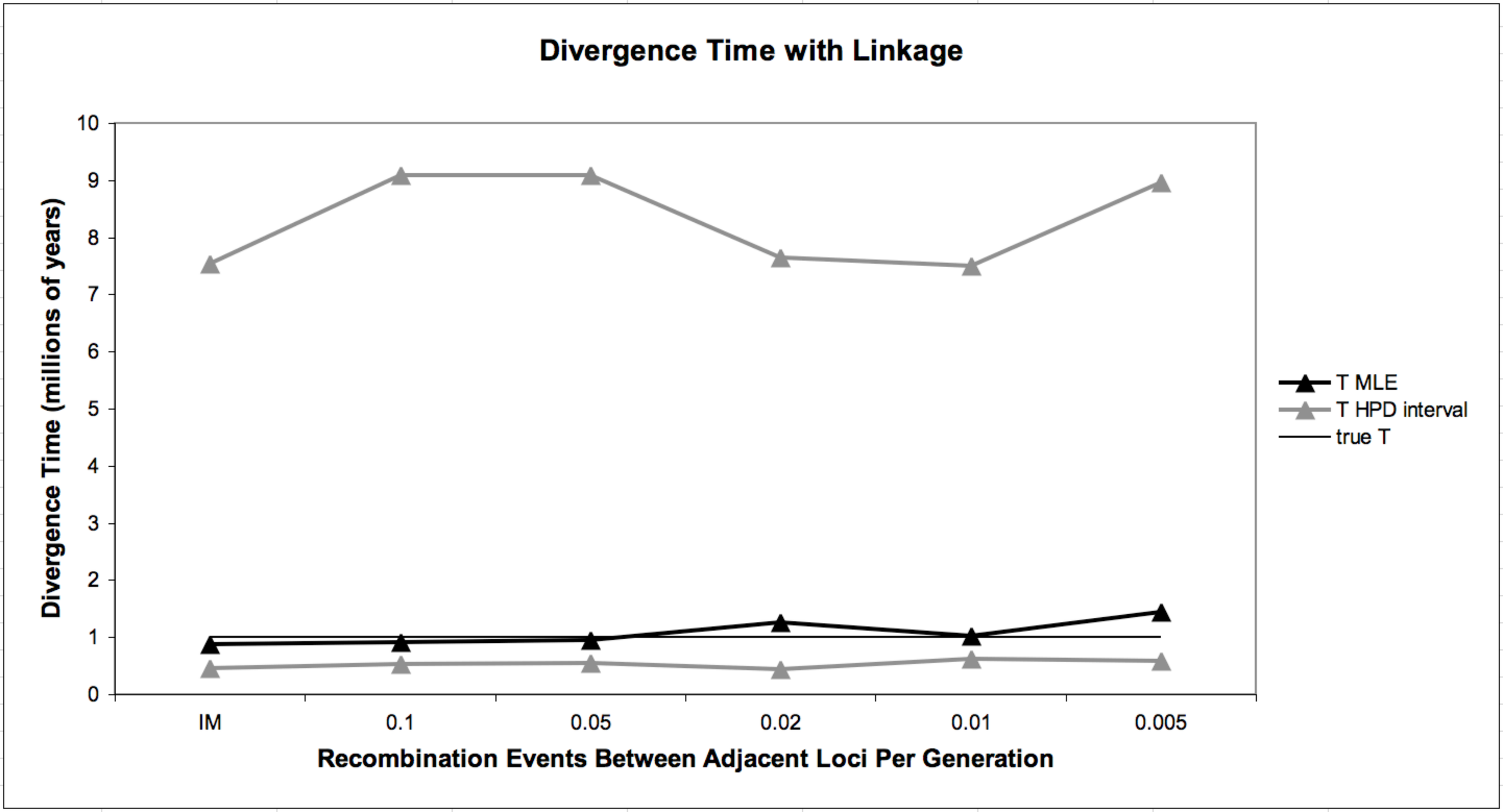

Divergence Time with Population Structure
Divergence Time (millions of years)
0
1
2
3
4
5
6
7
8
IM
2
1
0.5
0.2
0.1
$N_{ef}m$ Among Populations Within Each Species
T MLE
T HPD interval
true T

