Calculating Relatedness

by Ann T. Bowling, PhD
©1995 from CMK Record Spring 1995 XI/2
used by permission of Michael Bowling

Offspring resemble their parents to varying degrees, but the proportional genetic contribution of each parent is constant: half the genes of an offspring come from the sire and half from the dam. A relatedness coefficient of 50% or 0.5 is assigned to the parent-offspring relationship.

Full siblings on *average* share 50% of their genes, based on the likelihood that 25% of the time they will have received the same genes from their dam and 25% of the time they will have received the same genes from their sire. It is *possible*, with a very small likelihood, that full siblings may have either *no* genes in common or *all* genes in common. The random assortment of chromosomes during gamete formation means that we cannot predict the exact proportion of genes that any two full siblings have in common; we can only provide an average value for full siblings as a group. In practical terms, stallion advertisements to the contrary, one cannot assume that a full brother to a proven sire will be an equally successful breeding horse.

AZZ (Ibn Nura x Bint Azz), shown here with Lady Anne Blunt, was the last of her line. Lady Anne sent the mare to England in the vain hope that more sophisticated veterinary care might preserve this branch of Dahman Shahwan. (NBGS)

Half-siblings on average share 25% of their genes, and first cousins share 12.5%. More complicated relationships can easily be calculated. In the simplest of pedigrees evaluations, breeders may talk of "percentage of blood." Of course blood is not the vehicle of inheritance, but is used in this context to imply genetic traits. These calculations provide the most probable proportion by source for an individual's genes by summing the relatedness coefficients for every occurrence of a particular ancestor in a pedigree. The relatedness decreases by half with each succeeding generation (Figure 1). The sum is not an exact proportion, but a statement of the most likely percentage. It is always possible that the true genetic proportion in common could be larger or smaller than that calculated as a relatedness coefficient.

SAHAB	Kaukab: 50%	Ibn Sherara: 25%	Sottam: 12.5%	Sueyd: 6.25%
				The Dahmah Nejiba of Khalil al-Hajry: 6.25%
			Sherara: 12.5%	A stallion of Áli Pasha Sherif: 6.25%
				A Jellabieh of Ali Pasha Sherif: 6.25%
		Bint Nura GSB: 25%	Aziz: 12.5%	Harkan: 6.25%
				Aziza: 6.25%
			Bint Nura: 12.5%	Zobeyni: 6.25%
				Nura: 6.25%
	Azz: 50%	Ibn Nura: 25%	Sottam: 12.5%	Sueyd: 6.25%
				The Dahmah Nejiba of Khalil al-Hajry: 6.25%
			Bint Nura: 12.5%	Zobeyni: 6.25%
				Nura: 6.25%
		Bint Azz: 25%	Wazir: 12.5%	Zobeyni: 6.25%
				Ghazieh: 6.25%
			Azz: 12.5%	A stallion of Ali Pasha Sherif: 6.25%
				The Dahmah Shahwaniah of Ibn Nakadan: 6.25%

Figure 1: The pedigree of SAHAB (see lead article, "The Banat Nura of Ali Pasha Sherif") exemplifies the fraction of an individual's genes most likely to come from each ancestor, presented in a conventional pedigree format. On average, a foal with this pedigree was likely to have received 25% of its genes from BINT NURA.