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Genetic diversity in native Greek horses

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Introduction

Greece is not well known for its horses (with one exception), however it does have a good diversity of horse types based upon both usage and geography. In this study, we examine microsatellite genetic diversity in eight groups of native Greek horses. We use the data to look at genetic diversity in these populations and to look at genetic relationships within the Greek populations and to compare these to other domestic horse breeds.

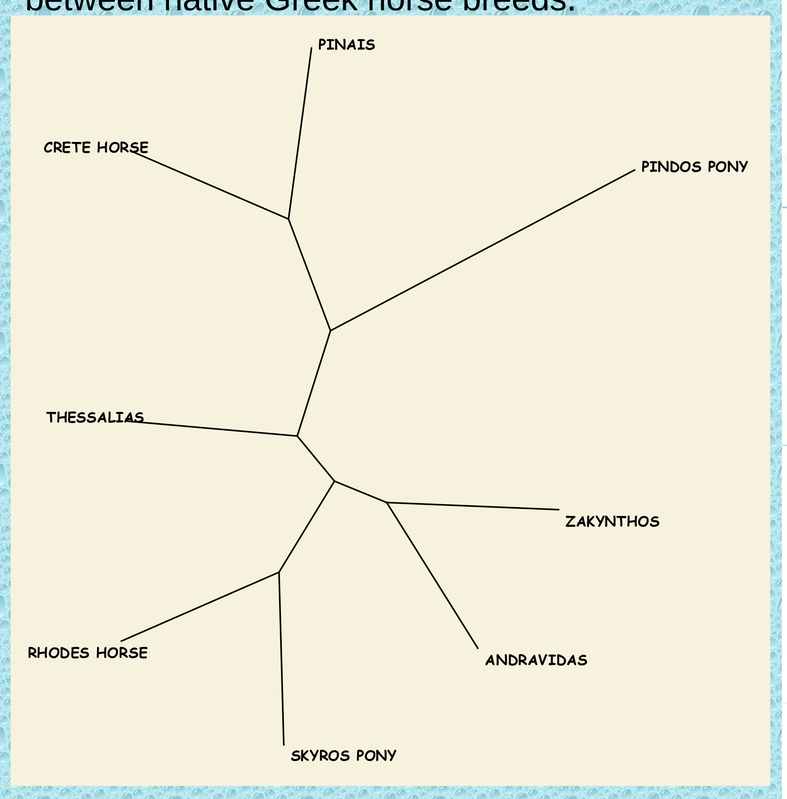
Materials and Methods

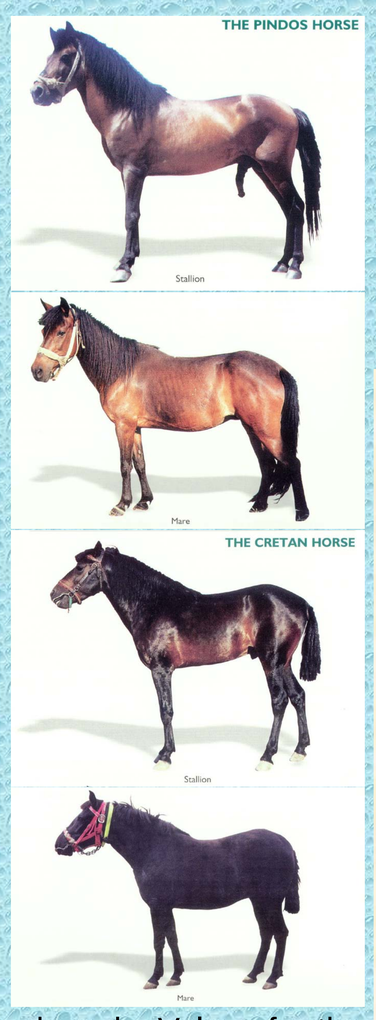
Genetic diversity was examined in eight native Greek horse breeds using 15 microsatellite loci. The DNA typing panel consisted of 15 microsatellites: *AHT4, AHT5*, *ASB2, HMS2, HMS3, HMS6, HMS7, HTG4, HTG6, HTG7, HTG10*, *VHL20, ASB17, ASB23* and *LEX33.* The breeds examined were the Andravidas, Crete Native Horse, Pindos, Pinias, Rhodes, Skyros Horse, Thessalias and Zakynthos. These do not necessarily represent breeds in the classical sense but do represent distinct breeding groups. All of these populations could be considered as rare so that sample size for some populations is low. For example, the Rhodes horse, which is nearly extinct, only six animals were typed but this represents the entire population except for one offspring from a mare and stallion that were tested. Diversity measures shown are observed and expected heterozygosity (Ho, He), the Caballero and Toro genetic diversity (GD), the internal diversity of the breed and mean genetic distance, the loss/gain is how much the total diversity would change by removing the breed, the Weitzman diversity (WV) and breed contribution to diversity (WMD).