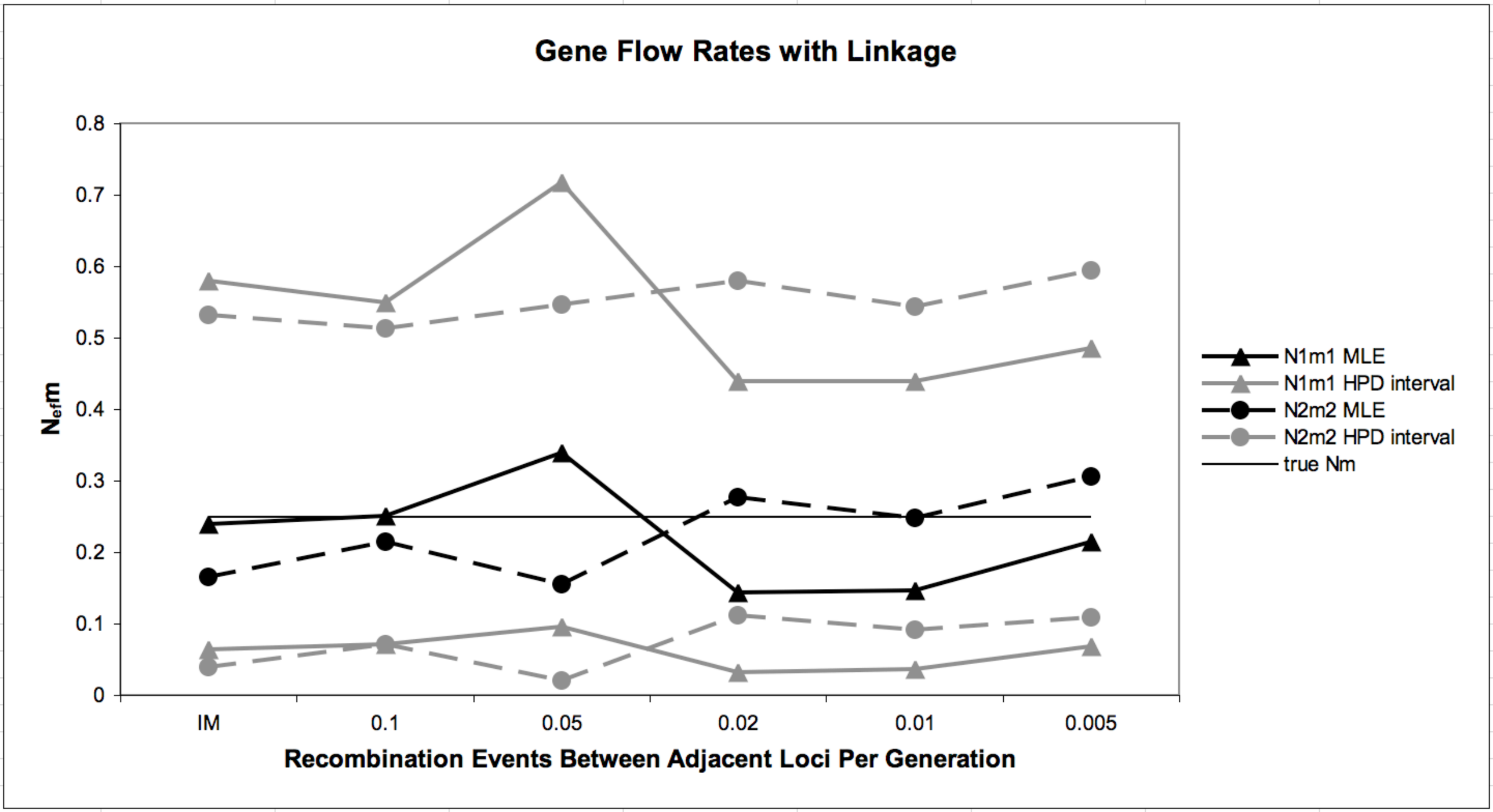

Gene Flow Rates with Population Structure
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Nefm Between Species
IM
2
1
0.5
0.2
0.1
Nefm Among Populations Within Each Species
N1m1 MLE
N1m1 HPD interval
N2m2 MLE
N2m2 HPD interval
true Nm

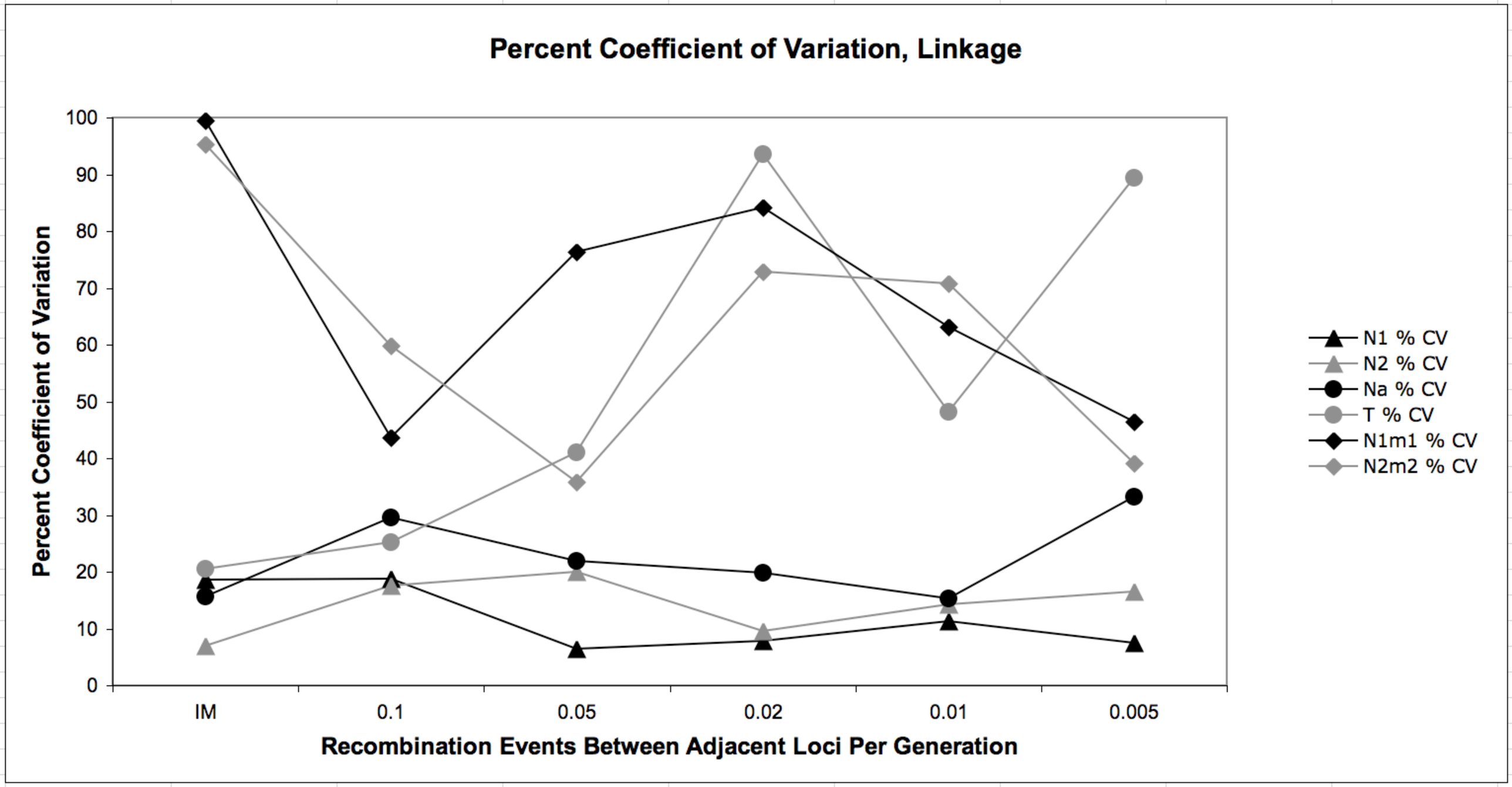

Percent Coefficient of Variation, Population Structure
Percent Coefficient of Variation
120
100
80
60
40
20
0
IM
2
1
0.5
0.2
0.1
Nefm Among Populations Within Each Species
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV

