Supplementary Table 1 *RPGRIP1*$^{-/-}$ MLHD samples used in SNP array genotyping

Sample ID	Age	Sex	RD phenotype	Sample source	Notes
AHT_D	<2 (2)	M	EORD	Research colony	-
AHT_E	<2 (2)	F	EORD	Research colony	Excluded from GWAS analysis
MLD002	2.7	F	EORD	Family K	Dam:MLD001
MLD021	<<5 (2)	M	EORD	Family K	Excluded from GWAS analysis, Dam:MLD001
MLD027	1	F	EORD	Japanese pet	WGA_PCR
MLD028	1.5	F	EORD	Japanese pet	-
MLD029	1.3	M	EORD	Japanese pet	-
MLD030	1.8	F	EORD	Japanese pet	-
MLD031	1.8	M	EORD	Japanese pet	-
MLD032	3	F	EORD	Japanese pet	-
MLD033	3	F	EORD	Japanese pet	-
MLD034	<2 (2)	M	EORD	Japanese pet	-
MLD035	1.8	F	EORD	Japanese pet	-
MLD037	1	M	EORD	Japanese pet	-
MLD064	<3.4 (3.4)	M	EORD	Japanese pet	-
MLD066	2	F	EORD	Japanese pet	-
MLD070	3	F	EORD	Japanese pet	WGA_PCR
MLD078	1.5	F	EORD	Japanese pet	-
MLD079	0.7	M	EORD	Japanese pet	-
MLD081	1	M	EORD	Japanese pet	-
MLD082	2	F	EORD	Japanese pet	-
MLD083	2	M	EORD	Japanese pet	WGA_F29
MLD084	<2.5 (2.5)	F	EORD	Japanese pet	-
MLD085	1.4	F	EORD	Japanese pet	-
MLD088	2.5	F	EORD	Japanese pet	WGA_F29
MLD105	0.3	F	EORD	Japanese pet	-
MLD113	<3.3 (3.3)	M	EORD	Japanese pet	-
MLD117	1	F	EORD	Japanese pet	-
MLD124	<<4.5 (2)	F	EORD	Japanese pet	-
MLD142	2.5-3 (3)	M	EORD	Japanese pet	-
MLD222	2.8	F	EORD	Japanese pet	-
MLD234	2.9	M	EORD	Japanese pet	-
MLD455	3	F	EORD	Japanese pet	Dam:MLD453
MLD004	2.4-5.2 (5.2)	F	MORD	Family K	Excluded from analysis, Dam:MLD002
MLD023	5	M	MORD	Japanese pet	-
MLD025	4	M	MORD	Japanese pet	-
MLD112	3.5-4.5 (4.5)	M	MORD	Japanese pet	-
MLD001	9.2-10.6 (10.6)	F	LORD	Family K	Excluded from GWAS analysis
MLD003	7.8-9.3 (9.3)	F	LORD	Family K	Excluded from GWAS analysis, Dam:MLD002
MLD005	>10.8 (10.8)	M	LORD	Family K	Excluded from GWAS analysis, Dam:MLD001
MLD007	9.4	M	LORD	Family K	Excluded from GWAS analysis, Dam:MLD001
MLD009	5.2-6.6 (6.6)	M	LORD	Family K	Excluded from GWAS analysis, Dam:MLD002
MLD022	7	M	LORD	Japanese pet	-
MLD024	9	M	LORD	Japanese pet	-
MLD039	7	F	LORD	Japanese pet	-
MLD061	8	F	LORD	Japanese pet	-
MLD103	15	M	LORD	Japanese pet	-
MLD114	8.5	M	LORD	Japanese pet	-
MLD115	9	F	LORD	Japanese pet	-
MLD151	6	M	LORD	Japanese pet	-
MLD291	5.6	M	LORD	Japanese pet	-
MLD435	10	M	LORD	Japanese pet	-

MLD436	9	F	LORD	Japanese pet	-
MLD438	9.8	M	LORD	Japanese pet	-
MLD443	7.8	F	LORD	Japanese pet	-
MLD445	~16 (16)	M	LORD	Japanese pet	-
MLD446	15	F	LORD	Japanese pet	-
MLD006	8.9	M	Normal	Family K	Excluded from GWAS analysis, Dam:MLD001
MLD008	5.6	M	Normal	Family K	Excluded from GWAS analysis, Dam:MLD004