Table 1. Diversity measures for native Greek horse breeds.

Breed	N	Ho	He	Ae	GD	Internal Diversity	Mean Distance	Loss/Gain	WV	WMD
SKYROS PONY	100	0.602	0.685	3.578	0.910	0.1030	-0.1115	-0.00820	1.520	17.300
CRETE HORSE	30	0.752	0.777	4.604	0.910	-0.0690	0.0108	-0.05810	1.652	10.120
PINAIS	62	0.697	0.784	4.869	0.909	-0.1150	0.0789	-0.03580	1.732	5.770
PINDOS PONY	18	0.843	0.792	4.915	0.910	-0.0190	-0.0171	-0.03610	1.588	13.600
ZAKYNTHOS	14	0.732	0.778	4.600	0.910	-0.0340	-0.0121	-0.02190	1.675	8.870
ANDRAVIDAS	34	0.738	0.781	4.849	0.910	-0.0970	0.0738	-0.02300	1.734	5.660
THESSALIAS	12	0.729	0.774	4.752	0.911	-0.0049	0.0081	0.00320	1.644	10.550
RHODES HORSE	6	0.264	0.213	1.409	0.910	0.1680	-0.1805	-0.01210	1.142	37.870
Andalusian	33	0.758	0.895	4.259	0.909	-0.0620	0.0026	-0.00364	10.880	2.850
Akhal Teke	84	0.753	0.891	4.023	0.910	-0.1230	0.1397	0.00170	10.982	1.940
Arabian	84	0.698	0.881	3.814	0.909	-0.1010	0.0042	-0.00589	10.814	3.450
Caspian Pony	77	0.780	0.894	4.716	0.919	-0.1660	0.1724	0.00060	11.006	1.730
Fell Pony	38	0.808	0.823	3.954	0.909	0.0046	-0.1380	-0.00920	10.904	2.640
Haflinger	47	0.671	0.776	3.874	0.909	0.1860	-0.2709	-0.00854	10.634	5.050
Hanoverian	34	0.791	0.890	4.590	0.910	-0.0030	0.0049	0.00189	11.062	1.230
Lippizan	76	0.717	0.874	3.578	0.910	-0.0039	0.1006	0.00614	11.002	1.770
Lusitano	70	0.742	0.893	4.364	0.910	-0.1300	0.0087	-0.00431	.	.
Peruvian Paso	46	0.791	0.884	4.774	0.909	-0.0079	0.0023	-0.05600	10.884	2.820
Standardbred	30	0.768	0.852	4.024	0.910	-0.0008	0.0032	0.00236	.	.
Suffolk	100	0.701	0.837	3.777	0.908	0.1560	-0.2793	-0.12300	10.852	3.110
Thoroughbred	175	0.784	0.858	3.918	0.910	0.5660	-0.4860	0.00798	10.245	8.530
Columbian Paso Fino	30	0.796	0.874	4.316	0.909	-0.0029	0.0000	-0.00293	.	.
Dales Pony	42	0.742	0.857	3.889	0.909	-0.0022	-0.0070	-0.00923	10.850	3.120
Exmoor Pony	98	0.678	0.834	2.871	0.909	0.1540	-0.1745	-0.00202	10.679	4.650
Morgan Horse	75	0.753	0.891	4.192	0.909	-0.1210	0.0847	-0.00358	10.938	2.330
Shetland Pony	97	0.754	0.876	3.373	0.910	-0.0077	0.1318	0.00548	10.920	2.500
American Saddlebred	228	0.767	0.881	4.250	0.910	-0.2390	0.3306	0.09120	10.999	1.790
Cleveland Bay	58	0.680	0.835	2.934	0.910	0.1240	-0.0098	0.00254	10.770	3.840
Shire	32	0.702	0.829	3.181	0.909	0.0041	-0.0075	-0.00334	10.752	3.990
Dartmoor Pony	75	0.753	0.849	3.543	0.910	0.0067	0.0015	0.00816	10.830	3.300
Highland Pony	25	0.720	0.799	3.319	0.909	0.0070	-0.1140	-0.00443	10.775	3.790
Gotland Russ	64	0.664	0.839	3.147	0.909	0.0053	-0.1392	-0.00859	10.434	6.830
Trakhener	32	0.813	0.861	4.594	0.910	0.0037	-0.0012	0.00248	11.066	1.190
Tennessee Walker	59	0.729	0.856	3.662	0.910	0.0011	0.0344	0.00454	10.830	3.300
Canadian Horse	52	0.739	0.872	3.885	0.909	-0.0050	0.0417	-0.00092	10.880	2.850

