Genetic Analysis of the Gotland Russ horse

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A total of 73 Gotland Russ horses have been DNA typed for genetic variation at 12 equine microsatellite loci using standard procedures. The sample collection and analysis were for a study of several rare horse breeds for the Festival of Rare Breeds held at the Kentucky Horse Park in September of 2008. 43 of the Gotland horses came from Europe, mainly Sweden, while the remaining 30 were horses in the USA. Several genetic variability measures were calculated and shown in the Table below. Also shown in the table are measures from a representative sample of domestic horse breeds.

	N	***Ho***	***He***	***Fis***	***Ae***	***TNV***	***MNA***	***Ra***	***%Ra***
Gotland Russ all	73	0.648	0.665	0.025	3.182	72	6.00	27	0.375
Gotland Russ Europe	43	0.643	0.660	0.025	3.147	70	5.83	26	0.371
Gotland Russ USA	30	0.656	0.596	-0.099	2.752	45	3.75	6	0.133
American Saddlebred	576	0.740	0.745	0.007	4.250	102	8.50	42	0.412
Andalusian	52	0.722	0.753	0.041	4.259	79	6.58	21	0.266
Arabian	47	0.660	0.727	0.092	3.814	86	7.17	30	0.349
Exmoor Pony	98	0.535	0.627	0.146	2.871	66	5.50	21	0.318
Friesian	304	0.545	0.539	-0.011	2.561	70	5.83	28	0.400
Irish Draught	135	0.802	0.799	-0.003	5.194	102	8.50	28	0.275
Morgan Horse	64	0.715	0.746	0.041	4.192	92	7.67	33	0.359
Suffolk Punch	57	0.683	0.711	0.038	3.878	71	5.92	13	0.183
Tennessee Walker	60	0.666	0.693	0.038	3.662	87	7.25	34	0.391
Thoroughbred	1195	0.734	0.726	-0.011	3.918	69	5.75	18	0.261
Domestic Horse Mean	80	0.710	0.720	0.012	4.012	80.88	6.74	23.79	0.283
Standard Deviation		0.078	0.071	0.086	0.735	16.79	1.40	10.11	0.082
Minimum		0.347	0.394	-0.312	1.779	26	2.17	0	0
Maximum		0.822	0.799	0.211	5.298	119	9.92	55	0.462

N=sample size, *Ho*=Observed Heterozygosity, *He*=Expected Heterozygosity, *Fis*=Estimated Inbreeding Level based upon the ration of *Ho* to *He* , *Ae*=Effective Number of Alleles, *TNV*=Total Number of Variants, *MNA*=Mean Number of Alleles per locus, *Ra*=Number of Rare alleles and *%Ra*=Percentage of Rare alleles.

