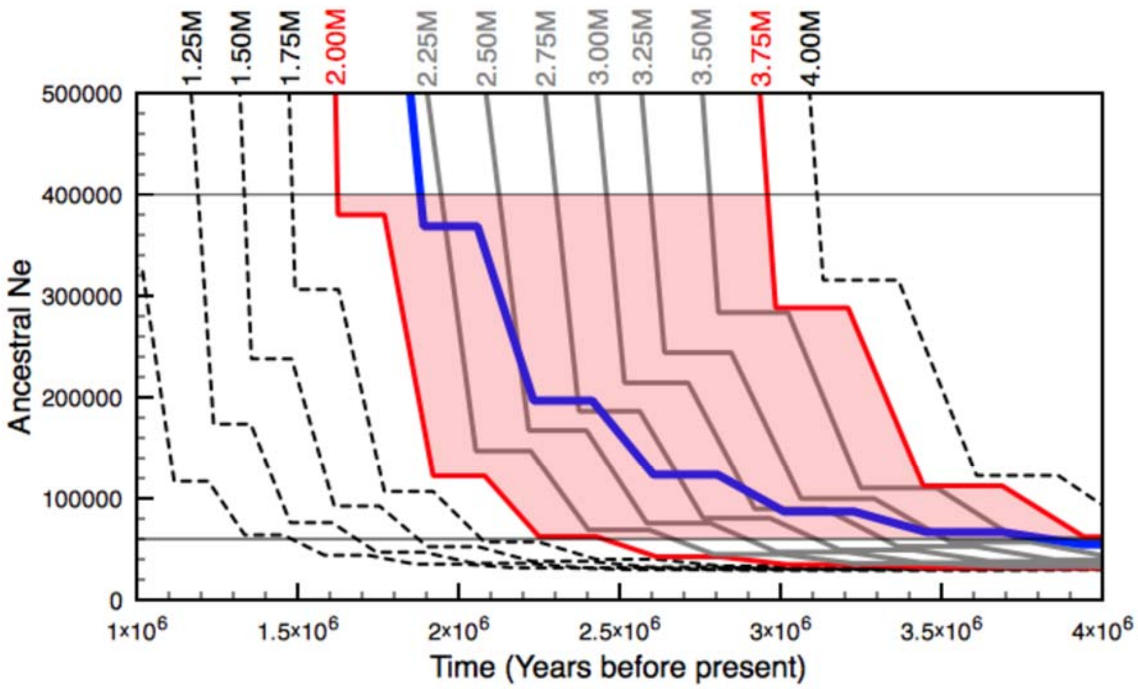
Supplementary material for Cahill JA, Soares AER, Green RE and Shapiro B, 2016. Inferring species divergence times using Pairwise Sequential Markovian Coalescent (PSMC) modelling and low coverage genomic data, *Phil. Trans. R. Soc. B.* doi: 10.1098/rstb.2015.0138

Supplementary Materials

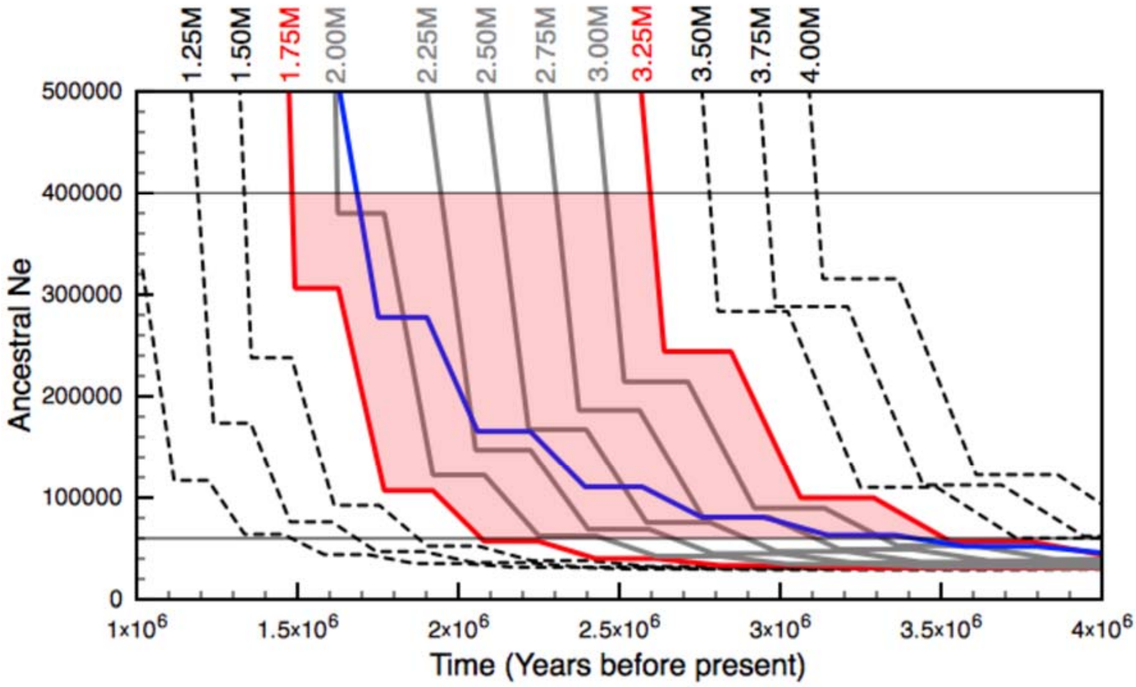
In the main text, we describe our approach to pinpoint the transition (divergence) time using simulation. In Figs 2 (main text) and S1-S17 (below), hPSMC plots generated for the artificially created hybrid genomes (blue lines) are compared to simulated data sets. Divergence is inferred to have occurred between the simulated divergence times that are the closest-matching simulations with transition times that do not intersect the transition time of real data (red shaded region). The horizontal lines delineate the range of ancestral effective population size estimates that correspond to 1.5 to 10 times the pre-divergence N_e. Supplementary Figs. S1-S9 describe divergence estimates for great apes, Supplementary Figs. S10-S17 describe divergence estimates for *Ursus* bears.

In Fig 1 (main text), we showed hPSMC plot results for simulated data under a range of simple population models. In Figs. S18-S21 (below) we further expand on our exploration of parameter space and test the impact of jointly varying pre-divergence N_e, post-divergence migration and initial divergence time. We conducted simulations using ms [1] for all combinations of four values for each parameter (Table S3). For haploidized data, we found that the proportion of migrants per generation affects inferred population size differently, depending on pre-divergence N_e. For larger pre-divergence N_e inferred ancestral population size increases at more ancient time intervals compared to simulations that are free of post-divergence migration (Fig S18-S21). Consequently, this method for estimating divergence time may overestimate the antiquity of the recent bound for divergence in cases of large N_e and prolonged post divergence gene flow.