MLD010	6.1	F	Normal	Family K	Excluded from GWAS analysis, Dam:MLD004
MLD011	5.2	M	Normal	Family K	Excluded from GWAS analysis, Dam:MLD001
MLD012	5.7	F	Normal	Family K	Excluded from GWAS analysis, Dam:MLD003
MLD087	4.8	F	Normal	Japanese pet	-
MLD102	5	F	Normal	Japanese pet	-
MLD104	6.9	M	Normal	Japanese pet	-
MLD106	10.4	M	Normal	Japanese pet	-
MLD127	8.6	M	Normal	Japanese pet	-
MLD130	5.3	F	Normal	Japanese pet	-
MLD132	8.5	M	Normal	Japanese pet	-
MLD134	10	F	Normal	Japanese pet	-
MLD153	10.4	M	Normal	Japanese pet	-
MLD201	9.2	F	Normal	Japanese pet	WGA_PCR
MLD214	9.8	F	Normal	Japanese pet	-
MLD219	7	M	Normal	Japanese pet	WGA_PCR
MLD235	9.9	F	Normal	Japanese pet	-
MLD242	12.4	F	Normal	Japanese pet	-
MLD265	5.4	F	Normal	Japanese pet	-
MLD269	4.9	F	Normal	Japanese pet	-
MLD288	9.4	M	Normal	Japanese pet	-
MLD343	7.2	M	Normal	Japanese pet	-
MLD345	6	M	Normal	Japanese pet	-
MLD354	5.3	F	Normal	Japanese pet	-
MLD366	14	F	Normal	Japanese pet	-
MLD369	8	F	Normal	Japanese pet	-
MLD370	10.4	F	Normal	Japanese pet	-
MLD405	10.7	F	Normal	Japanese pet	-
MLD413	6	M	Normal	Japanese pet	-
MLD415	5.5	F	Normal	Japanese pet	-
MLD424	8.8	M	Normal	Japanese pet	-
MLD453	9.4	F	Normal	Japanese pet	-
AHT11044	6.3	M	Normal	UK pet	-
AHT11056	7.7	F	Normal	UK pet	-
AHT11057	8.8	M	Normal	UK pet	-
AHT11058	6.4	F	Normal	UK pet	-
AHT11062	7.7	F	Normal	UK pet	-
AHT11063	5.4	F	Normal	UK pet	-

The ages denote the onset of RD in affected dogs and the timing of last examination in Normal dogs. Where a definite age was unavailable, the value shown in brackets was used in the PLINK analysis. Some samples were prepared by whole genome amplification either by PCR-based (WGA_PCR, GenomePlex®; Sigma-Aldrich) or Phi29 DNA polymerase-based (WGA_F29, illustra GenomiPhi V2; GE Healthcare) methods.

Supplementary Table 2 Primer sequences for canine *LRAT*

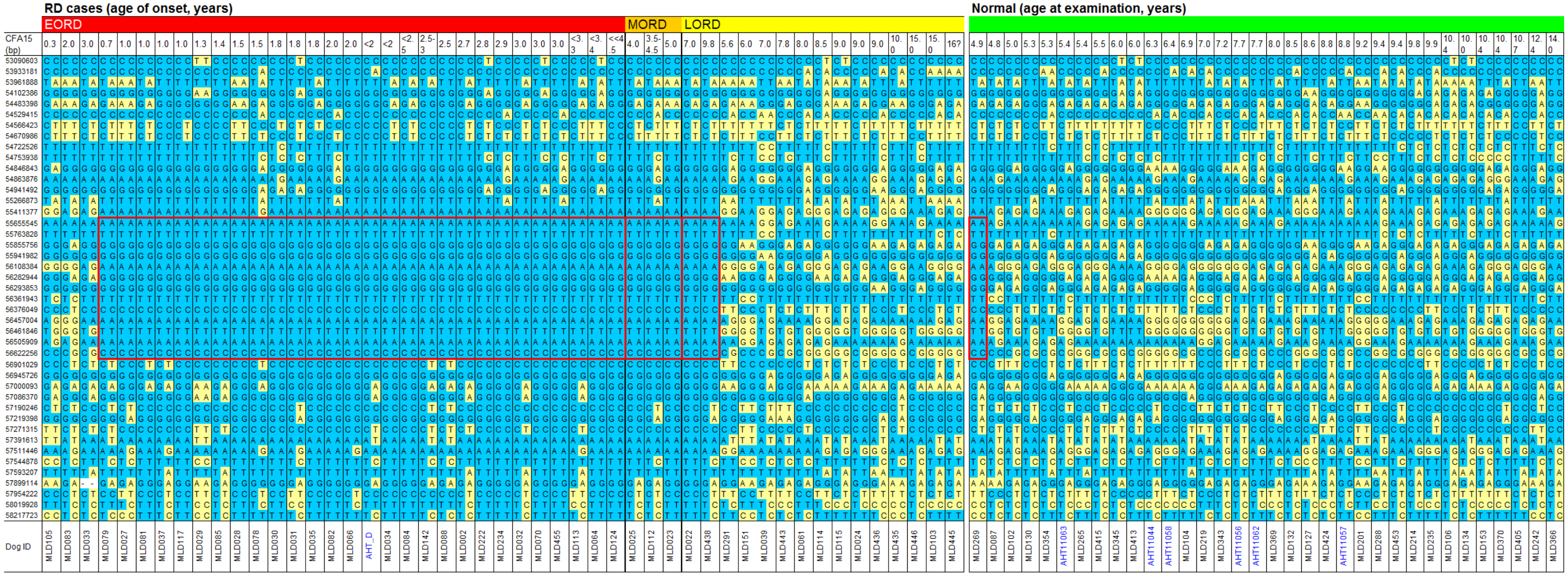
Gene	**Featrure**	**Forward primer sequence (5'>3')**	**Reverse primer sequence (5'>3')**	**Nt from *LRAT***	
				Start	**End**
LRAT	Exon 1-2	TGCAGGTGAGGTCCCCG	CTGCTCTTTAGTCGTTTCGAC	-63	823
	Exon 3	GGTACGTGTGATCCTTCTCAG	CATGTTTTCATCTGAACGAGGG	4706	5389
	Upstream	ACAGGACAAACGGAAACGTC	GGAGTCGCTGGTGTTAATC	-2759	-2037
		CCCAAAGTTTACAACCGCTCA	GCCCGATTCGGAGCTAATA	-2091	-1643
		TCTGCTTTCGATCCGTTTG	CCTGCAAAAGGCGGATTAACG	-1960	-1367
		ACCCCGAAGCTAGGGAAAT	GGCGAAACGCACCTGGG	-1412	-721
		CCCAGGTGCGTTTCGCC	CAGCTTCTCCAGCAACAGG	-737	47
	Intron	CGGAGTGTGGCGATTGCAG	TGTAAGGTGACGGATGTTAGC	716	1630
		GCCAAGTCTCTGTTTTATTGAGA	CCAAACTGTTACATCATTCAAAGT	1493	2437