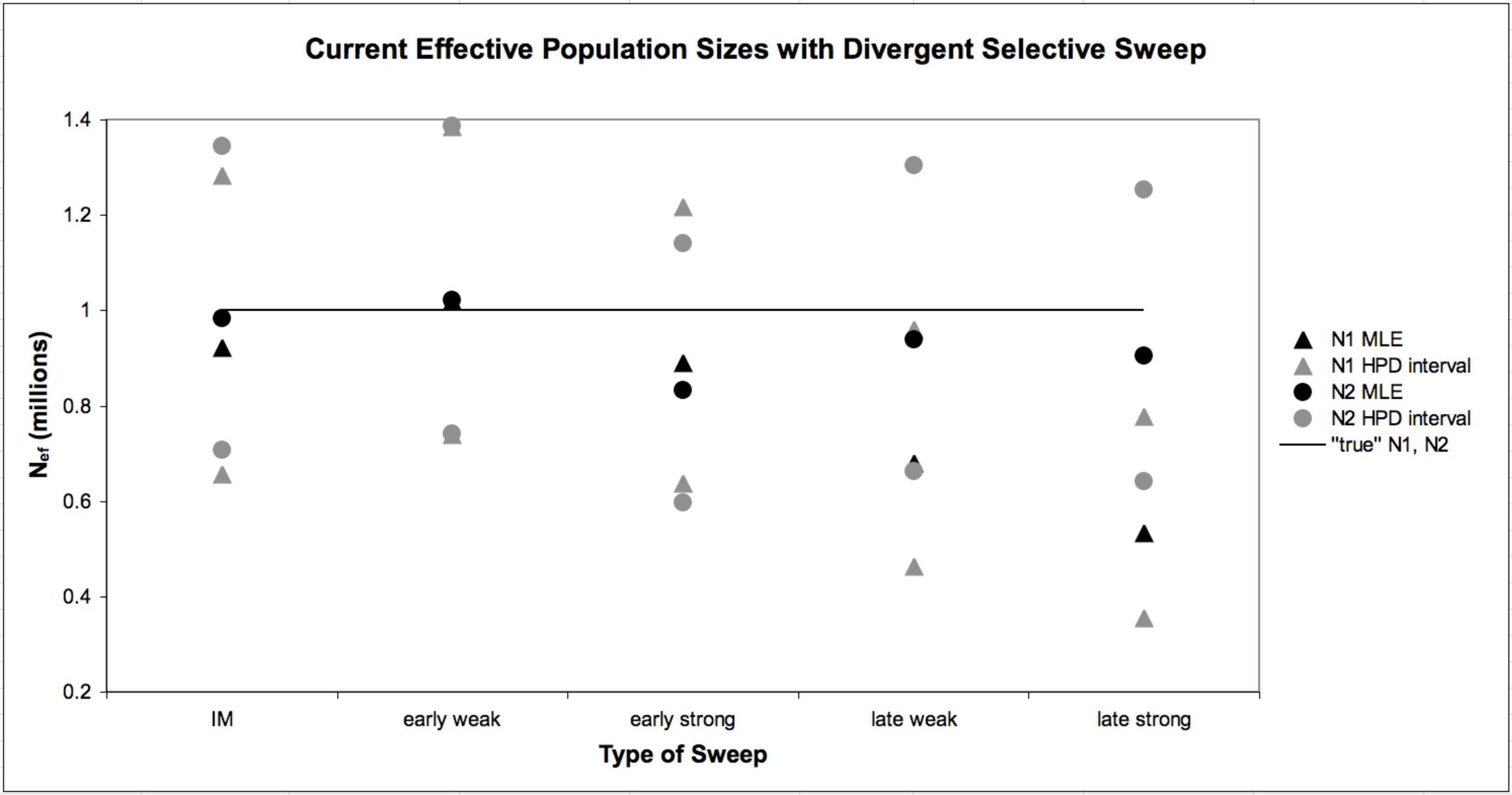

Current Effective Population Sizes with Linkage
1.6
1.4
1.2
1
0.8
0.6
0.4
Nef (millions)
IM
0.1
0.05
0.02
0.01
0.005
Recombination Events Between Adjacent Loci Per Generation
N1 MLE
N1 HPD interval
N2 MLE
N2 HPD interval
true N1, N2

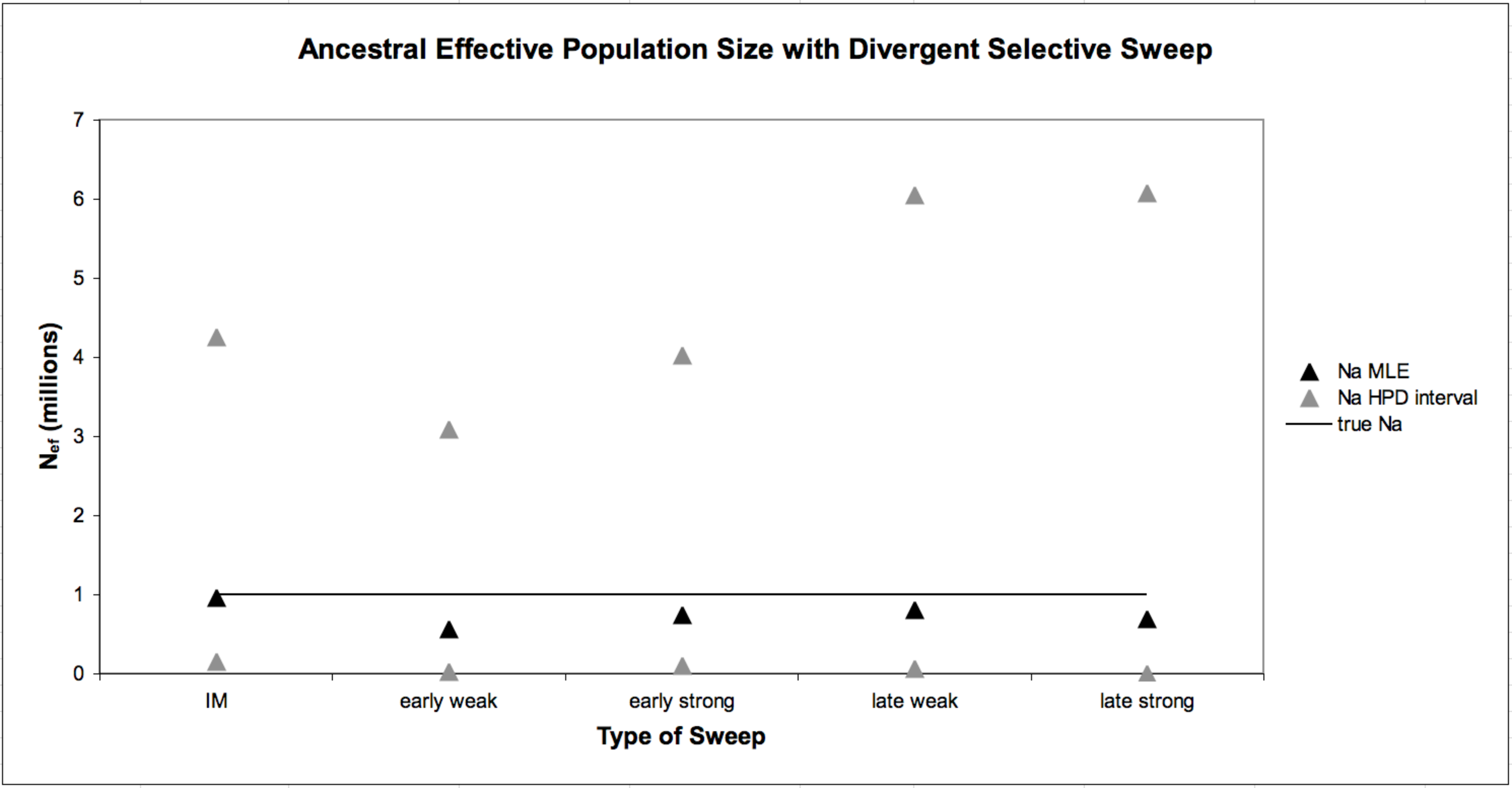

Ancestral Effective Population Size with Linkage
10
9
8
7
6
5
4
3
2
1
0
Nef (millions)
IM
0.1
0.05
0.02
0.01
0.005
Recombination Events Between Adjacent Loci Per Generation
Na MLE
Na HPD interval
true Na