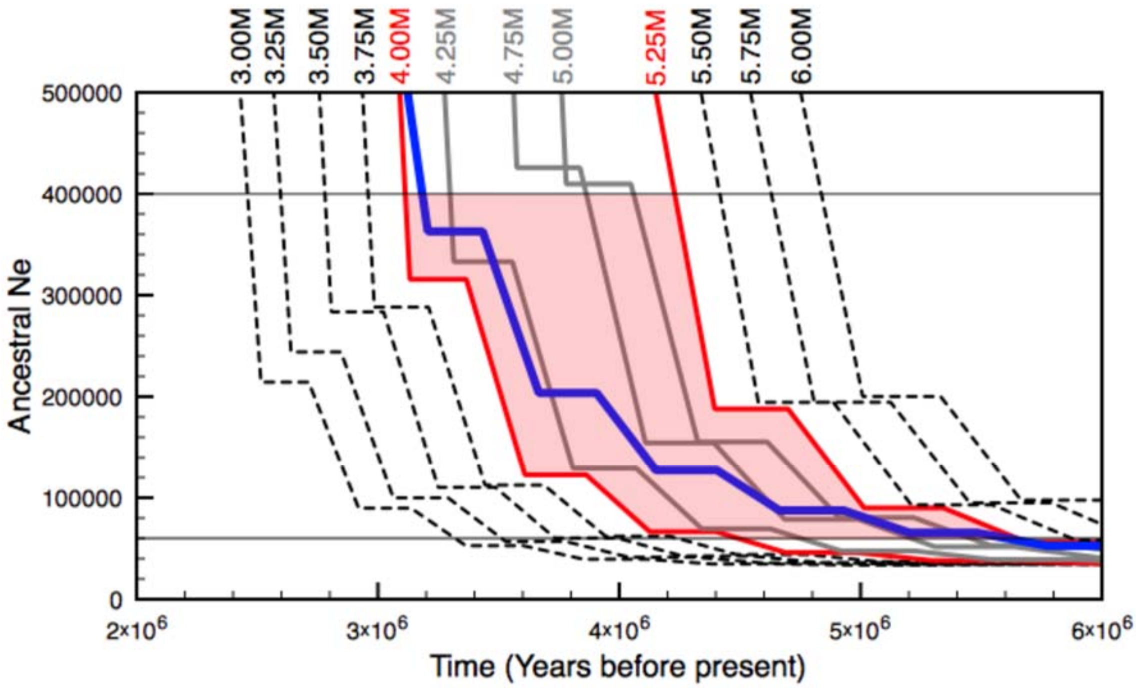
Figures



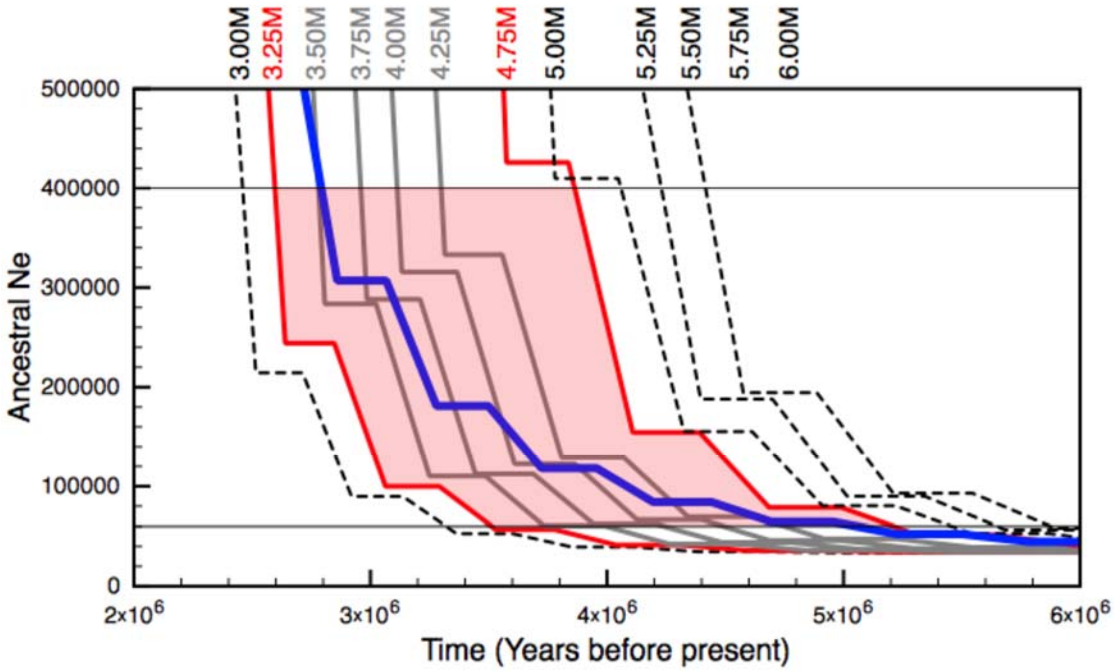
Supplementary Figure 1: human/bonobo divergence time estimation.



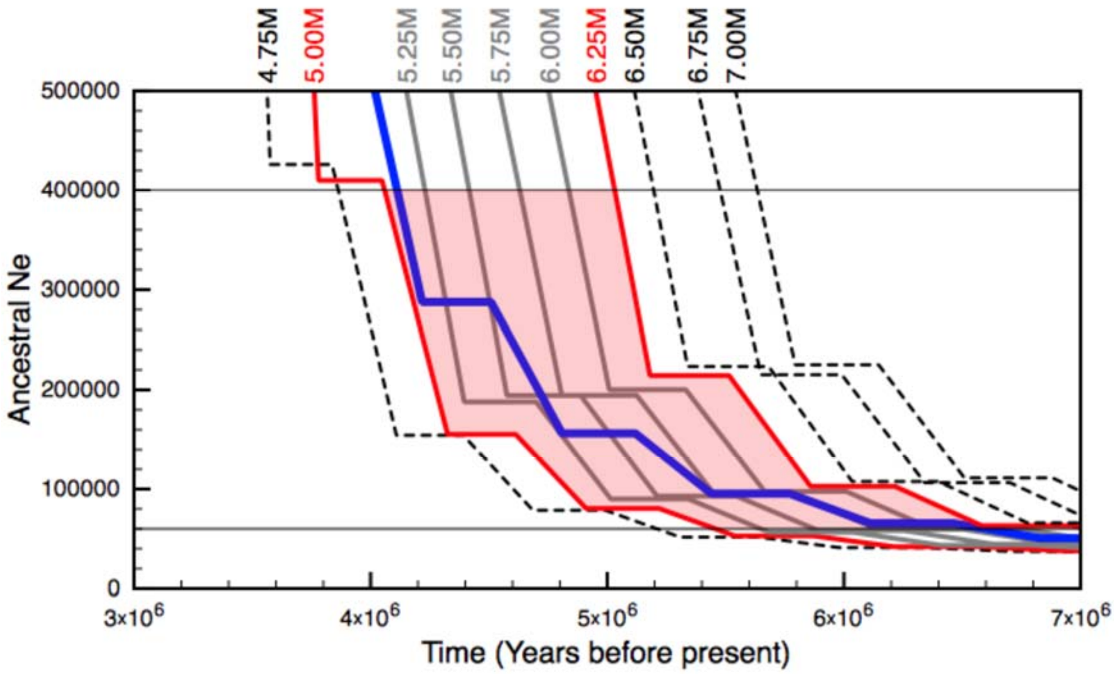
Supplementary Figure 2: human/chimpanzee divergence time estimation.



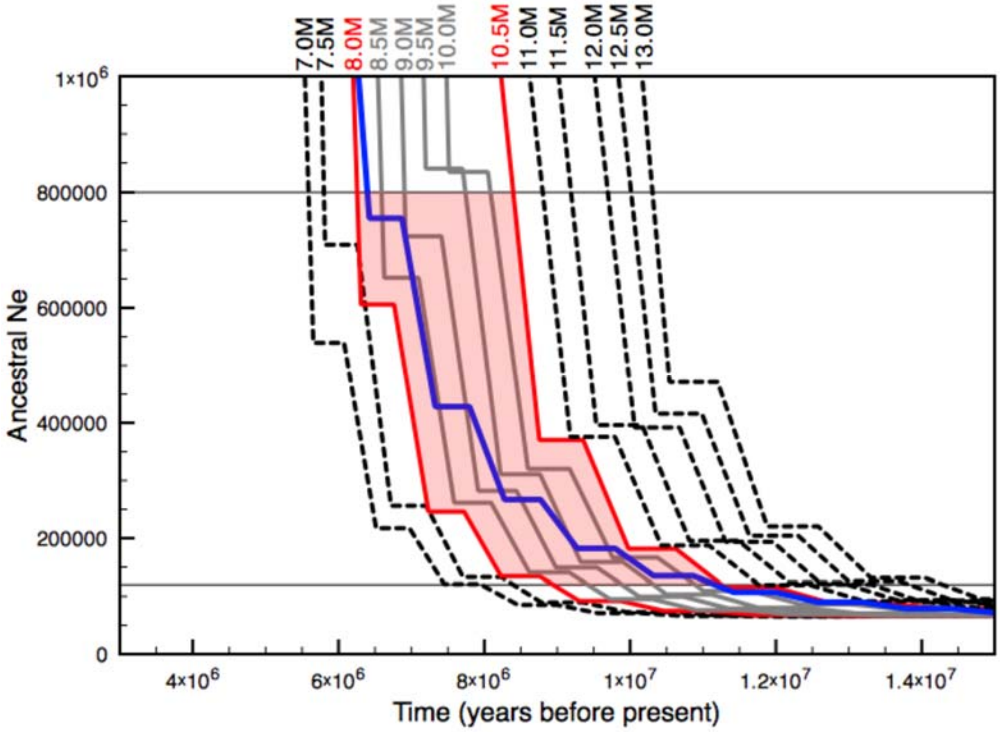
Supplementary Figure 3: bonobo/gorilla divergence time estimation.



