

Supplementary information, Data S6 Mutation rate estimation

In order to determine the long-term mutation rate, we took advantage of the multiple species alignment provided in the Ensembl database (Compara, <http://asia.ensembl.org/info/genome/compara/analyses.html#ancestral>). After extracting datasets using different sister groups, we compiled all the information presented into Supplementary information, Table S4. We can see that the estimated mutation rate is very close to the values found in the literature (2.2×10^{-9} per year per site)^{7,8}.

In addition to our estimated value, we also surveyed the literature for reported mutation rates. There are two major mutation rates. One is 1.0×10^{-8} per site per generation and the other is 6.6×10^{-9} per site per generation. The two most recent papers from Freedman *et al.*, 2014⁹ and Skoglund *et al.*, 2011¹⁰, both cited the mutation rate from the original dog genome paper (1.0×10^{-8} per site per generation)¹¹, which is extracted from the data in Table S20 of this paper. The original context/motivation in the dog genome is a simulation study exploring possible demographic scenarios that are compatible with the observed data. We think this value, even though it is a very sensible choice (being very similar to human mutation rate), might be an over-estimate of the mutation rate (see next section).

Whole genome mutation rates for large mammals have been recently directly measured taking advantage of the advances in genomics. Interestingly, the newly measured mutation rate for humans is about 1.2×10^{-8} per site per generation and a similar value is also observed for the chimpanzee. If the per year mutation rate is relatively constant (i.e., molecular clock), then the per generation mutation rate should be significantly smaller for species with shorter generation time like dogs. We thus argue that, based on our own estimation and the comparison of humans/chimpanzees, a lower mutation rate (than human) of 6.6×10^{-9} per generation per site might be more appropriate for dogs.