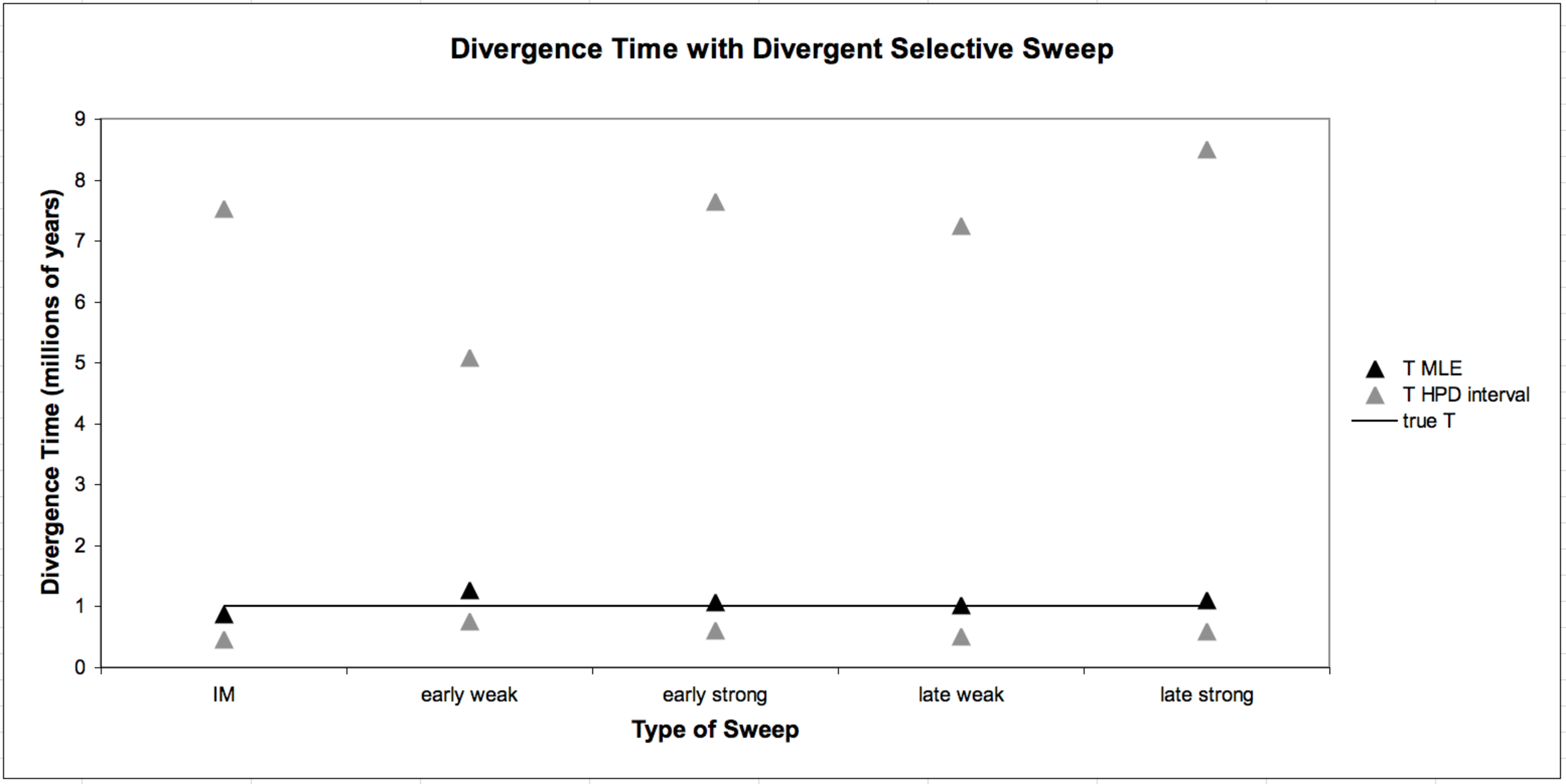

Divergence Time with Linkage
Divergence Time (millions of years)
10
9
8
7
6
5
4
3
2
1
0
IM
0.1
0.05
0.02
0.01
0.005
Recombination Events Between Adjacent Loci Per Generation
T MLE
T HPD interval
true T