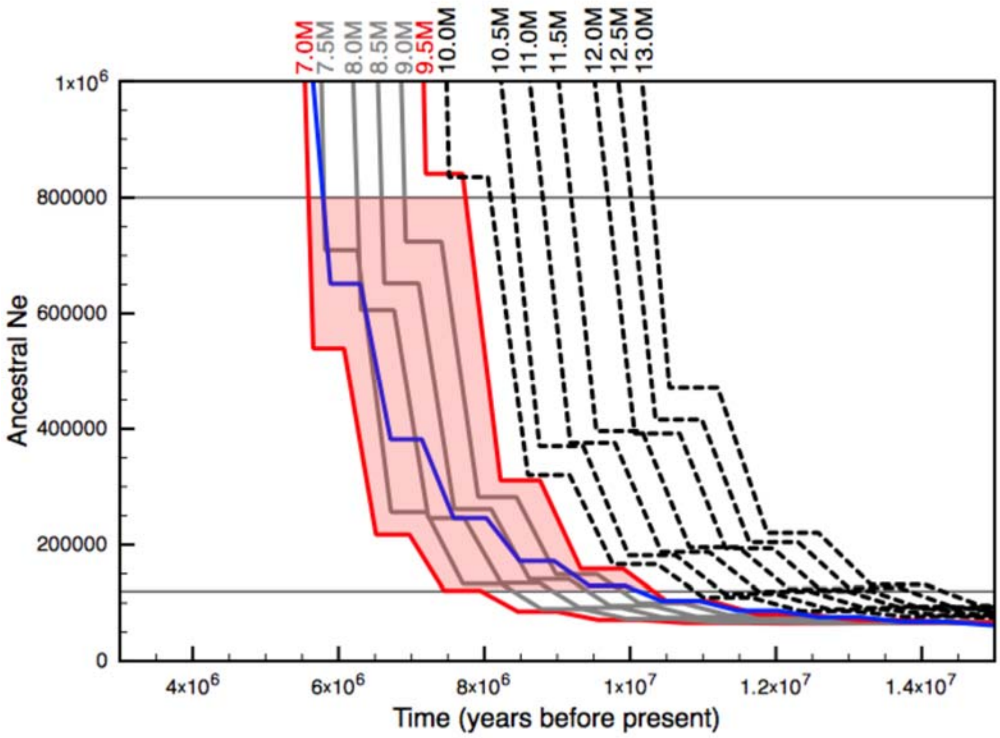
Supplementary Figure 4: chimpanzee/gorilla divergence time estimation.



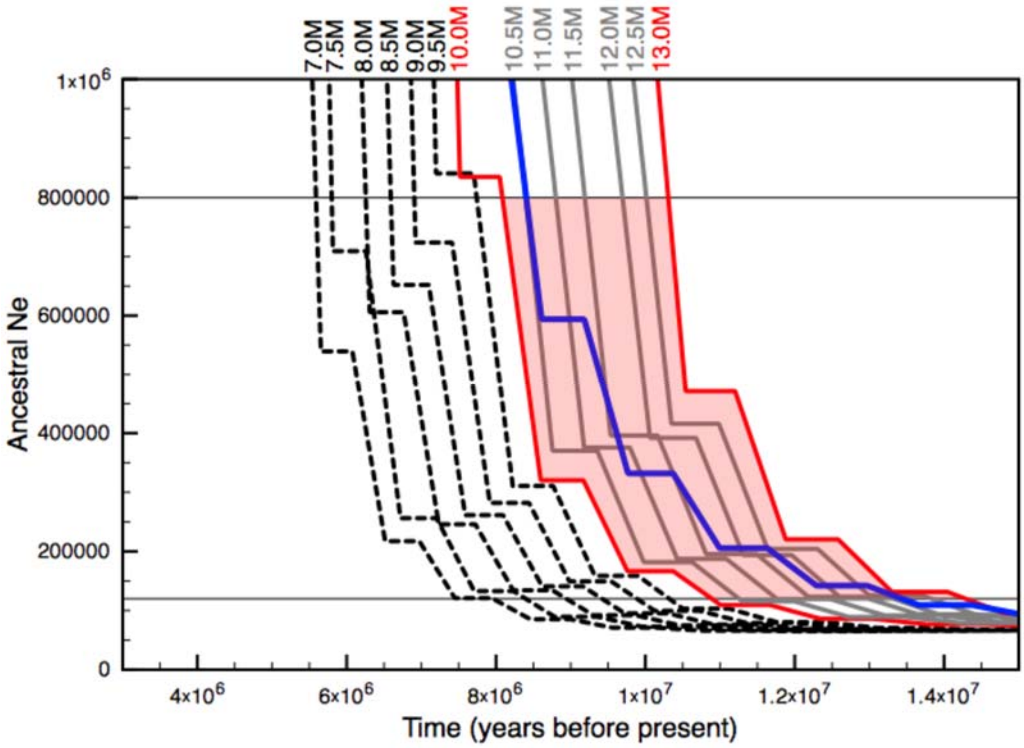
Supplementary Figure 5: human/gorilla divergence time estimation.



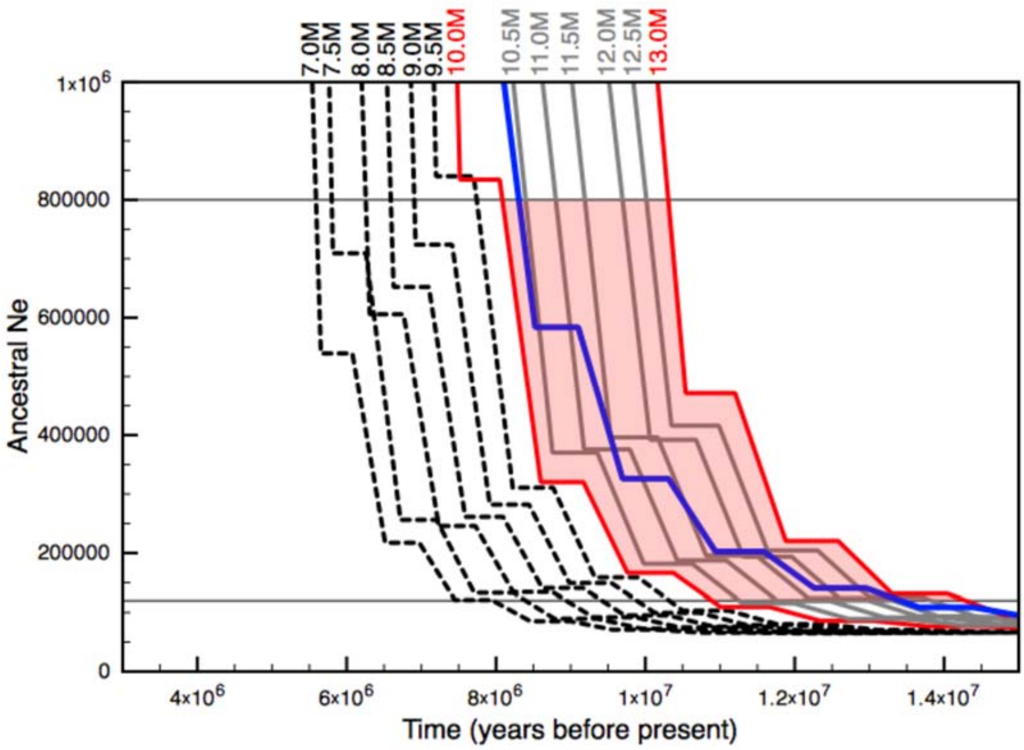
Supplementary Figure 6: bonobo/orangutan divergence time estimation.



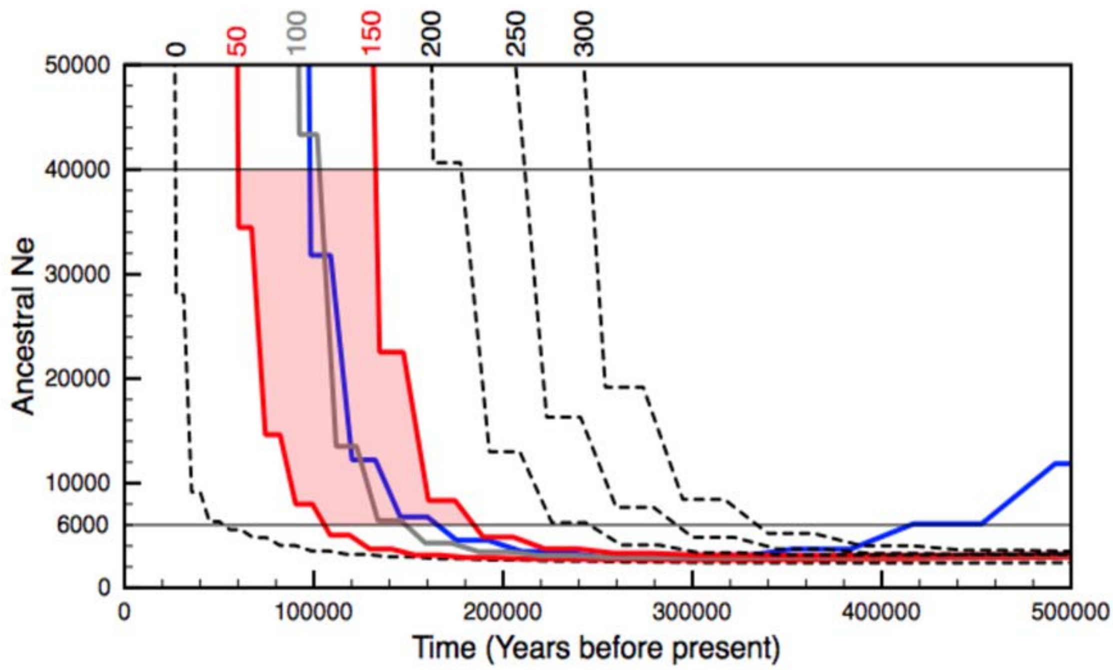
Supplementary Figure 7: chimpanzee/orangutan divergence time estimation.