		TGTTGCTGCCTAACACCTCTTGTG	ATCGAGTTTTCAGGACAATGAGAA	2371	3298
		GCCAAGCACCTTTTCTCATTGTCC	ATGATCCATACCCCTGAGGAAG	3263	4177
		AGAGGGTAGTCTGGACAAGTT	TGCTGAAGCAAGAACACTTCTCTG	4014	4825
	Human 3'-UTR equivalent	CTAAACTAAACGATTTTCCCCTCGT	AAGTCTAGCTTGTGGCCTAGTTTTT	5350	6198
		AGTGAGCGTTCATGTACTTTTGC	GAGATCGTGAAATTACAACAGGTCA	6134	6866
		TGCTAGACACTGACCTGTTGTAAT	TCCACTGCCGGTTCATAAAG	6832	7723
		GCAATGATCAAGTGATGCAAG	GGCTCCCAGATGTAGATGACA	7658	8537

Supplementary Table 3 Primer sequences for the coding regions of canine *MAP9*, *GUCY1A3*, and *GUCY1B3*

Gene	**Exon**	**Forward primer sequence (5'>3')**	**Reverse primer sequence (5'>3')**
MAP9	1	CAGACCCGGTCAGAGTTTGAAT	CGTAGTAAAAACCTAGTACTGAAGC
MAP9	2	TTCTCCTGCCCTAAATACACG	TGACAGGCATCCTTTTACTGC
MAP9	3	TGCCTAAGTTAGCTGTGTTTTAGAGC	TGCAAGACTGACATGCAACTGG
MAP9	4	GCATCCTGGTAGTCGTTGAAG	ACAGTGCCGTGATCATTCAATA
MAP9	5	TTGAGATGCCGGTGAACGTACT	GCTTGGGGTAGGTTGCCCTTAC
MAP9	6	AGATGAATGTAATTGCTCTCCTTG	GGAGTTTTCCACAGACAGTTCAGA
MAP9	7	TTGGCCCTAAGCCTAACTGTGA	GGTGTCCCGTGTCTTATCA
MAP9	8	CCTGCCAACTCCTGAAATAGAGG	CCTTGGTGAATGGGTAACCTTGT
MAP9	9	TTCTTAACTCATGCTCGTCTTTACG	CTAATGGTGCCGACGTGTTGAT
MAP9	10-12	TCGTATCTACCTGTCTCCGTCTGT	ACAGATTCCACAAGGCAGCTCT
MAP9	13	CCCCACATGCAGTCACTTACCA	CAGTCCCCACCAGAGAAACACA
MAP9	14-15	TGTGCTAGATCACTTAGGGCAAC	TGACTGTTGTCTGTTGGGGAGTG
MAP9	16	GGAAATTATAACTTGGGTTATCTG	GTTGCTGTCGAAAACACGATGG
MAP9	17	CTTCAGCAAGCAACCTGATTTG	GATTGTCACGTTAAGTCTGGGACA
GUCY1A3	1	TTTTCTGGACCAGTGCATAGCGG	CTCGCGTCCACGCTCCACAG
GUCY1A3	2	TGTGTAGCATTGTGCTCCTGCCA	GGCCAGTCAGGAAGACCTGGA
GUCY1A3	3	TTGTGGTAGGGACATGTGGAATGC	GCCTTGAAAGTGAGAAAGCACGC
GUCY1A3	4	GGCTGTCAGCGAGACCACCC	AGCAGCAGTACACGGCGACA
GUCY1A3	5	TTCTTCCCATCCCCCTAGTTGGC	ATGAGTCAGCTTCCCATGCGGC
GUCY1A3	6	TGTTACCAGACGTAAAGGGAACT	TTCATTTCTAGTCCTTAACCAAGA
GUCY1A3	7	GCGTCAGCGTTCCCCTTAGTGA	CCAGGATGCGGCTTGCAGAGA
GUCY1A3	8	GCCACTCCCTGATGTTGTGCT	ACACAGACGTTTGCCGACTGC
GUCY1A3	9	TGGTGACCGTGCGAGGTGTG	TCAGCGTGGGGGAAGACAGGA
GUCY1A3	10	TCTGAGCACATTAGGGCACGCT	TGTGTTGAATTTCGAGTACAGGT
GUCY1B3	1	CCGTTAAACTGGGGGCGGG	CCGCGTGGACAAACACACACTT
GUCY1B3	2	TCAGGCATTGCATTGGGCATTAGA	CCTCCACCATCGTGCAGCGT
GUCY1B3	3	TCCACTTGCACAAAAGTTGGGGAT	GGATGTTCAAGGTGGGCAACCA
GUCY1B3	4	TCAACGCAACCACCCACTCTCT	TGCTCGTGCAGCACTGTTTTGGT
GUCY1B3	5	AAGCCTACCCGGACAAGAGGGTA	AGCCAGCCGTCCTAGGGAAAGTT
GUCY1B3	6	TGCATGGAGCCTCTTTCTCCCT	TTCCACCGCCCCTCAGGCAAATA
GUCY1B3	7	AGCCCTCGCAAAGGTCTTACCA	ACACTCGCAAACTGATTCAGACAGG
GUCY1B3	8	ACAGACCAGGTTGCACAGGACA	ACAGGCCCCGTGCCTTTTTAGT
GUCY1B3	9	ACAGCTTTCCTACTGTGAGGCCA	AACAGTGACTGCGTGGAGGCTGTA
GUCY1B3	10	GGCAGTGGCTCTTGTGCCGTA	CTTTGCCCTCAAGGTGTCTTTCCT