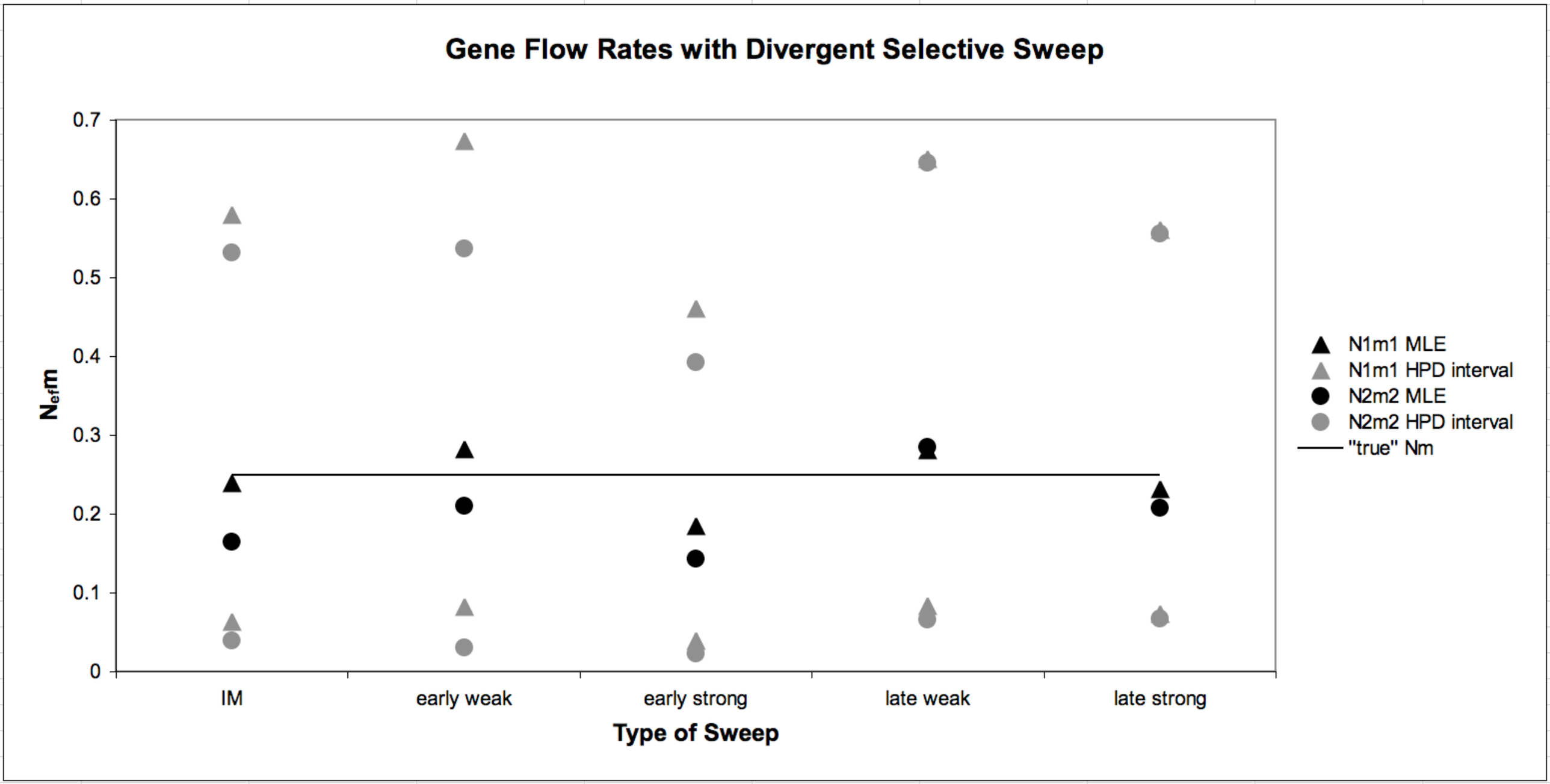

Gene Flow Rates with Linkage
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$N_{ef}m$
IM
0.1
0.05
0.02
0.01
0.005
Recombination Events Between Adjacent Loci Per Generation
N1m1 MLE
N1m1 HPD interval
N2m2 MLE
N2m2 HPD interval
true Nm

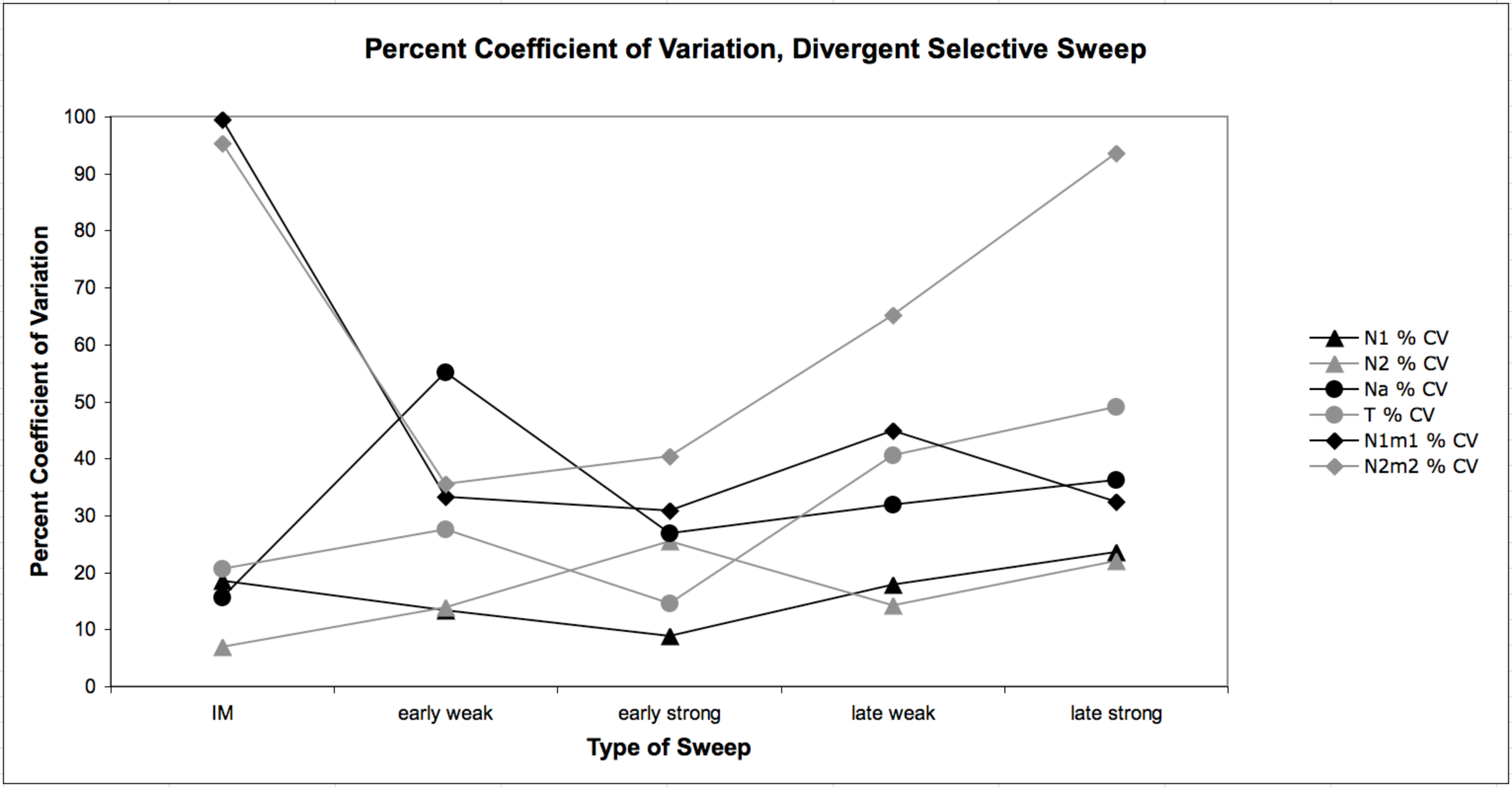

Percent Coefficient of Variation, Linkage
Percent Coefficient of Variation
100
90
80
70
60
50
40
30
20
10
0
IM
0.1
0.05
0.02
0.01
0.005
Recombination Events Between Adjacent Loci Per Generation
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV


Current Effective Population Sizes with Divergent Selective Sweep
1.4
1.2
1
0.8
0.6
0.4
0.2
Nef (millions)
IM
early weak
early strong
late weak
late strong
Type of Sweep
N1 MLE
N1 HPD interval
N2 MLE
N2 HPD interval
"true" N1, N2