Figure 2. Partial RML tree of genetic similarity between native Greek horse breeds.





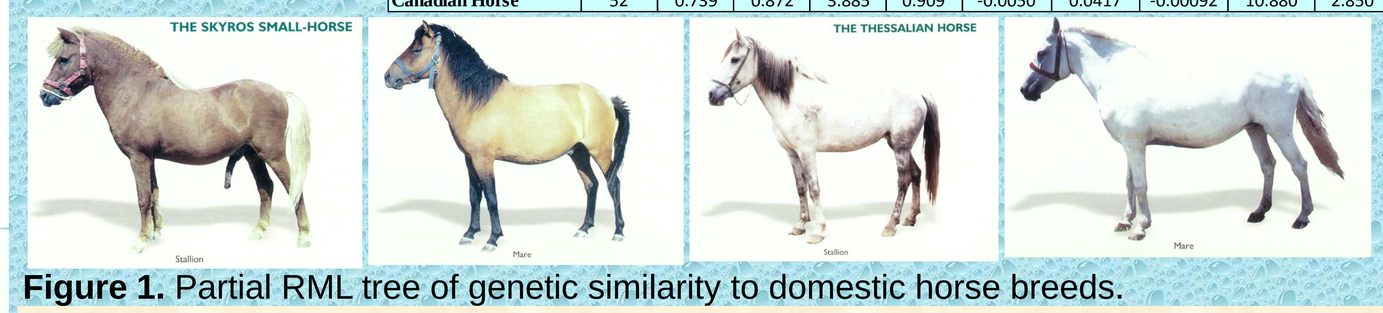
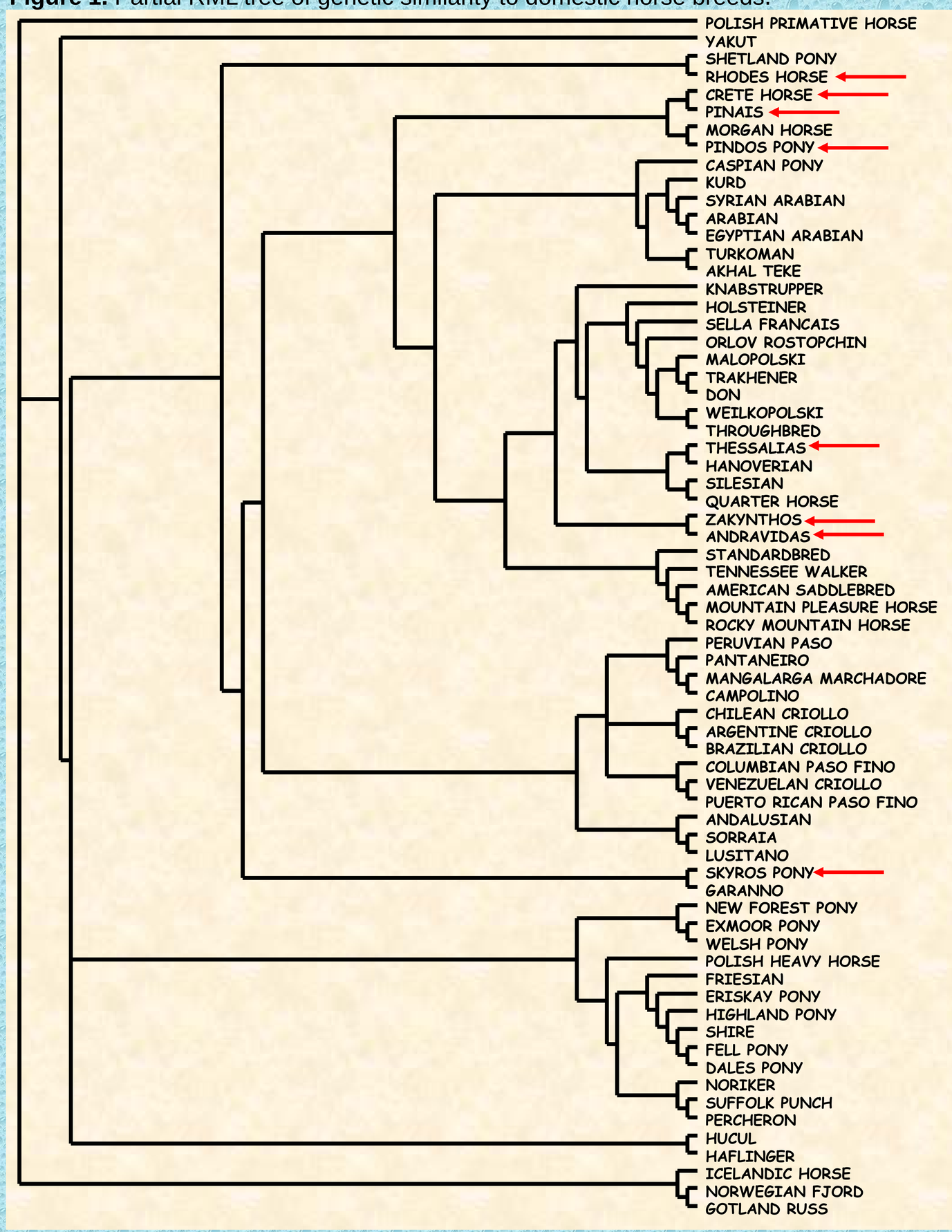