GUCY1B3	11	CAGGTTCAAGTAGATGGCGAATCTGT	TGAGAGTTAAACCACACGTAACGACAC
GUCY1B3	12	AGCAGAACGGAAACCACTGGAGA	TCACAGCCCTCTCGCCTCAGC
GUCY1B3	13	GTGGCCCTGTTTCACCCAGAAT	AGAGCGCCTAACATTTATCCCAAGC

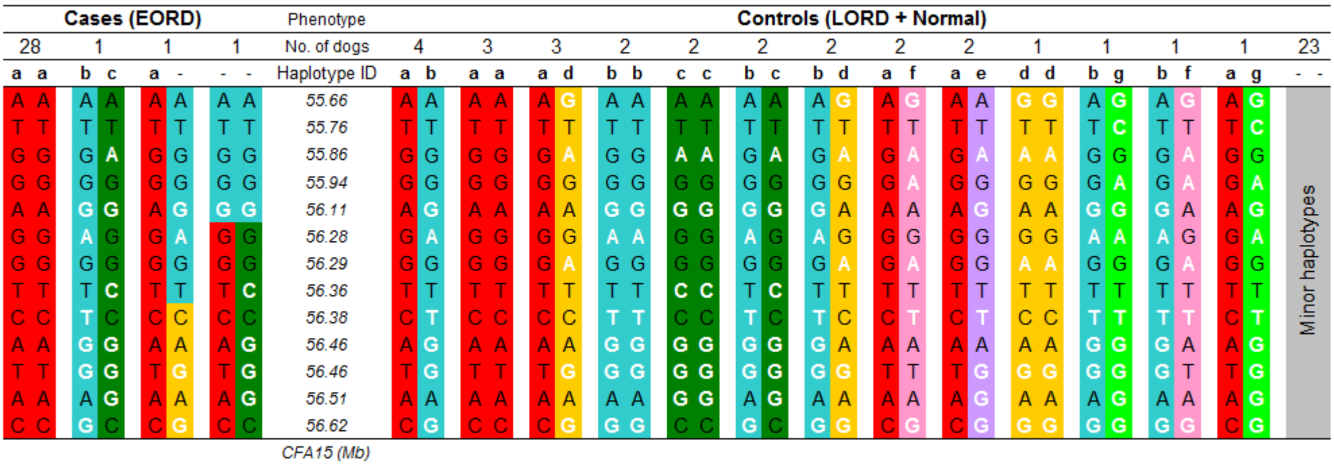
Supplementary Fig. 1 SNP genotypes of 83 *RPGRIP1*$^{-/-}$ MLHDs at the CFA15 locus associated with EORD. EORD (red header), MORD (orange header) and LORD (yellow header) samples are shown in the order of the onset age (except individuals with atypical haplotypes), while Normal samples (green header) are shown in the order of the age at examination. SNP alleles in light blue boxes represent the predominant allele in EORD, while those in light yellow boxes represent the alternative allele. The 1.49-Mb region of homozygosity shared by 90% of the EORD cases is outlined in red. The Dog ID of the UK dogs is shown in blue.

Supplementary Fig. 2 Haplotype combinations of the locus associated with EORD. Haplotype blocks were inferred using the controls (M1: 15 LORD + 34 Normal). Haplotype ‘a’ corresponds to the major haplotype in the EORD cases. Alternative haplotypes (b-g) are indicated in different color blocks where alternative SNP alleles are shown in white letters. Left, four different haplotype pairs in the EORD cases (n=31). Right, haplotype pairs in the controls (n=49) are shown where both haplotype frequencies are ≥0.03. Haplotype frequencies in the controls: a=0.22, b=0.22, c=0.09, d=0.07, e=0.05, f=0.03, g=0.03.



	RD cases (age of onset, years)																																																	Normal (age at examination, years)																																	
	EORD																														MORD			LORD																																														
CFA15 (bp)	0.3	2.0	3.0	0.7	1.0	1.0	1.0	1.0	1.3	1.4	1.5	1.5	1.8	1.8	1.8	2.0	2.0	<2	<2	<2.5	2.5-3	2.5	2.7	2.8	2.9	3.0	3.0	3.0	<3.3	<3.4	<<4.5	4.0	3.5-4.5	5.0	7.0	9.8	5.6	6.0	7.0	7.8	8.0	8.5	9.0	9.0	9.0	10.0	15.0	15.0	16?	4.9	4.8	5.0	5.3	5.3	5.4	5.4	5.5	6.0	6.0	6.3	6.4	6.9	7.0	7.2	7.7	7.7	8.0	8.5	8.6	8.8	8.8	9.2	9.4	9.4	9.8	9.9	10.4	10.0	10.4	10.4	10.7	12.4	14.0
53090603	C C	C C	C C	C C	C C	C C	C C	C C	T T	C C	C C	C C	C C	C T	C C	C C	C C	C C	C C	C C	C C	C C	C C	C T	C C	C C	C T	C C	C C	C T	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C T	C T	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C T	C T	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C T	C T	C C	C C	C C	C C	C C