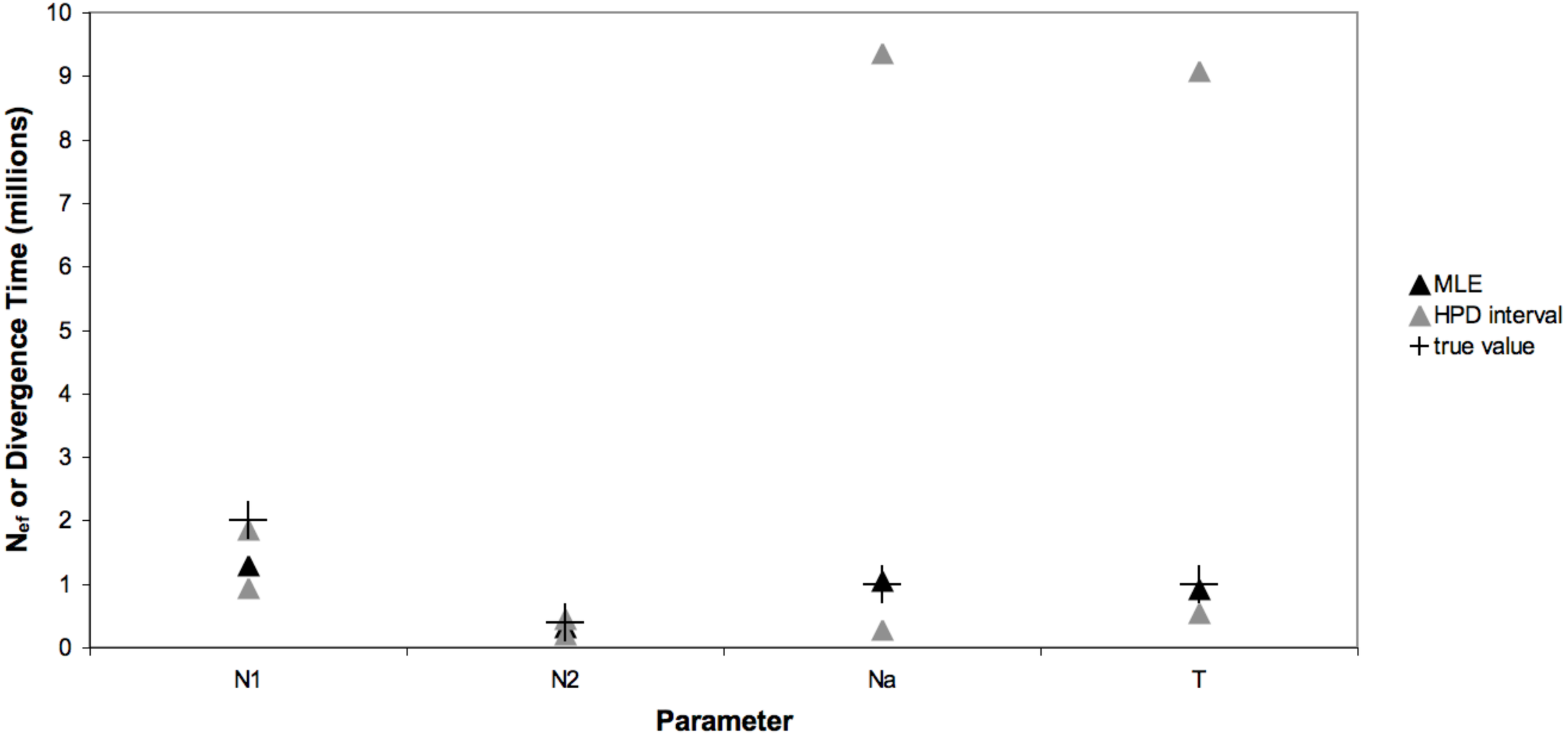

Ancestral Effective Population Size with Divergent Selective Sweep
7
6
5
4
3
2
1
0
Nef (millions)
IM
early weak
early strong
late weak
late strong
Type of Sweep
Na MLE
Na HPD interval
true Na

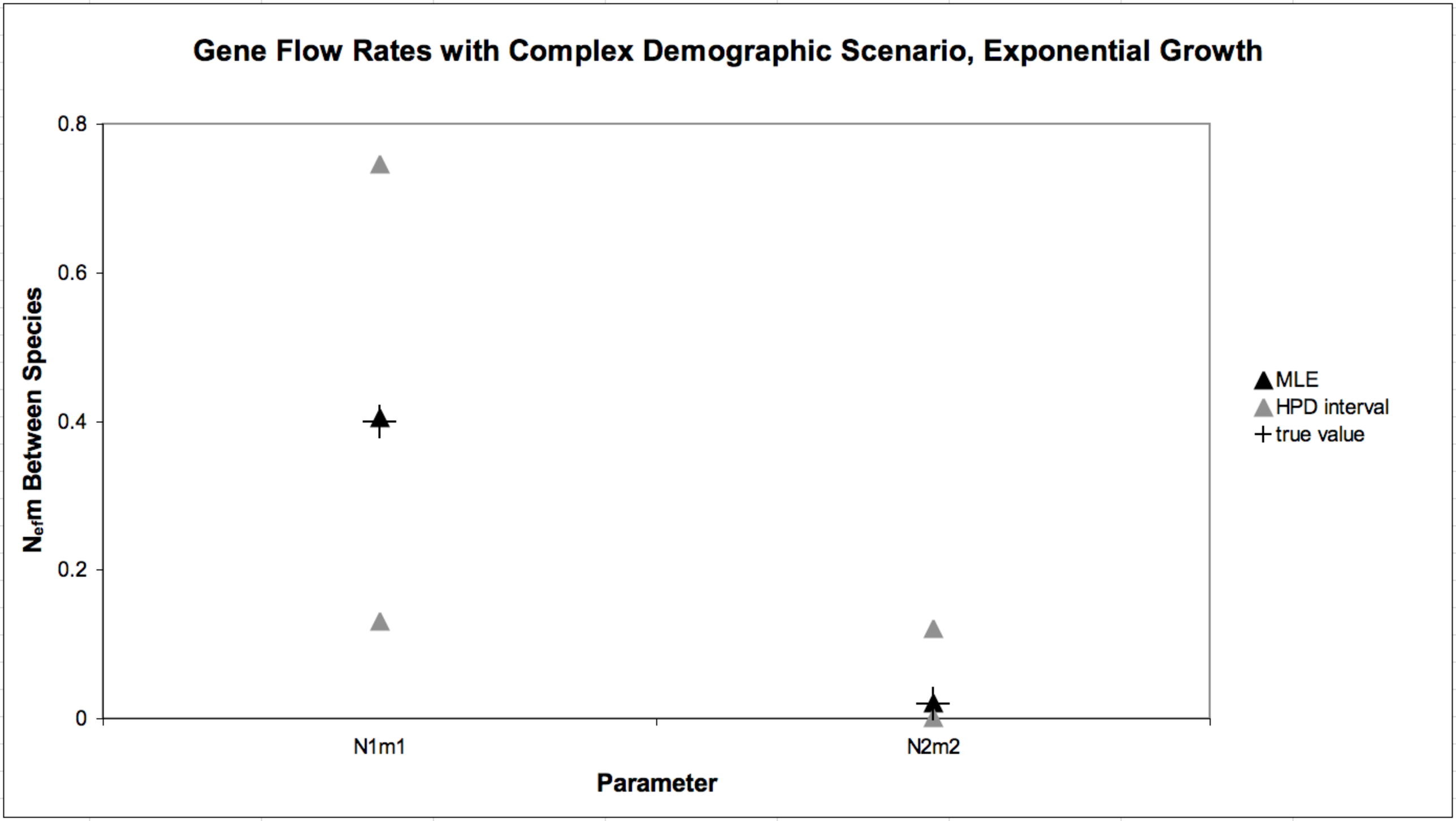

Divergence Time with Divergent Selective Sweep
Divergence Time (millions of years)
0
1
2
3
4
5
6
7
8
9
IM
early weak
early strong
late weak
late strong
Type of Sweep
T MLE
T HPD interval
true T