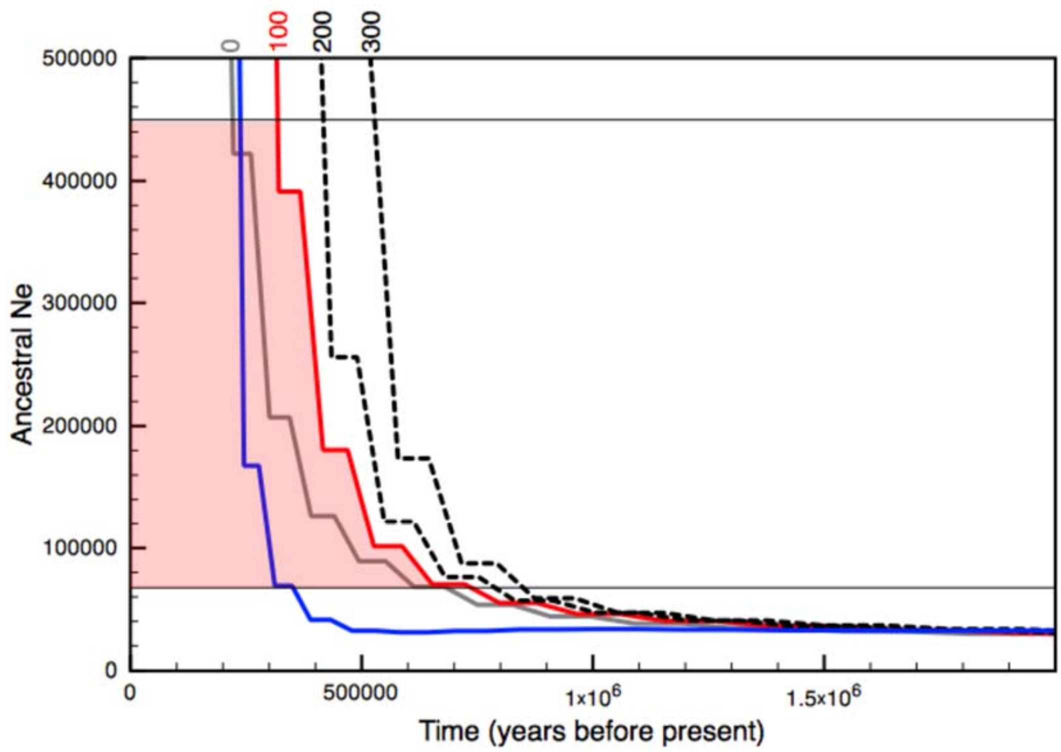
Supplementary Figure 8: human/orangutan divergence time estimation.



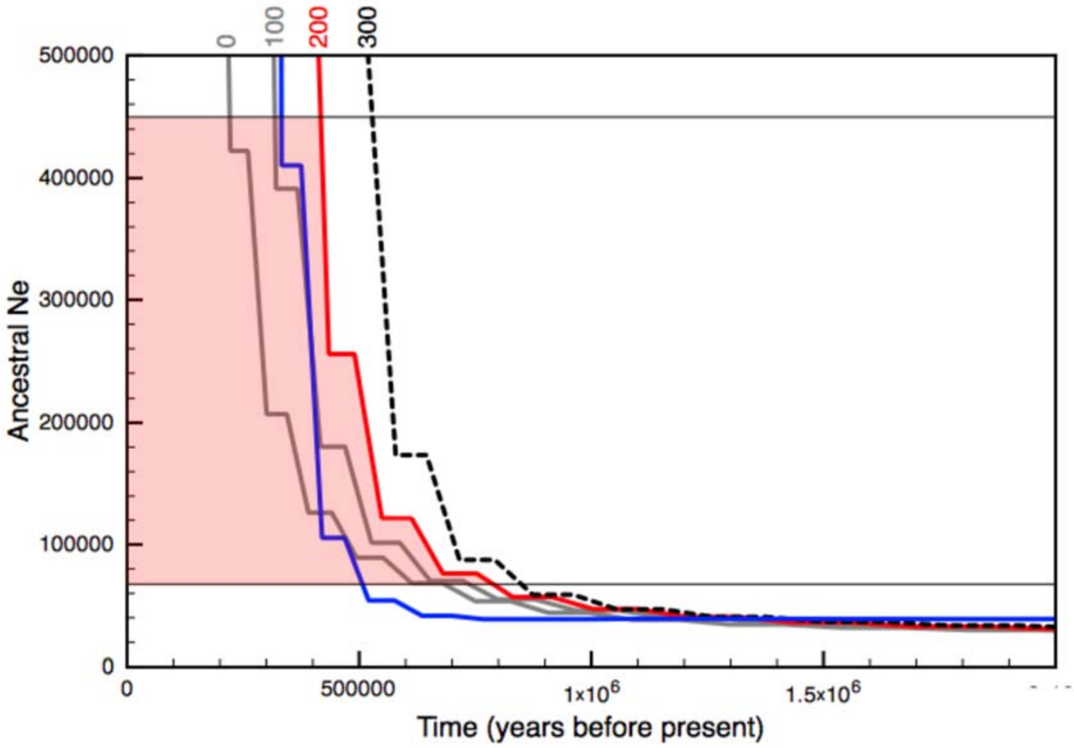
Supplementary Figure 9: gorilla/orangutan divergence time estimation.



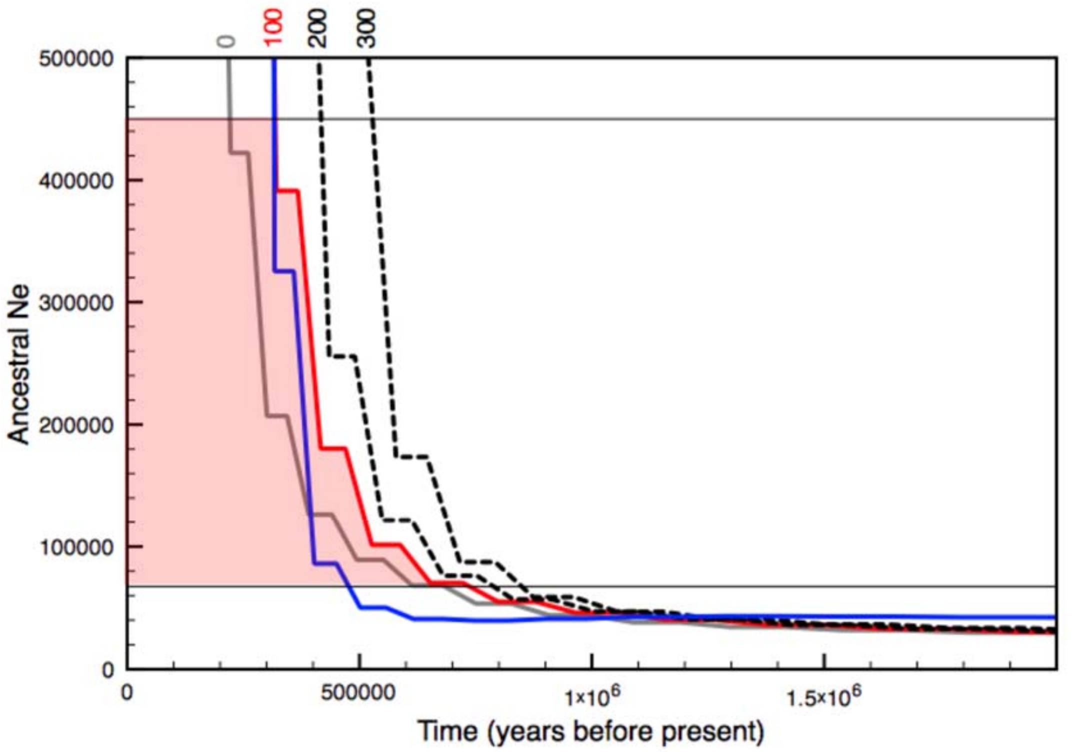
Supplementary Figure 10: polar(Alaska)/polar(Svalbard) divergence time estimation.