Figure 1. Partial RML tree of genetic similarity to domestic horse breeds.



Results and Discussion

Variability levels for the Crete, Pindos and Pinias populations were near the average for domestic horse breeds. Values for the Andravidas, Thessalias and Zakynthos were somewhat higher than the domestic mean. The Skyros had a relatively low level of variability (Observed heterozygosity of 0.602 compared to a domestic horse mean of 0.713) while the Rhodes horse had one of the lowest levels of heterozygosity seen for any horse population (0.264). In terms of genetic diversity, two of the island populations (Skyros and Rhodes) make the greatest contribution to overall diversity even though they have lower variation.

Phylogenetic analysis placed the Crete, Pindos and Pinias breeds within the cluster of horses with an oriental origin. The Skyros showed no close relationship to any group of horses, possibly due to the low variation and its isolation on an island. The Andravidas, Thessalias and Zakynthos breeds fell into the cluster that contained the Thoroughbred and its allies. There is known crossing of these three breeds to European breeds to attempt to improve their market value. The horses of Greece illustrate a common problem for conservation of rare breeds. The Greek horses are named for the regions where they are found and for these breeds there are no organized breed associations and the preservation of the horses is left strictly in the hands of those who use them. In some cases, the circumstances are such that the breed characters are maintained (for example, in the hard mountainous areas the horses are still used as they have been for generations and old characteristics are maintained) but in others, the economics of horse breeding leads to crossing with breeds that will improve the price of the animals. It is of course necessary for the animal breeders to make money to continue to raise the animals; however, homogenization has become a major threat to livestock diversity. It is important that outcrossing be recognized to develop plans the preserve native breeds.

* photos obtained from Thomas A. Alifakiotis “The Indigenous Horses of Greece”