Gene Flow Rates with Divergent Selective Sweep
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$N_{ef}m$
IM
early weak
early strong
late weak
late strong
Type of Sweep
N1m1 MLE
N1m1 HPD interval
N2m2 MLE
N2m2 HPD interval
"true" Nm

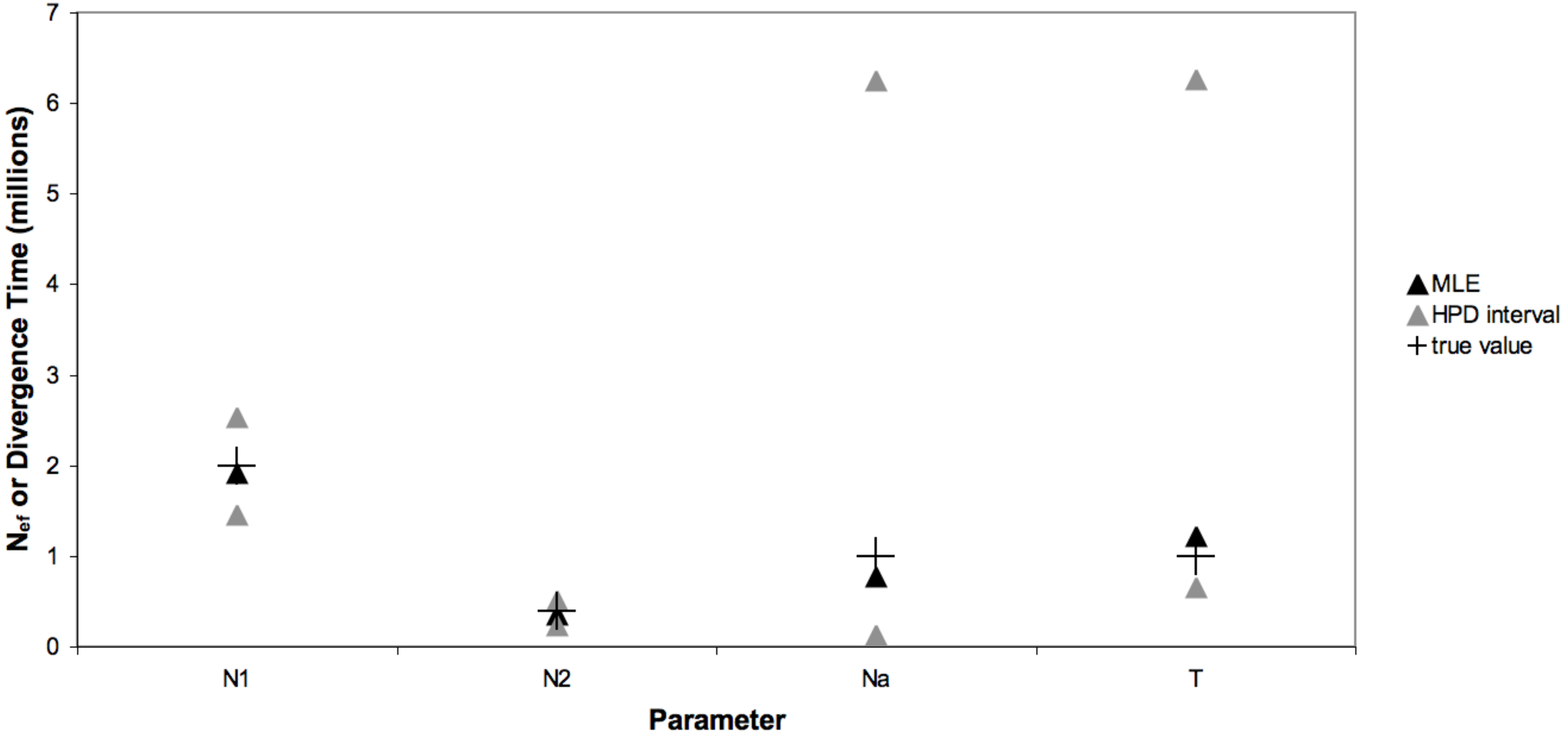

Percent Coefficient of Variation, Divergent Selective Sweep
Percent Coefficient of Variation
100
90
80
70
60
50
40
30
20
10
0
IM
early weak
early strong
late weak
late strong
Type of Sweep
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV