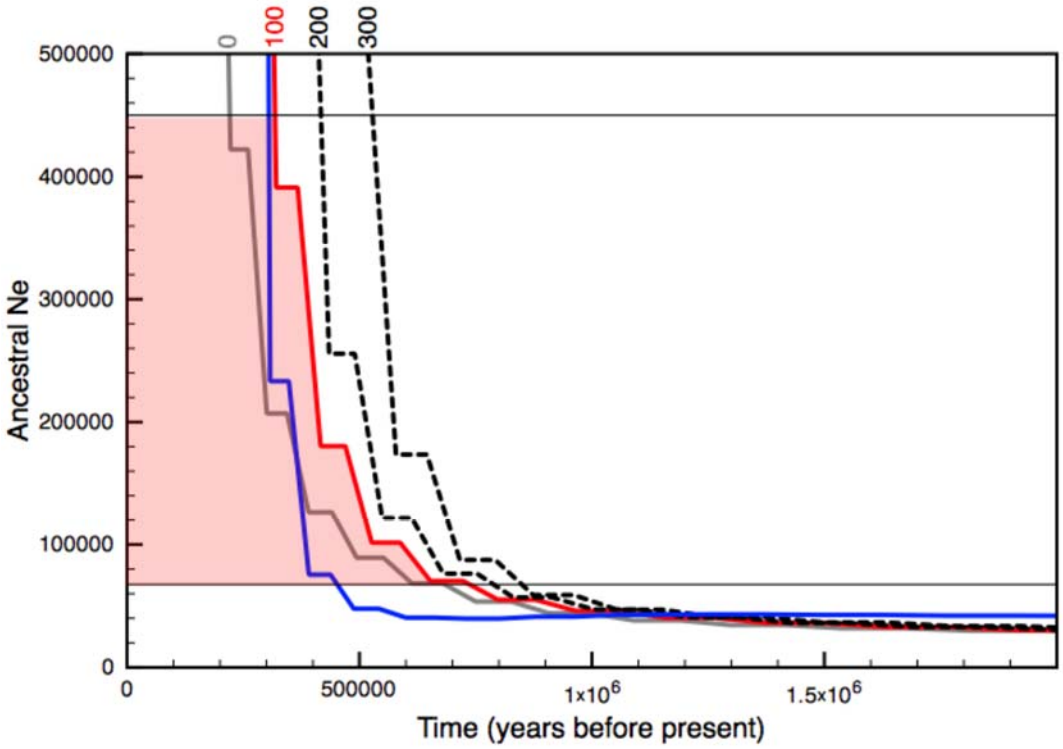
Supplementary Figure 11: brown(Alaska)/brown(Sweden) divergence time estimation.



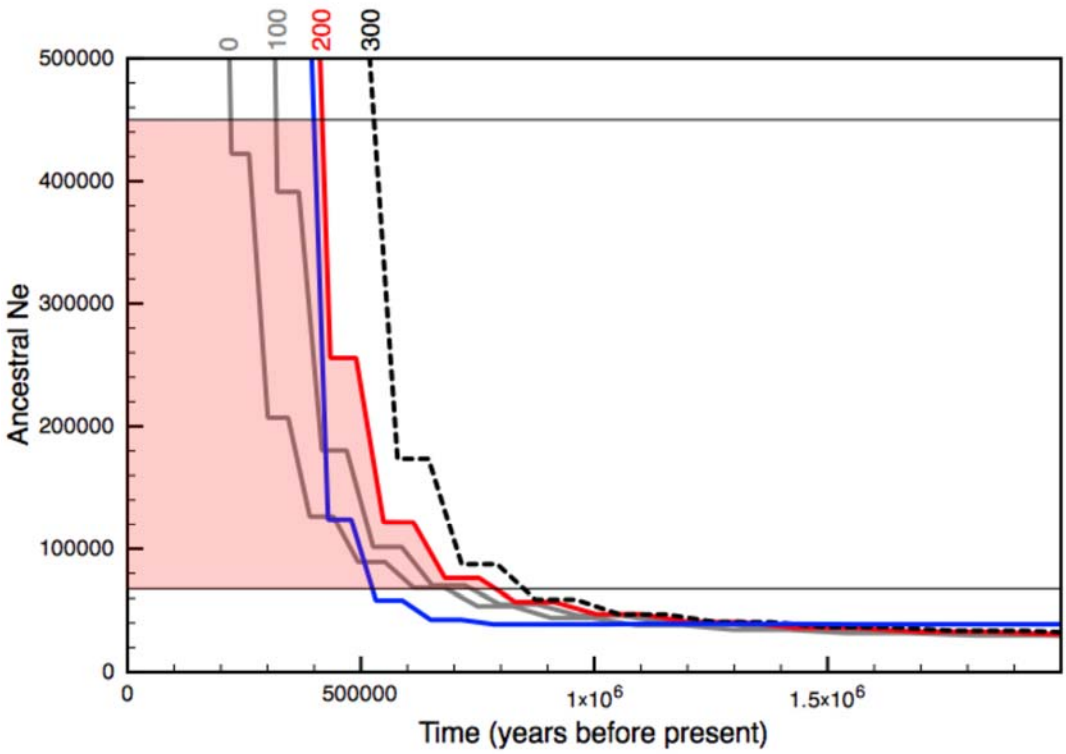
Supplementary Figure 12: polar(Alaska)/brown(Alaska) divergence time estimation.



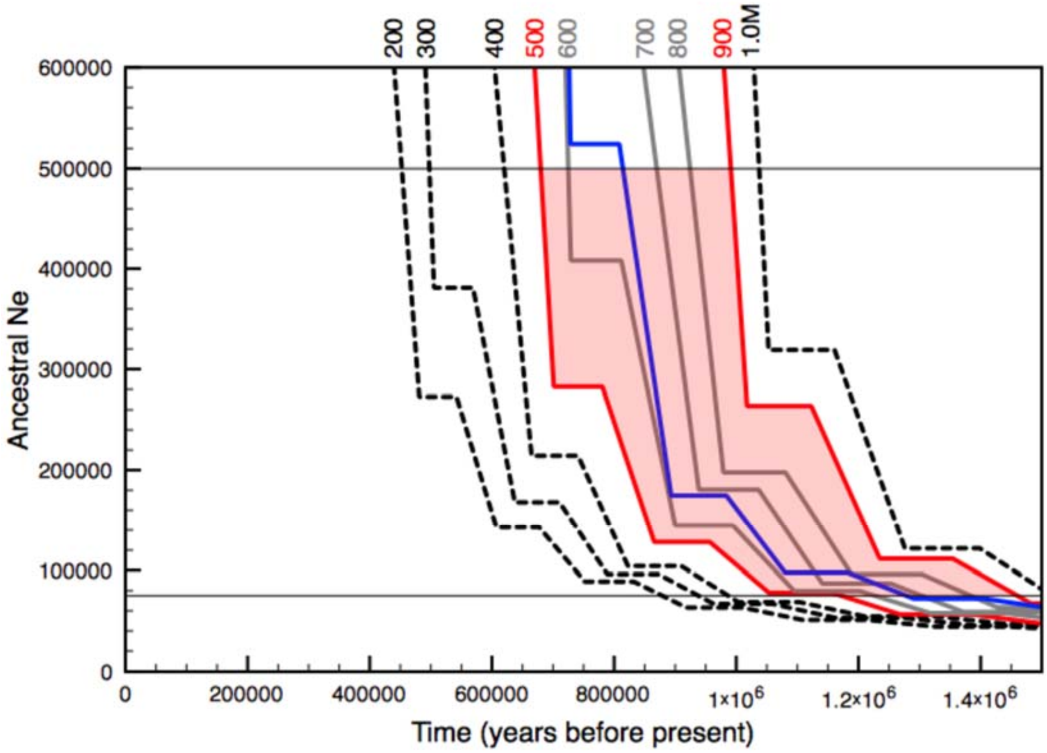
Supplementary Figure 13: polar(Svalbard)/brown(Sweden) divergence time estimation.