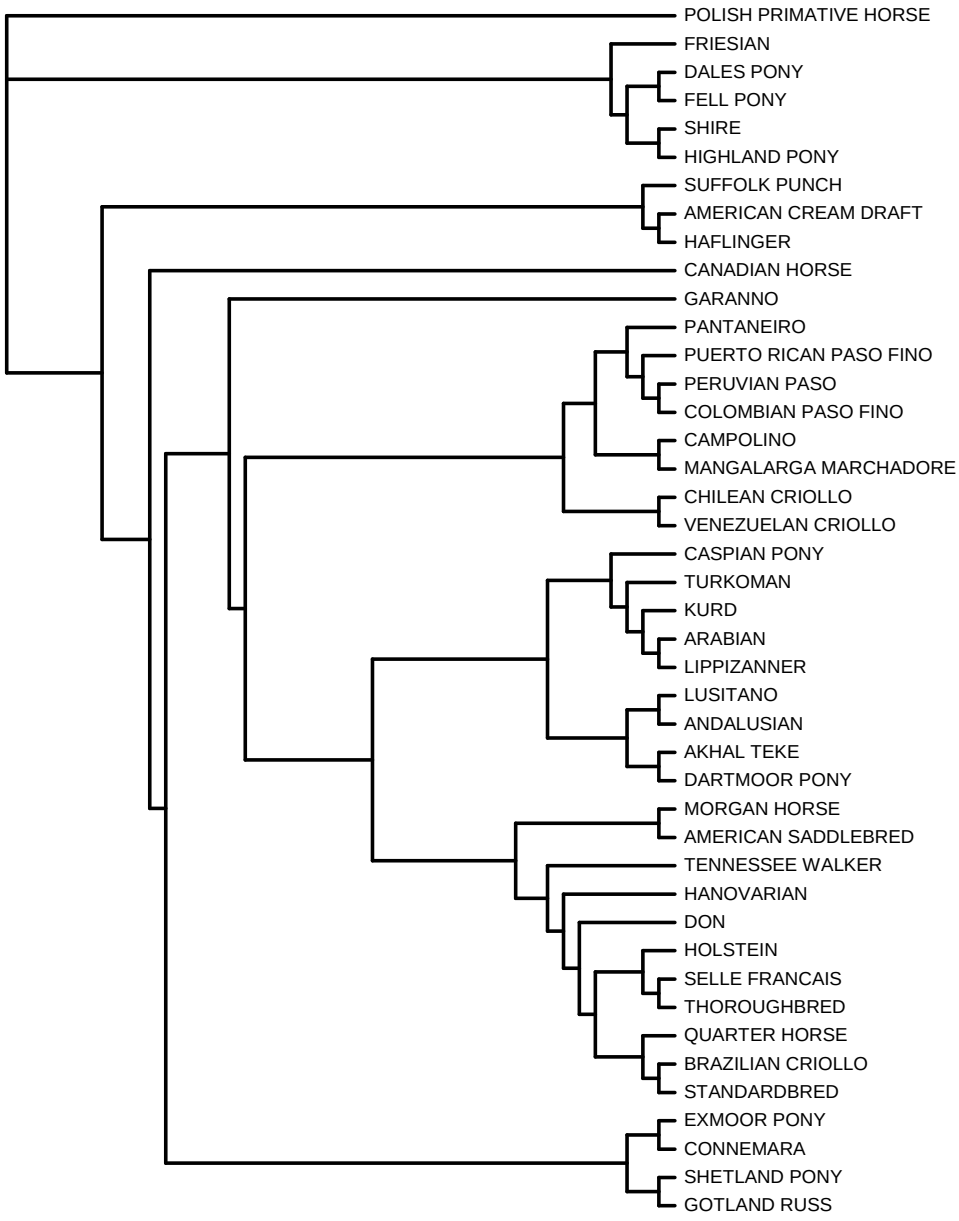
The variability of the Gotland Russ horse as a whole is fairly low but not exceptionally low. There were interesting differences in the heterozygosity values of the European horses compared to those from the USA. Observed heterozygosity (*Ho*) in Europe was lower than was seen in the US while the opposite was true for expected heterozygosity (*He*). This would appear to be due to the small numbers of animals that were the founders of the US population.

This small number represents a bottleneck and the variability values fit the pattern frequently seen with bottlenecks in population size which can reduce the allelic diversity (as shown by the measures *Ae, TNV* and *MNA*). Under this condition, *Ho* can remain relatively high while *He* (which is more strongly influenced by allelic diversity) is reduced. The allelic diversity numbers of the US population are well below those of any of the domestic breeds and the European Gotland population.

The *TNV* values also show differences between the European and US Gotland Russ populations. The number of variants found in the US is far lower than that in Europe which again, is related to the small number of individuals that have contributed to this group. However, there are two variants found in the US that were not seen in the European horses. Whether these are variants that exist in Europe but were not in the sampled animals, formerly existed in Europe but have been lost, are new mutations in the US population or are the result of a cross breeding can not be determined at this time. The two variants were at very low frequency so the possibility of cross breeding appears unlikely. Sampling is the most probable cause.

In comparison to the other 13 breeds analyzed for the Festival, the Gotland Russ had the largest contribution to total genetic diversity. The Gotland contributed about 10% to the total. This indicates that the Gotland, out of the total 14 breeds considered, was the most genetically unique. This is not due to any genetic variants that were present in the Gotland that were not present in other breeds, rather it was due to combinations of variants that were not common in other breeds.

The Gotland Russ showed closest relationship to the Shetland Pony in an analysis of genetic relationships among 43 domestic horse breeds. Two other British Pony breeds also are on the branch with the Gotland in the dendrogram shown below. Both the European, USA and combined data showed the same pattern as this tree which is based upon the European sample.


POLISH PRIMATIVE HORSE
FRIESIAN
DALES PONY
FELL PONY
SHIRE
HIGHLAND PONY
SUFFOLK PUNCH
AMERICAN CREAM DRAFT
HAFLINGER
CANADIAN HORSE
GARANNO
PANTANEIRO
PUERTO RICAN PASO FINO
PERUVIAN PASO
COLOMBIAN PASO FINO
CAMPOLINO
MANGALARGA MARCHADORE
CHILEAN CRIOLLO
VENEZUELAN CRIOLLO
CASPIAN PONY
TURKOMAN
KURD
ARABIAN
LIPPIZANNER
LUSITANO
ANDALUSIAN
AKHAL TEKE
DARTMOOR PONY
MORGAN HORSE
AMERICAN SADDLEBRED
TENNESSEE WALKER
HANOVARIAN
DON
HOLSTEIN
SELLE FRANCAIS
THOROUGHBRED
QUARTER HORSE
BRAZILIAN CRIOLLO
STANDARDBRED
EXMOOR PONY
CONNEMARA
SHETLAND PONY
GOTLAND RUSS