53933181	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C A	C C	C C	C C	C C	C C	C A	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C A	C A	C C	C C	C A	C A	C C	A A	A A	C C	C C	C C	C C	A A	C C	C C	C A	C C	C C	C C	C A	C A	C A	C C	C C	C C	C C	C A	C C	C C	C A	C C	C A	C A	C C	C A	C C	C C	C C	C C	C C	C C	C C
53961888	T A	A A	T A	T A	A A	T A	T T	T T	T T	T T	A A	T A	T T	T T	T A	T T	T T	T T	T A	T A	T A	T T	T A	T T	T T	T A	T T	T T	T A	T A	T T	T A	T A	A A	T A	T A	A A	A A	T T	A A	T A	T A	A A	T A	T T	T A	T T	T T	T T	T A	T A	T A	T T	T A	T A	T A	T T	T A	T A	T T	T T	T T	T A	T A	T A	T T	T A	T T	T T	T A	T T	A A	T A	T A	T A	T A	A A	A A	T T	T A	T T	A A	T T
54102386	G G	G G	G G	G G	G G	G G	G G	G G	A A	G G	G G	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G A	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	A A	G G	G G	G G	G G	G G	G A	G A	G A	G A	G A	G G	G G	G A	G G
54483398	G A	A A	G A	G A	A A	G A	G G	G G	G G	G G	A A	G A	G G	G G	G A	G G	G G	G G	G A	G A	G G	G G	G A	G G	G G	G A	G G	G G	G A	G A	G G	G A	G A	A A	G A	G A	G A	A A	G G	G A	G G	G A	A A	G A	G G	A A	G G	G A	G A	G A	G A	G A	G G	G A	G A	G A	G A	G A	G A	G G	G G	G A	G A	G A	G G	G A	G A	G G	G A	G A	G G	A A	G G	G G	G G	G A	G A	G A	G G	G G	G G	G A	G G
54529415	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C A	C C	C C	C C	C A	C C	C C	C C	C C	C C	C C	C C	C C	C A	C C	C C	C A	C C	C C	C C	C C	C A	C C	C C	C C	C A	C C	A A	C C	C A	C A	C C	C C	C A	C C	C C	C A	C A	C C	C C	C C	C C	C A	C C	C C	C C	C C	C C	C A	C A	C C	C A	C C	C A	C A	C C	C A	C A	C C	A A	C C	A A	C A	C A	C A	C A	C A	C A	C A	C C	C A	C C
54566423	C T	T T	C T	C T	T T	C T	C C	C T	C C	C C	T T	C C	C T	C T	C T	C C	C C	C C	C T	C T	C C	C C	C T	C T	C C	C T	C T	C C	C T	T T	C C	C T	C T	T T	C T	C T	T T	T T	T T	C T	C T	T T	T T	C T	T T	T T	C T	T T	T T	C T	C T	C T	C C	T T	C T	T T	T T	T T	T T	C C	C C	C T	T T	C T	C C	C T	T T	C T	C T	C T	C C	T T	C T	C T	C T	T T	T T	T T	C T	T T	C C	T T	C T
54670986	C T	T T	C T	C T	T T	C T	C C	C T	C C	C C	T T	C T	C C	C T	C C	C T	C C	C C	C T	C T	C C	C C	C T	C T	C T	C T	C T	C T	C T	T T	C C	C T	T T	T T	C T	C T	C T	T T	C C	T T	C T	C T	T T	C T	C T	T T	C C	T T	T T	C T	C T	C T	C C	C T	C T	C T	C T	T T	T T	C T	C C	C T	T T	C T	C T	T T	C T	C T	T T	C T	C T	T T	C T	C C	C C	C T	C T	C T	C T	C C	C C	C T	C C
54722526	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T C	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	C C	T T	T T	T C	T T	T T	T C	T T	T C	T T	T T	T T	T T	T T	T T	T C	T T	T C	T C	T T	T T	T T	T T	T T	T T	T T	T T	T T	T C	T T	T T	T T	T T	T T	T T	T C	T C	T C	T C	T C	T C	T C	T T	T C	T C
