Effect of Mutation Rate on Divergence

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According to my last name, I am in group M-P. I ran the EasyPop simulation with $m = 10^{-3}$, $\mu = 10^{-5}$, and $Ne = 10^3$, using both the KAM mutation model and SSM mutation model.

- Keeping the proportion of male/female migration low (0.001) severely reduces the amount of gene flow in the population. High migration rates have a homogenising effect, and so reducing migration increases variability between populations.
- The effective population size affects the rate at which the populations differentiate, with smaller populations differentiating faster than larger populations. For these simulations, the effective population size is kept constant at 1000 individuals.
- The mutation rate μ also affects the rate at which populations differentiate. Increasing the mutation rate should increase the rate at which populations diverge. However, on smaller time-scales, the effect of mutation rate is often negligible.

I will focus on the effect of mutation rate and different mutation models on F_{ST}. To do this I run a control simulation to determine the expected F_{ST} after 10000 generations. Then I will vary the mutation rate and the mutation model to determine their effects on this F_{ST}

1 Control Simulation

After 10000 generations, the simulation gave an F_{ST} value of 0.0488. A plot of F_{ST} over time is given in Figure 1.

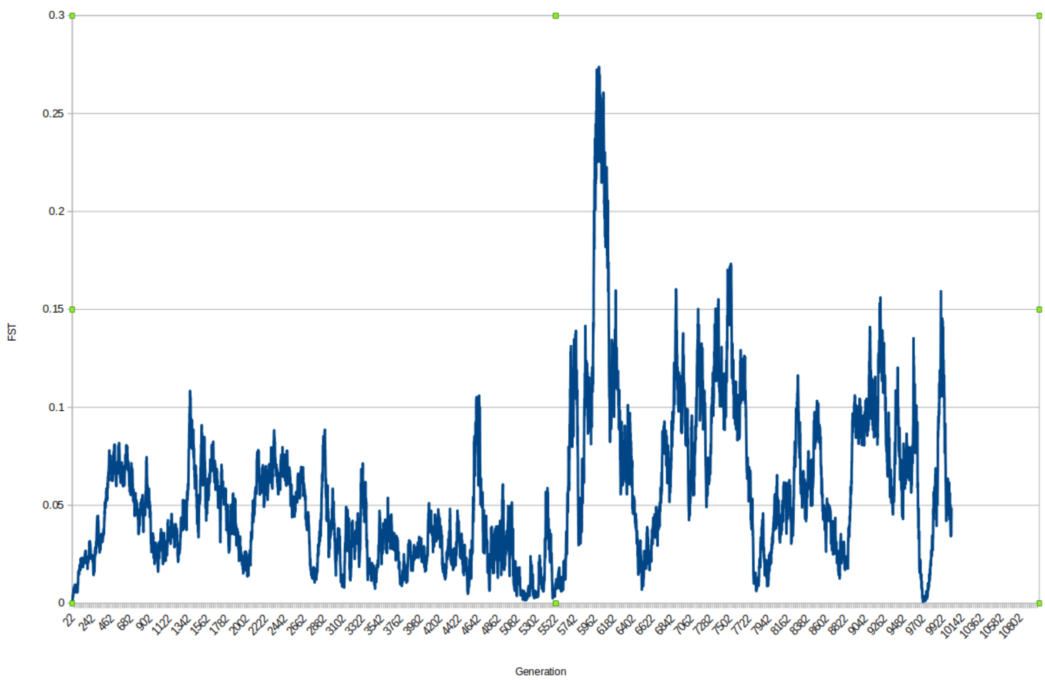

Figure 1: Line chart of FST over 10000 generations with KAM model

2 Reducing the Mutation Rate

The mutation rate was decreased 100-fold and the simulation was run again for 10,000 generations, first using the KAM mutation model, and then using the SSM mutation model. The final

F_{ST} for the KAM model was 0.0042, while the final F_{ST} for the SSM model was 0.0051. Line plots for each of these simulations are given in Figures 2 and 3.