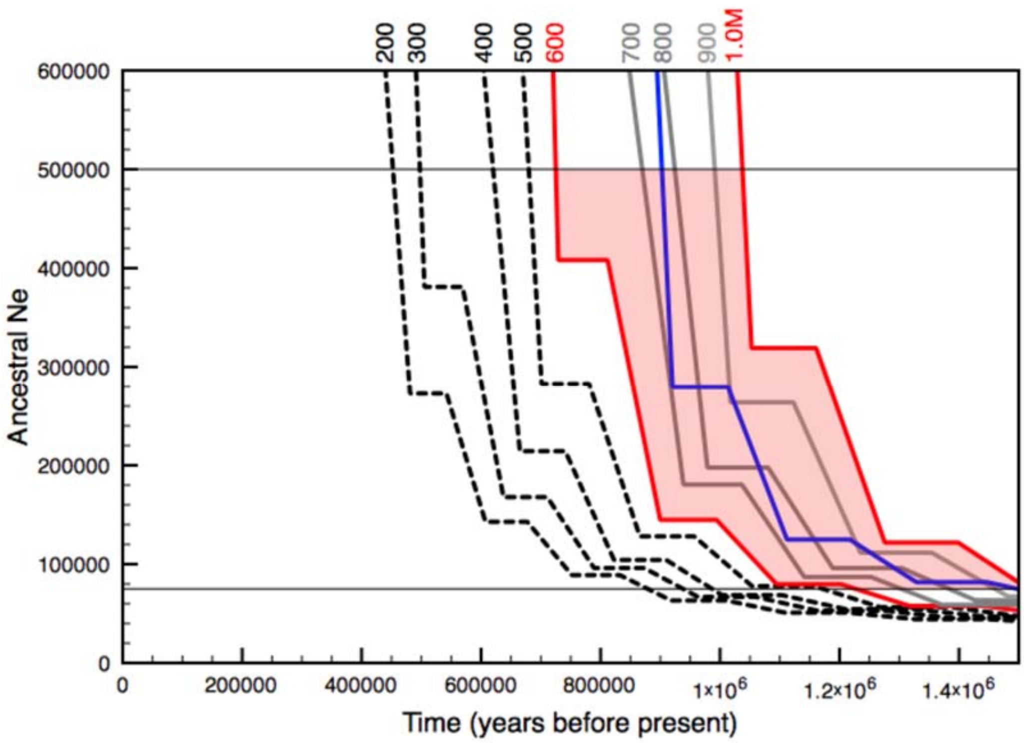
Supplementary Figure 14: polar(Alaska)/brown(Sweden) divergence time estimation.



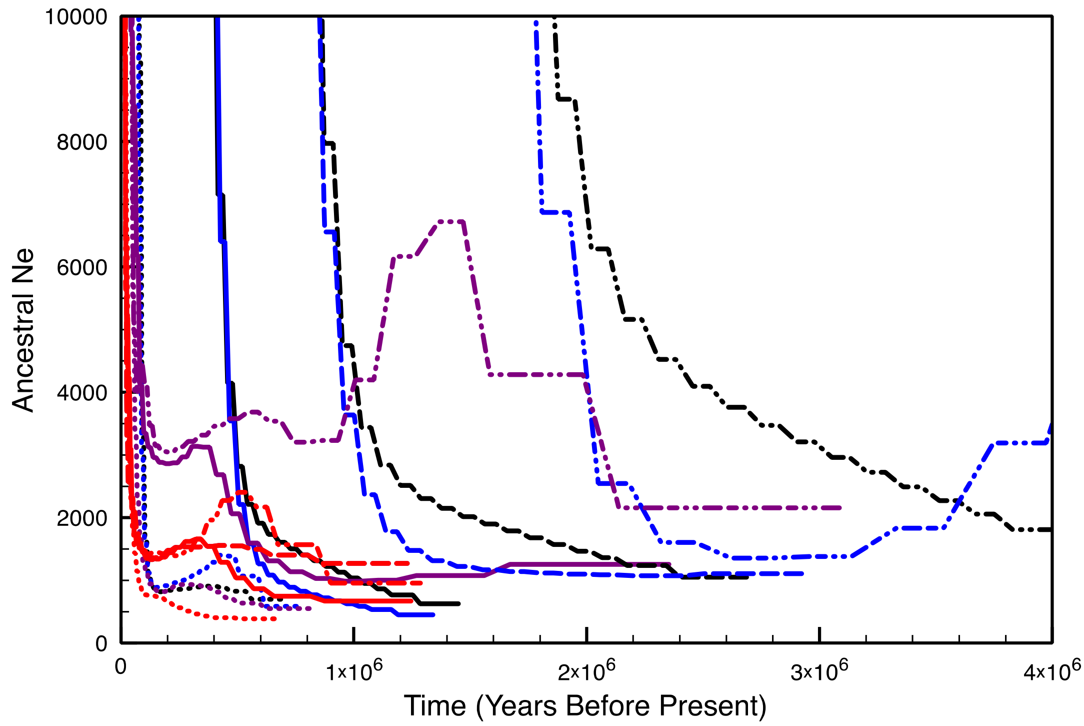
Supplementary Figure 15: polar(Svalbard)/brown(Alaska) divergence time estimation.



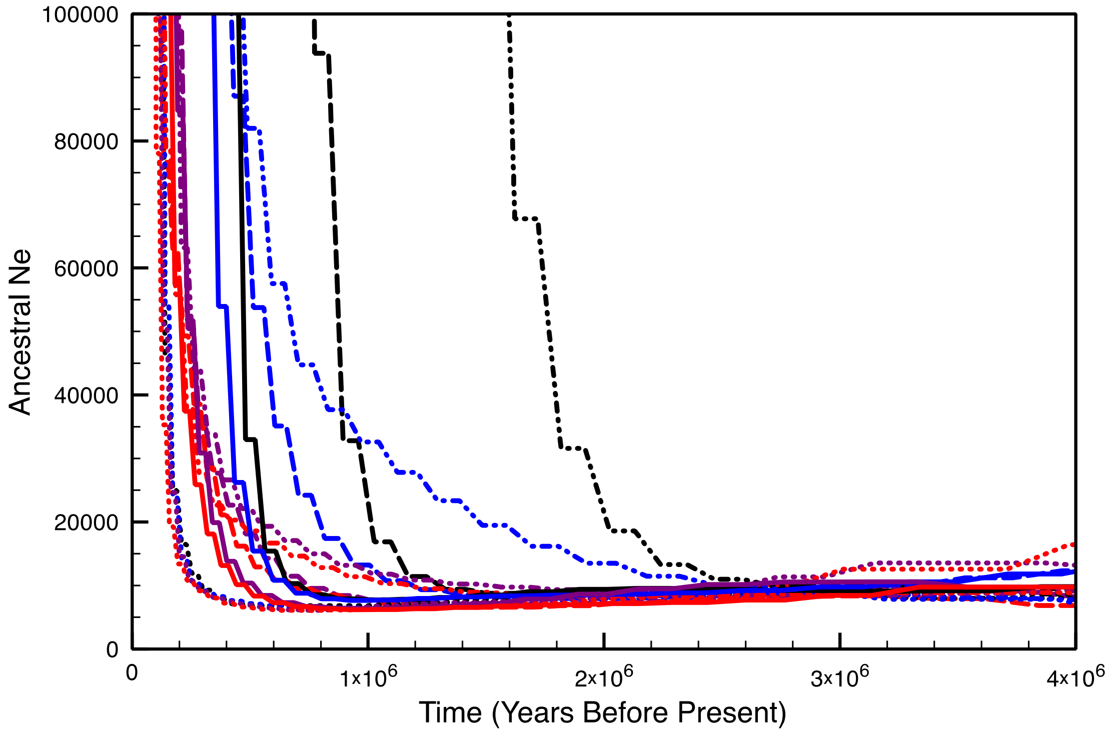
Supplementary Figure 16: polar(Alaska)/black divergence time estimation.