54753938	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T C	T C	T C	T T	T C	T T	T T	T T	T T	T T	T T	T T	T C	T C	T T	T C	T C	T T	T C	T T	T T	T C	T T	T T	T T	T C	T T	C C	T C	T T	T C	T T	T T	T C	T T	T C	T T	T T	T T	T T	T T	T T	T T	T T	T C	T C	T C	T C	T C	T T	T T	T T	T T	T C	T C	T C	T T	T C	T T	T C	T T	C C	T T	T C	T C	T C	T C	C C	C C	T T	T T	T C
54846843	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G A	G G	G G	G G	G G	G A	G G	G G	G G	G A	G G	G G	G G	G A	G G	G G	G G	G A	G G	G G	G A	G A	G G	G G	G A	G G	G G	G A	G G	G G	G G	G G	A A	A A	G G	G G	G A	A A	G A	G G	G G	G G	G G	A A	G G	A A	G G	G G	G G	G G	G G	G A	G A	G G	G A	G G
54863876	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A G	A A	A A	A G	A A	A A	A A	A A	A A	A A	A A	A A	A G	A A	A A	A G	A A	A A	A A	A A	A G	A A	A A	A A	A G	A A	G G	A A	A G	A G	A A	A A	G G	A A	A G	A G	A G	A A	A G	A A	A A	A A	A A	A G	A G	A A	A A	A G	A A	A G	A A	A A	A G	A G	A G	A A	A A	A A	A G	A A	A G	A A	A G	A G	A G	A G	A G	G G	A A	A G	A G
54941492	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G A	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G A	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	A A	G G	G A	G G	G G	G G	G G	G G	G G	G A	G G	G A	G A	G A	G A	G G	G G	G G	G G	G G	G G	G G	G A	G G	G A	G G	G G	G G	G G	G A	G G	G G	G G	G G	G A	G A	G G	G G	G A
55266873	T A	T A	T A	T T	T T	T T	T T	T T	T T	T T	T T	T A	T T	T T	T T	T A	T T	T T	T T	T T	T T	T T	T T	T T	T A	T T	T T	T A	T T	T T	T T	T T	T A	T T	T T	T T	A A	T T	T T	T T	T A	T A	T A	T T	T A	A A	T T	A A	A A	T T	T T	T T	T A	T T	T T	T T	T A	T T	T T	T A	T T	T A	T A	T T	T A	A A	T T	T A	A A	T T	T A	T T	T A	T T	T T	T A	T T	T T	T T	T A	T T	T T	T T
55411377	G G	A G	A G	A A	A A	A A	A A	A A	A A	A A	A A	A G	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	G G	A A	G G	A G	A G	G G	A G	A G	A G	G G	A A	A G	A G	A A	A G	A G	A G	A A	A G	A G	A G	A A	A A	G G	G G	G G	A G	A G	G G	A G	A A	A G	G G	A A	A G	A A	A G	A A	A G	A G	A A	A G	A G	A G	A A	A G	A A
55655545	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	G G	A G	A A	A G	A A	A A	G G	A A	A G	A A	A A	A A	A G	A A	A A	A A	A A	A G	A G	A G	A G	A A	A A	A G	A A	A A	A G	A A	A G	A A	A A	A A	A A	A A	A G	A A	A G	A G	A G	A G	A G	A G	A A	A A	A G
55763828	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	C C	T T	T T	T C	T T	T T	T T	T T	T T	T C	T C	T T	T T	T T	T T	T C	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T C	T C	T C	T T	T T	T C	T T	T C	T T	T T	T T
55855756	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	A A	G G	G A	G A	G G	G G	G G	A A	G A	G A	G A	G A	G G	G A	G A	G A	G G	G A	G A	G A	G A	G A	G G	G G	G G	G A	G A	G A	G G	G G	G G	A A	G G	G G	A A	G A	G G	G A	G A	G A	G G	G A	G A	G A	G A	G A