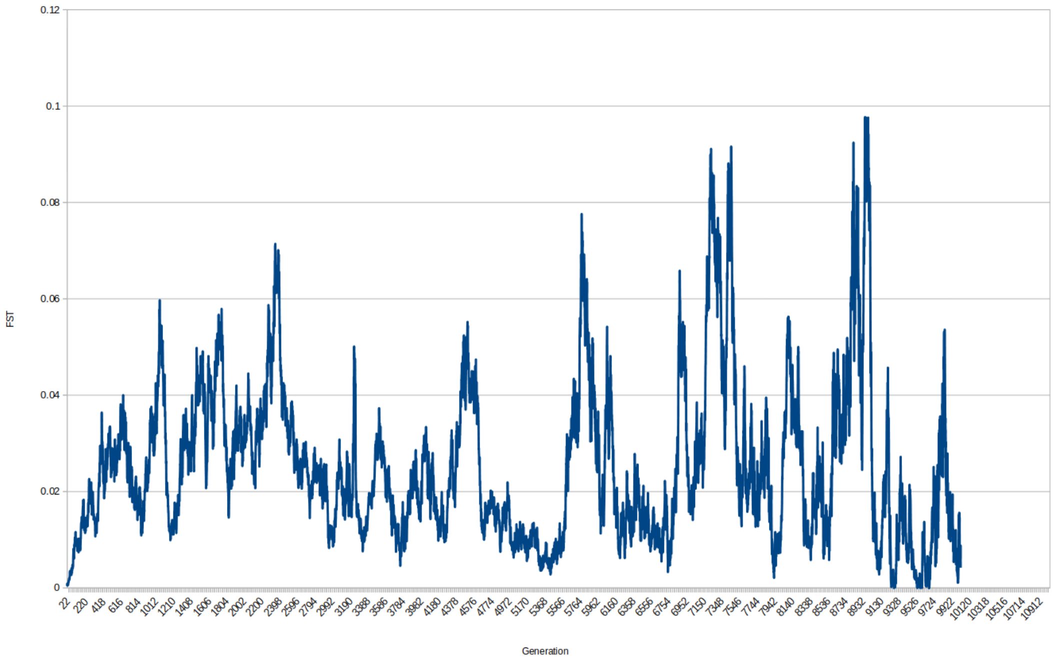

Figure 2: Line chart of FST over 10000 generations with KAM model

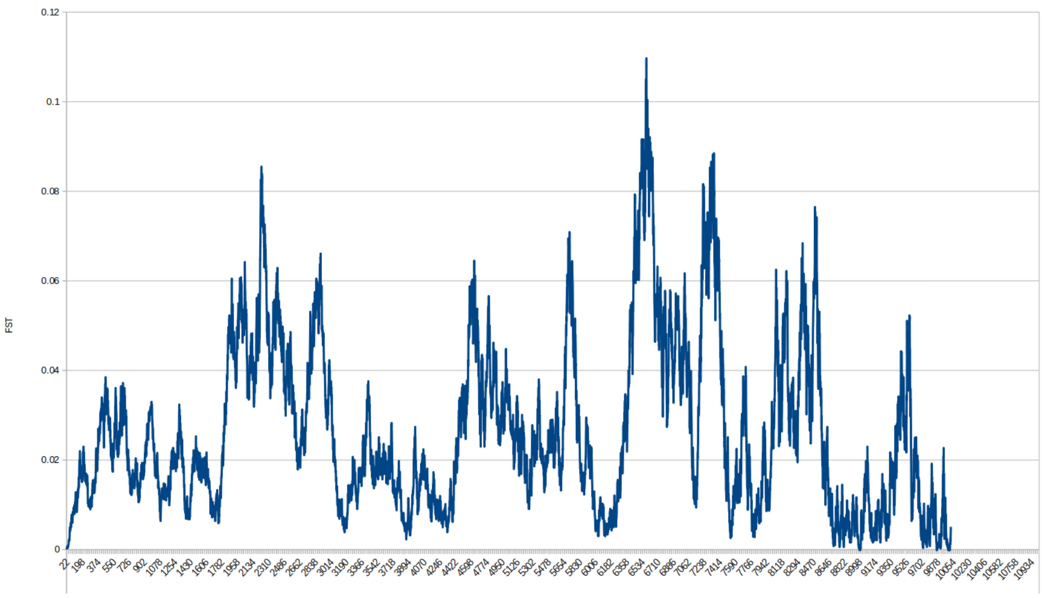

Figure 3: Line chart of FST over 10000 generations with SSM model

Both the SSM and KAM models of mutation gave a similar decrease in F_{ST} when the mutation rate was reduced. The populations were less divergent, as expected. Looking at the y-axes, we can also see that there is less fluctuation in the F_{ST} when the mutation rate is reduced, due to the fact that the populations in are less likely to be highly divergent, and so the range of F_{ST} values is reduced. It should be noted that each of these simulations was only run once, and so it's not a statistically robust analysis. Nonetheless, the effect of changing the mutation rate on population divergence is clear. Decreased, mutation rate leads to reduced divergence, for both the KAM and SSM mutation models.