

How to calculate recombination fraction from Kosambi distance and *vice versa*

Vikram E. Chhatre

Southern Institute of Forest Genetics,
USDA Forest Service, Saucier MS &
Texas A&M University, College Station TX
crypticlineage@gmail.com

January 25, 2013

Kosambi mapping function is still widely used in estimating mapping distance from recombination frequency. Sometimes one has access to mapping distance in centi Morgans only and need to reverse calculate recombination fractions from it. Below we will estimate each parameter from the other.

1 Estimating recombination fraction

Let us say we have map distance of 0.215 cM (centi Morgans) between a given pair of loci. First convert this distance to Morgans:

$$d = \frac{d_{cM}}{100} \quad (1)$$

$$d = \frac{0.215}{100} = 0.00215M \quad (2)$$

The Kosambi function to estimate recombination fraction can be described as:

$$r = \left(\frac{1}{2}\right) \left(\frac{e^{4d} - 1}{e^{4d} + 1}\right) \quad (3)$$

Where r is the recombination fraction, d is the distance in Morgans, and e is the inverse of natural logarithm \ln . The value of e is 2.718.

Substituting the values:

$$r = \left(\frac{1}{2}\right) \left(\frac{2.718^{(4 \times 0.00215)} - 1}{2.718^{(4 \times 0.00215)} + 1}\right) = 0.0021498 \quad (4)$$

Thus, the recombination fraction for two loci 0.215 cM apart is 0.0021498

2 Estimating Kosambi map distance

Now we will do the reverse and estimate the map distance from a given recombination frequency. Using the value we obtained above, we should be able to get the exact same distance using Kosambi function. Kosambi function from equation 4 can be solved for d as follows:

$$d = \left(\frac{1}{4}\right) \ln \left(\frac{1+2r}{1-2r}\right) \quad (5)$$

Substituting the value:

$$d = \left(\frac{1}{4}\right) \ln \left(\frac{1+(2 \times 0.0021498)}{1-(2 \times 0.0021498)}\right) = 0.002149813 \quad (6)$$

Remember to multiply the Kosambi distance in Morgans by 100 to obtain distance in centi Morgans.

$$d_{cM} = d \times 100 = 0.002149813 \times 100 = 0.215 \quad (7)$$

Acknowledgements

Thanks to Craig Echt of USDA Forest Service for helpful discussion, and thanks to C. Dana Nelson, also of USDA Forest Service for asking questions that led to this estimation.