55941982	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	A A	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	G A	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G A	G G	G G	G G	G A	G G	G A	G G	G A	G G	G G	G G	G G	G G
56108384	G G	G G	A G	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	G G	G G	A G	A G	A G	G G	A G	A G	A A	G G	A A	G G	G G	A A	A G	G G	A G	A G	G G	A G	G G	A A	A A	G G	G G	A G	G G	G G	G G	A G	A G	A G	A G	A A	A G	G G	A G	A G	A G	A G	A A	A G	A G	G G	A G	G G	A A
56282944	G G	G A	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	A A	G G	G A	G G	G G	A A	G A	G A	G G	G A	G G	G A	G A	G G	G G	G A	G G	G G	G A	G A	G A	G G	G G	A A	A A	G A	G G	G A	G A	G A	G G	G A	G G	G G	G A	G G	G A	G G	G G	G A	G G	G A	G A	G A	G G	G A	G G
56293853	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	A A	G G	G A	G G	G G	G G	G A	G A	G G	G A	G G	G A	G A	G A	G A	G G	G G	G A	G G	G G	G A	G G	G G	G G	G A	G A	G G	G G	G A	G A	G A	G A	G A	G G	G A	G G	G A	G G	G A
56361943	T C	T C	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	C C	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	C C	T T	T T	T T	T C	T T	T T	T T	T T	T T	T T	T C	C C	T C	T T	T T	T C	T T	T T	T T	T T	C C	T T	T T	T T	T T	T T	T T	T T	T T	T T	T C	T T
56376049	C C	C T	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	T T	C C	C T	C T	C T	T T	C T	C T	C C	C T	C C	C T	C T	C C	C C	C T	C T	C T	C T	C T	C T	C T	C T	T T	T T	C T	C C	C T	C T	C T	C T	C T	T T	C T	C T	C C	C C	C C	C C	T T	C C	C T	C T	T T	C C	C C	C C
56457004	A G	G G	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A G	G G	A G	A A	A A	G G	A G	A G	A A	A A	A A	A G	A G	A A	G G	A G	A A	A A	G G	A G	A G	A A	A A	G G	G G	G G	G G	G A	G A	G A	A A	A G	A A	A A	A G	G G	G G	A A	A G	A G	A A	A G	A G	A G	A G	A G	A A
56461846	T G	G G	T G	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	G G	G G	T G	T G	T G	G G	G G	T G	G G	G G	T G	G G	G G	T T	G G	T G	T G	T T	G G	G G	T G	T T	T T	G G	G G	G G	G G	G G	T G	T G	T G	T G	T G	T T	T G	G G	G G	T G	T G	T G	T G	T G	G G	G G	T G	G G	T G
56505909	A G	A G	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	G G	A G	A G	A G	A G	A A	A A	A A	A G	A A	A A	A A	A A	A G	A A	A G	A G	A G	A A	A A	A A	A A	A A	A A	A A	G G	A G	A A	A A	A G	A A	A G	A A	A A	G G	A A	A G	A A	A A	A A	A G	A A	A G	A A	A G	A A
56622256	C C	C G	C G	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C G	C C	C G	C G	C G	G G	G G	C G	G G	G G	C G	G G	G G	C C	C C	C G	C G	C G	C G	G G	C G	C G	C G	G G	G G	C G	C C	C G	C G	C G	C C	C G	G G	C G	C G	C C	G G	C G	C G	G G	C G	C G	G G	G G	C G	C G	C G