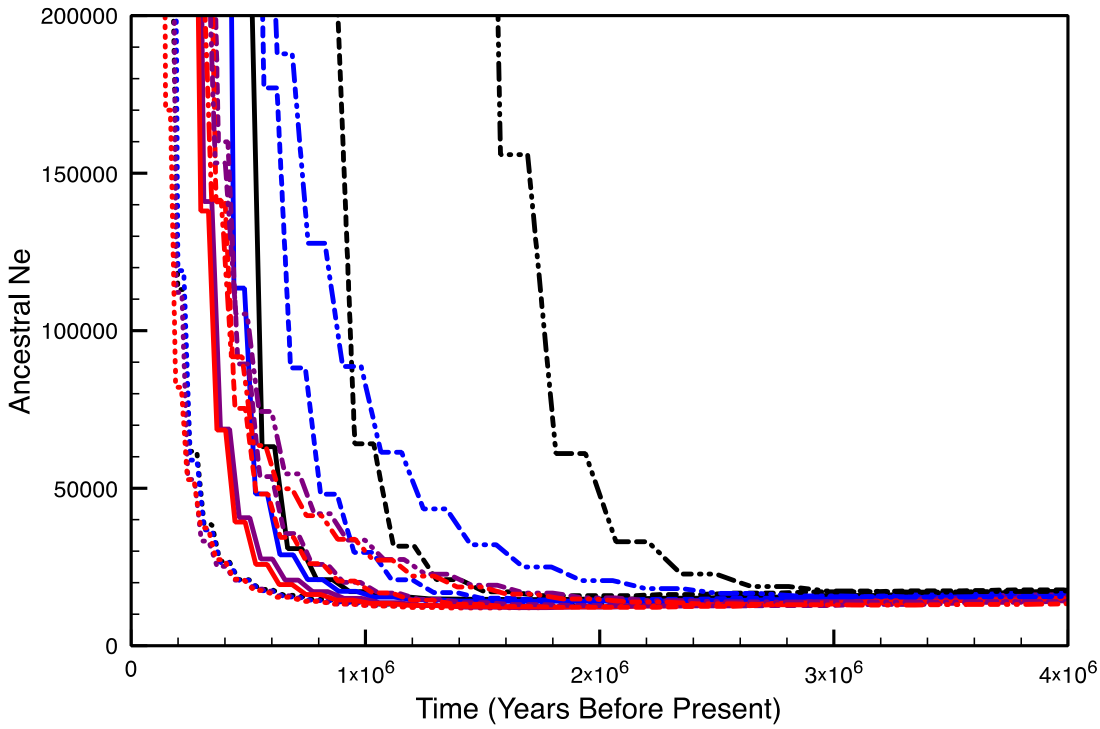
Supplementary Figure 17: brown(Alaska)/black) divergence time estimation.



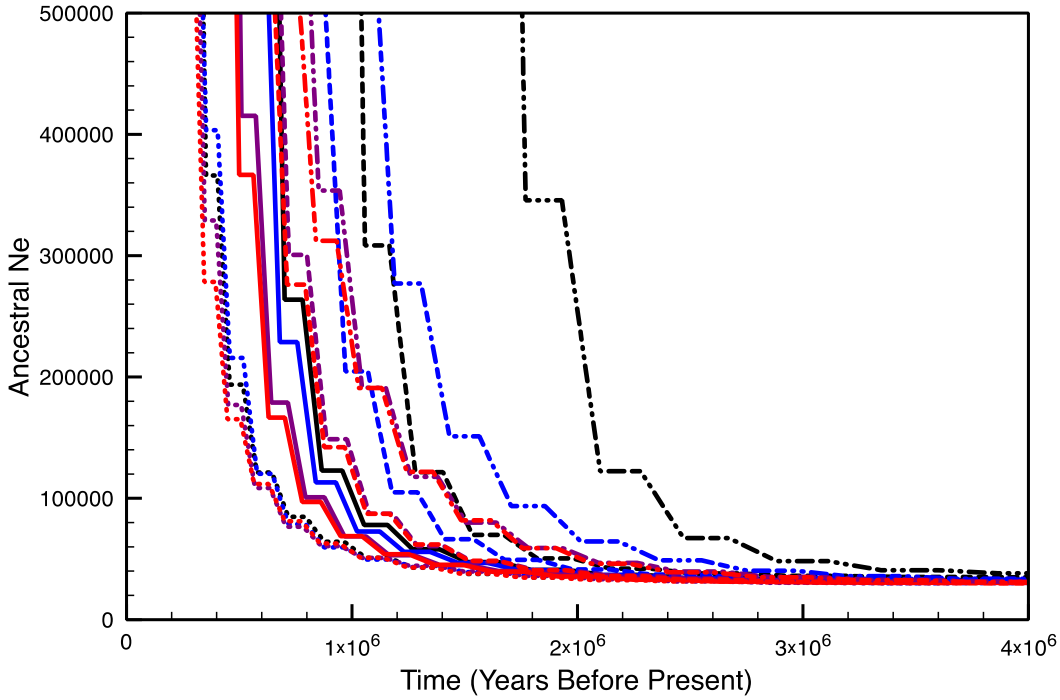
Supplementary Figure 18: hPSMC plots from simulated data (Table S3). Here we show simulations with a pre-divergence effective population size of 1,000. Migration rate is indicated by line colour: 0 migrants per generation (black), 0.001% of the population (blue), 0.01% of the population (purple), 0.1% of the population (red). Divergence time is indicated by line: 100,000 years ago (dotted), 500,000 years ago (solid), 1,000,000 years ago (dashed), 2,000,000 years ago (dash and dot).



Supplementary Figure 19: hPSMC plots from simulated data (Table S3). Here we show simulations with a pre-divergence effective population size of 10,000. Migration rate is indicated by line color: 0 migrants per generation (black), 0.001% of the population (blue), 0.01% of the population (purple), 0.1% of the population (red). Divergence time is indicated by line shape: 100,000 years ago (dotted), 500,000 years ago (solid), 1,000,000 years ago (dashed), 2,000,000 years ago (dash and dot).



Supplementary Figure 20: hPSMC plots from simulated data (Table S3). Here we show simulations with a pre-divergence effective population size of 20,000. Migration rate is indicated by line color: 0 migrants per generation (black), 0.001% of the population (blue), 0.01% of the population (purple), 0.1% of the population (red). Divergence time is indicated by line shape: 100,000 years ago (dotted), 500,000 years ago (solid), 1,000,000 years ago (dashed), 2,000,000 years ago (dash and dot).



Supplementary Figure 21: hPSMC plots from simulated data (Table S3). Here we show simulations with a pre-divergence effective population size of 50,000. Migration rate is indicated by line color: 0

migrants per generation (black), 0.001% of the population (blue), 0.01% of the population (purple), 0.1% of the population (red). Divergence time is indicated by line shape: 100,000 years ago (dotted), 500,000 years ago (solid), 1,000,000 years ago (dashed), 2,000,000 years ago (dash and dot).

Tables

Supplementary Table 1: ms [1] simulation parameters for simulated data model testing shown in Fig. 1.

Test	Ne	Divergence (years)	Migrants per Generation	phased or haploidized	ms command
Fig 1A	10000	100000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 1 1 -ej 0.1 2 1
Fig 1A	10000	500000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 0.5 2 1
Fig 1A	10000	1000000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 1.0 2 1
Fig 1A	10000	2000000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 2.0 2 1
Fig 1A	10000	3000000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 3.0 2 1
Fig 1A	10000	4000000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 4.0 2 1
Fig 1A	10000	5000000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 5.0 2 1
Fig 1A	10000	100000	0	haploidized	ms 4 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 0.1 2 1
Fig 1A	10000	500000	0	haploidized	ms 4 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 0.5 2 1
Fig 1A	10000	1000000	0	haploidized	ms 4 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 1.0 2 1
Fig 1A	10000	2000000	0	haploidized	ms 4 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 2.0 2 1
Fig 1A	10000	3000000	0	haploidized	ms 4 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 3.0 2 1

Fig 1A	10000	4000000	0	haploidized	ms 4 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 4.0 2 1
Fig 1A	10000	5000000	0	haploidized	ms 4 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 5.0 2 1
Fig 1B	1000	1000000	0	haploidized	ms 4 40 -t 500.0 -r 200.0 5000000 -I 2 2 2 -ej 10.0 2 1
Fig 1B	10000	1000000	0	haploidized	ms 4 40 -t 5000.0 -r 2000.0 5000000 -I 2 2 2 -ej 1.0 2 1
Fig 1B	20000	1000000	0	haploidized	ms 4 40 -t 10000.0 -r 4000.0 5000000 -I 2 2 2 -ej 0.5 2 1
Fig 1B	50000	1000000	0	haploidized	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.2 2 1
Fig 1C	10000	1000000	0	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 2 2 -ej 1.0 2 1
Fig 1C	10000	1000000	0.1	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 1 1 0.4 -ej 1.0 2 1
Fig 1C	10000	1000000	1	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 1 1 4.0 -ej 1.0 2 1
Fig 1C	10000	1000000	10	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 1 1 40.0 -ej 1.0 2 1
Fig 1C	10000	1000000	100	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 1 1 400.0 -ej 1.0 2 1
Fig 1C	10000	1000000	1000	phased	ms 2 20 -t 10000.0 -r 4000.0 10000000.0 -I 2 1 1 4000.0 -ej 1.0 2 1

Supplementary Table S2. To correct for the effect of population size on inferring divergence time using hPSMC, we simulated simple population divergence events with the same pre-divergence effective population size as that which hPSMC inferred for our data. Then, we compared the hPSMC result for real data to the simulated data to estimate divergence time. Here, we show the ms [1] commands used to create these simulated population divergence events.