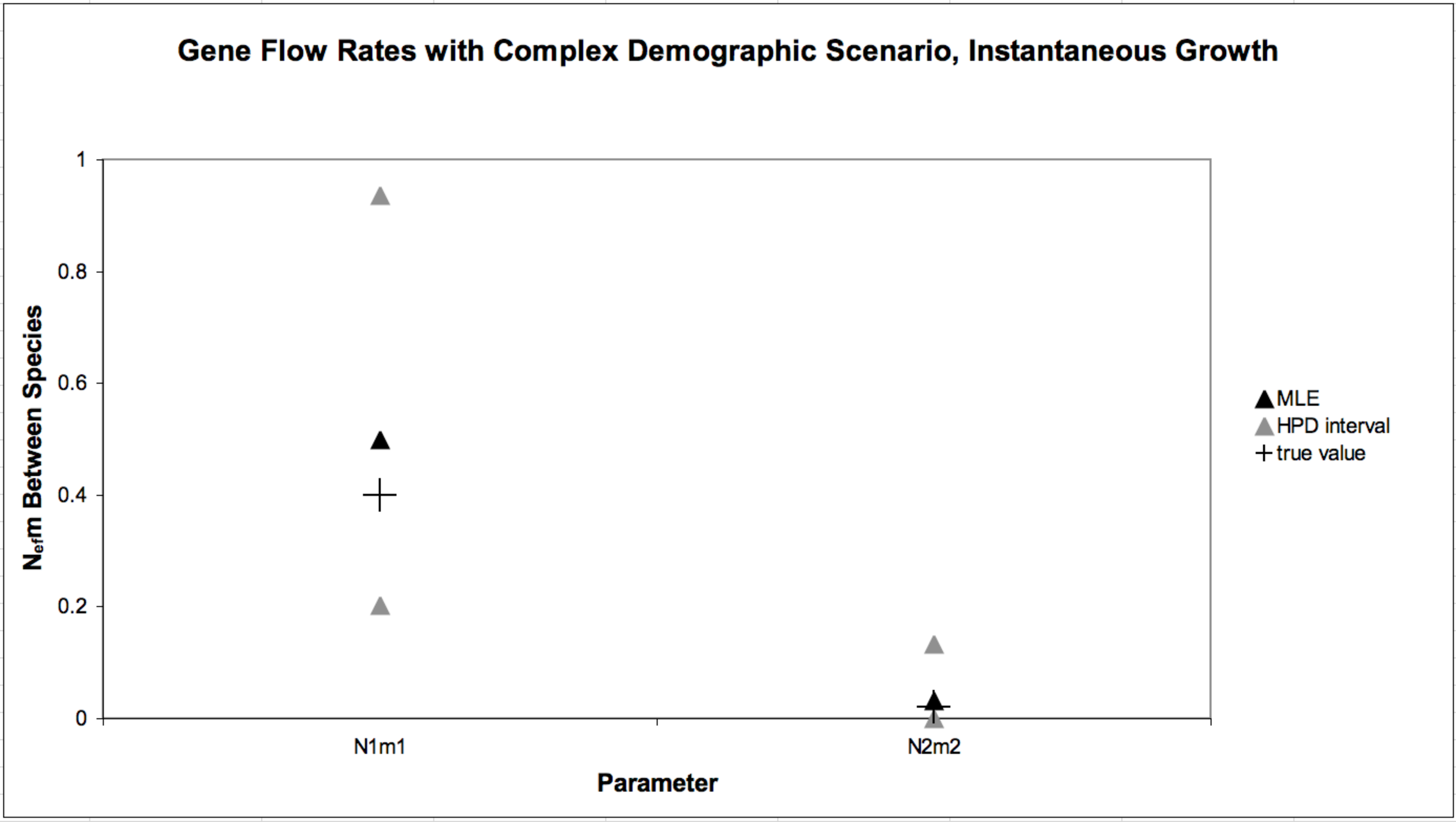
Effective Population Sizes and Divergence Time with Complex Demographic Scenario, Exponential Growth

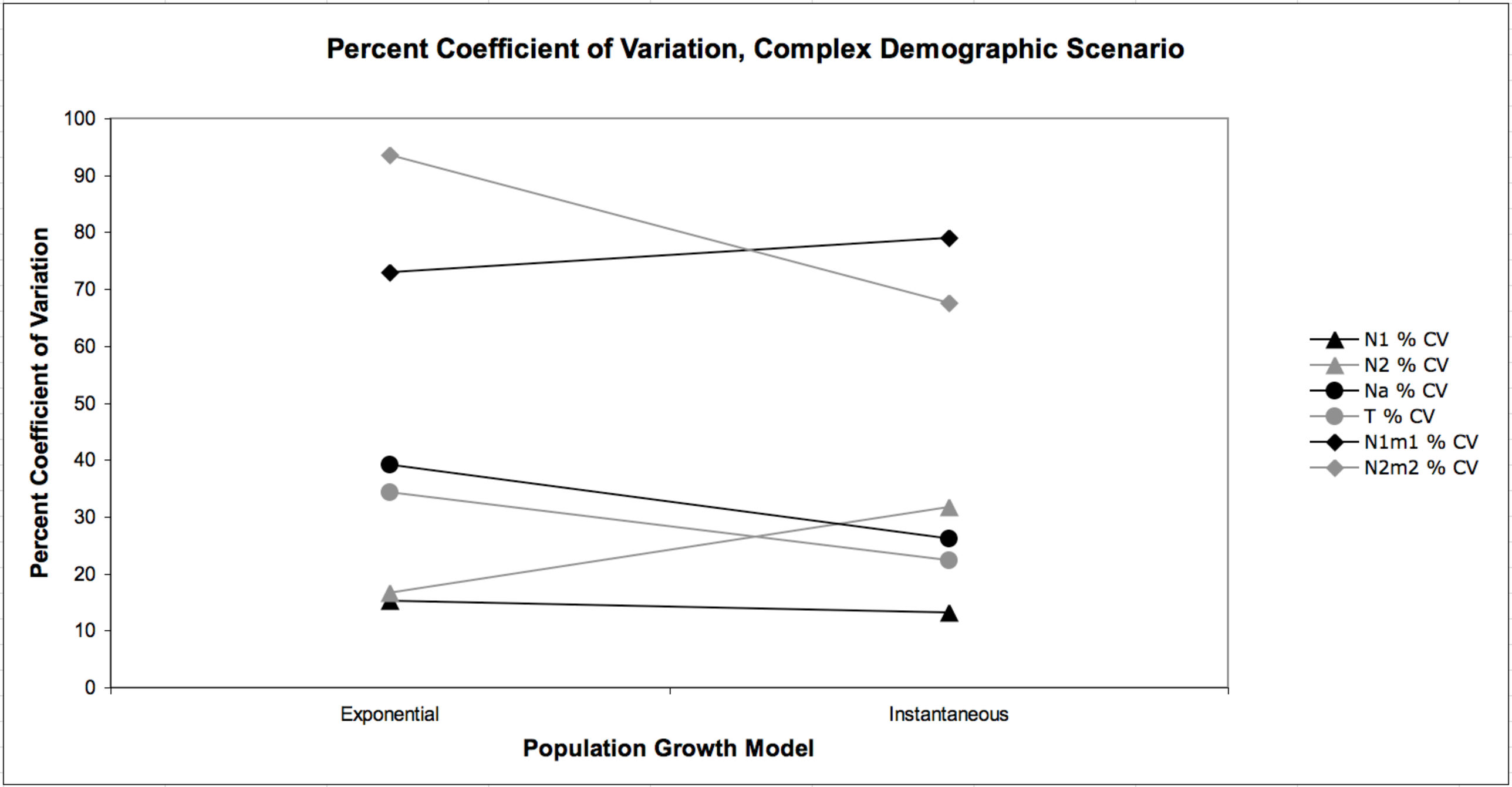



Gene Flow Rates with Complex Demographic Scenario, Exponential Growth
0.8
0.6
0.4
0.2
0
Nefm Between Species
N1m1
N2m2
Parameter
MLE
HPD interval
true value

Effective Population Sizes and Divergence Time with Complex Demographic Scenario, Instantaneous Growth




Gene Flow Rates with Complex Demographic Scenario, Instantaneous Growth
1
0.8
0.6
0.4
0.2
0
Nefm Between Species
N1m1
N2m2
Parameter
MLE
HPD interval
true value


Percent Coefficient of Variation, Complex Demographic Scenario
Percent Coefficient of Variation
100
90
80
70
60
50
40
30
20
10
0
Exponential
Instantaneous
Population Growth Model
N1 % CV
N2 % CV
Na % CV
T % CV
N1m1 % CV
N2m2 % CV