Divergence Time	Ne	ms command
0	4,000	ms 4 40 -t 2000.0 -r 800.0 5000000 -I 2 2 2 -ej 0.0 2 1
50,000	4,000	ms 4 40 -t 2000.0 -r 800.0 5000000 -I 2 2 2 -ej 0.125 2 1
100,000	4,000	ms 4 40 -t 2000.0 -r 800.0 5000000 -I 2 2 2 -ej 0.25 2 1
150,000	4,000	ms 4 40 -t 2000.0 -r 800.0 5000000 -I 2 2 2 -ej 0.375 2 1
200,000	4,000	ms 4 40 -t 2000.0 -r 800.0 5000000 -I 2 2 2 -ej 0.5 2 1
250,000	4,000	ms 4 40 -t 2000.0 -r 800.0 5000000 -I 2 2 2 -ej 0.625 2 1
300,000	4,000	ms 4 40 -t 2000.0 -r 800.0 5000000 -I 2 2 2 -ej 0.75 2 1
0	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.0 2 1
50,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.0277777777778 2 1
100,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.0555555555556 2 1
150,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.0833333333333 2 1
200,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.111111111111 2 1
250,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.138888888889 2 1
300,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.166666666667 2 1
350,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.194444444444 2 1
400,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.222222222222 2 1
450,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.25 2 1
500,000	18,000	ms 4 40 -t 9000.0 -r 3600.0 5000000 -I 2 2 2 -ej 0.277777777778 2 1
1,000,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.25 2 1
1,250,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.3125 2 1
1,500,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.375 2 1

1,750,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.4375 2 1
2,000,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.5 2 1
2,250,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.5625 2 1
2,500,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.625 2 1
2,750,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.6875 2 1
3,000,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.75 2 1
3,250,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.8125 2 1
3,500,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.875 2 1
3,750,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 0.9375 2 1
4,000,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.0 2 1
4,250,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.0625 2 1
4,500,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.125 2 1
4,750,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.1875 2 1
5,000,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.25 2 1
5,250,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.3125 2 1
5,500,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.375 2 1
5,750,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.4375 2 1
6,000,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000.0 -I 2 2 2 -ej 1.5 2 1
6,250,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000 -I 2 2 2 -ej 1.5625 2 1
6,500,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000 -I 2 2 2 -ej 1.625 2 1
6,750,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000 -I 2 2 2 -ej 1.6875 2 1
7,000,000	40,000	ms 4 40 -t 20000.0 -r 8000.0 5000000 -I 2 2 2 -ej 1.75 2 1
0	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.0 2 1
100,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.0222222222222 2 1
200,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.0444444444444 2 1
300,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.0666666666667 2 1
400,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.0888888888889 2 1
500,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.111111111111 2 1

600,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.133333333333 2 1
700,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.155555555556 2 1
800,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.177777777778 2 1
900,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.2 2 1
1,000,000	45,000	ms 4 40 -t 22500.0 -r 9000.0 5000000 -I 2 2 2 -ej 0.222222222222 2 1
0	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.00 2 1
100,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.02 2 1
200,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.04 2 1
300,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.06 2 1
400,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.08 2 1
500,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.1 2 1
600,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.12 2 1
700,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.14 2 1
800,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.16 2 1
900,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.18 2 1
1,000,000	50,000	ms 4 40 -t 25000.0 -r 10000.0 5000000 -I 2 2 2 -ej 0.2 2 1
7,000,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 0.875 2 1
7,500,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 0.9375 2 1
8,000,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.0 2 1
8,500,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.0625 2 1
9,000,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.125 2 1
9,500,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.1875 2 1
10,000,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.25 2 1
10,500,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.3125 2 1
11,000,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.375 2 1
11,500,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.4375 2 1
12,000,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.5 2 1

12,500,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.5625 2 1
13,000,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.625 2 1
13,500,000	80,000	ms 4 40 -t 40000.0 -r 16000.0 5000000 -I 2 2 2 -ej 1.6875 2 1

Supplementary Table S3. Expanding upon the simulations of divergence in Fig. 1 (main text) we tested different combinations of pre-divergence N_e, post-divergence migration and initial divergence time. Here we show the command line inputs for each parameter set.

Time of Initial Divergence (Years before present)	Pre-divergence effective population size	Proportion of the population made up of new migrants each generation	ms command line
100000	1000	0	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.0 -ej 1.0 2 1
100000	1000	1.00E-05	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.04 -ej 1.0 2 1
100000	1000	0.0001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.4 -ej 1.0 2 1
100000	1000	0.001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 4.0 -ej 1.0 2 1
100000	10000	0	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.0 -ej 0.1 2 1
100000	10000	1.00E-05	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.4 -ej 0.1 2 1
100000	10000	0.0001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 4.0 -ej 0.1 2 1
100000	10000	0.001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 40.0 -ej 0.1 2 1
100000	20000	0	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.0 -ej 0.05 2 1
100000	20000	1.00E-05	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.8 -ej 0.05 2 1
100000	20000	0.0001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 8.0 -ej 0.05 2 1
100000	20000	0.001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 80.0 -ej 0.05 2 1
100000	50000	0	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 0.0 -ej 0.02 2 1
100000	50000	1.00E-05	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 2.0 -ej 0.02 2 1
100000	50000	0.0001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 20.0 -ej 0.02 2 1
100000	50000	0.001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 200.0 -ej 0.02 2 1
500000	1000	0	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.0 -ej 5.0 2 1
500000	1000	1.00E-05	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.04 -ej 5.0 2 1
500000	1000	0.0001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.4 -ej 5.0 2 1
500000	1000	0.001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 4.0 -ej 5.0 2 1
500000	10000	0	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.0 -ej 0.5 2 1
500000	10000	1.00E-05	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.4 -ej 0.5 2 1

500000	10000	0.0001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 4.0 -ej 0.5 2 1
500000	10000	0.001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 40.0 -ej 0.5 2 1
500000	20000	0	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.0 -ej 0.25 2 1
500000	20000	1.00E-05	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.8 -ej 0.25 2 1
500000	20000	0.0001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 8.0 -ej 0.25 2 1
500000	20000	0.001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 80.0 -ej 0.25 2 1
500000	50000	0	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 0.0 -ej 0.1 2 1
500000	50000	1.00E-05	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 2.0 -ej 0.1 2 1
500000	50000	0.0001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 20.0 -ej 0.1 2 1
500000	50000	0.001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 200.0 -ej 0.1 2 1
1000000	1000	0	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.0 -ej 10.0 2 1
1000000	1000	1.00E-05	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.04 -ej 10.0 2 1
1000000	1000	0.0001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.4 -ej 10.0 2 1
1000000	1000	0.001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 4.0 -ej 10.0 2 1
1000000	10000	0	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.0 -ej 1.0 2 1
1000000	10000	1.00E-05	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.4 -ej 1.0 2 1
1000000	10000	0.0001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 4.0 -ej 1.0 2 1
1000000	10000	0.001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 40.0 -ej 1.0 2 1
1000000	20000	0	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.0 -ej 0.5 2 1
1000000	20000	1.00E-05	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.8 -ej 0.5 2 1
1000000	20000	0.0001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 8.0 -ej 0.5 2 1
1000000	20000	0.001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 80.0 -ej 0.5 2 1
1000000	50000	0	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 0.0 -ej 0.2 2 1
1000000	50000	1.00E-05	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 2.0 -ej 0.2 2 1
1000000	50000	0.0001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 20.0 -ej 0.2 2 1
1000000	50000	0.001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 200.0 -ej 0.2 2 1
2000000	1000	0	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.0 -ej 20.0 2 1
2000000	1000	1.00E-05	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.04 -ej 20.0 2 1
2000000	1000	0.0001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 0.4 -ej 20.0 2 1

2000000	1000	0.001	ms 4 40 -t 500.0 -r 200.0 5000000.0 -I 2 2 2 4.0 -ej 20.0 2 1
2000000	10000	0	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.0 -ej 2.0 2 1
2000000	10000	1.00E-05	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 0.4 -ej 2.0 2 1
2000000	10000	0.0001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 4.0 -ej 2.0 2 1
2000000	10000	0.001	ms 4 40 -t 5000.0 -r 2000.0 5000000.0 -I 2 2 2 40.0 -ej 2.0 2 1
2000000	20000	0	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.0 -ej 1.0 2 1
2000000	20000	1.00E-05	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 0.8 -ej 1.0 2 1
2000000	20000	0.0001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 8.0 -ej 1.0 2 1
2000000	20000	0.001	ms 4 40 -t 10000.0 -r 4000.0 5000000.0 -I 2 2 2 80.0 -ej 1.0 2 1
2000000	50000	0	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 0.0 -ej 0.4 2 1
2000000	50000	1.00E-05	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 2.0 -ej 0.4 2 1
2000000	50000	0.0001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 20.0 -ej 0.4 2 1
2000000	50000	0.001	ms 4 40 -t 25000.0 -r 10000.0 5000000.0 -I 2 2 2 200.0 -ej 0.4 2 1

References

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