56901029	C C	C T	C T	C T	C C	C T	C T	C C	C C	C C	C C	C T	C C	C C	C C	C C	C C	C C	C C	C C	C T	C T	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	T T	C C	C C	C C	C T	C T	C T	C T	C C	C T	C C	C T	C T	C C	C T	T T	C C	C T	C T	C T	T T	C T	C T	T T	T T	T T	C C	C T	T T	C T	C C	C T	C C	C T	C T	C C	C C	C C	C C	T T	C C	C C	C T	C T	C C	C T	C C
56945726	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G A	G A	G G	G G	G G	G G	G A	G A	G G	G G	G G	G G	G A	G G	G G	G G	G A	G A	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G A	G G	G G	G A	G G	G G	G A	G G	G A	G G	G G	G G	G G	G G
57000093	G A	G A	G A	G A	G G	G A	G A	G G	A A	G A	G G	G A	G G	G G	G G	G G	G G	G A	G G	G G	G A	G A	G A	G G	G G	G A	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	A A	G G	G A	G G	G A	A A	A A	G A	A A	G A	G A	A A	A A	G A	G G	A A	G G	G G	G A	A A	A A	G G	G G	A A	A A	A A	G G	G A	A A	G A	G A	G A	G A	G A	G A	G G	G A	G G	G G	G A	G A	G A	A A	G A	G G	G A	G A
57086370	G A	G G	G A	G G	G G	G G	G G	G G	A A	G A	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	G G	G A	G G	G G	G A	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	G G	G A	G G	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G
57190246	C T	C T	C C	C T	C T	C C	C C	C C	C C	C C	C C	C C	C C	C T	C C	C C	C C	C C	C C	C C	C T	C T	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C	C T	C C	C C	C T	C C	T T	C T	T T	C C	C C	C C	C C	C C	C T	C C	C C	C C	C T	C T	C T	C T	C C	C T	C C	C T	C C	C C	C T	C C	C C	T T	C T	C T	C C	T T	C C	C T	C C	C C	T T	C C	C T	C C	C C	C C	C C	C C	C T	C C	C T	C C
57219398	G G	G G	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G G	G A	G G	G G	G A	G G	G G	G A	A A	G G	G G	G G	G G	G A	G A	G G	G G	G G	G A	G G	G G	G A	G G	G G	G A	G G	G A	G A	G A	G G	G G	G G	G G	G G	G G	G A	G G	G A	G A	G G	G G	G G	G A	G G	G A	G G	G G	G G	G A	G G	G G	G G
57271315	T T	C T	C T	C T	C C	C C	C C	C C	T T	C T	C C	C C	C C	C C	C C	C C	C C	C T	C C	C C	C T	C T	C T	C C	C C	C T	C C	C C	C T	C C	C C	C C	C C	C C	C C	C C	C C	T T	C C	C C	C T	C C	C C	C C	C T	C T	C C	C C	C C	C T	C T	C T	C C	C C	C T	C T	C T	T T	C T	C C	C C	C T	T T	C T	C T	C C	C C	C C	C C	T T	C C	T T	C C	C C	C C	C T	C C	C C	C C	C C	C C	T T	C C
57391613	T T	A T	A A	A T	A A	A A	A A	A A	T T	A A	A A	A A	A A	A A	A A	A A	A A	A T	A A	A A	A T	A T	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A T	T T	A T	A T	A A	A T	A T	A A	A T	A A	A A	A T	A T	A A	A T	A T	A A	A T	A T	A T	A T	A T	A A	A A	A A	A T	A T	A T	A T	A A	A A	A A	A T	A A	A A	T T	A T	A A	A A	A A	A A	A T	A A	A T	A A	A T	A A
57511446	A A	A G	A A	A A	A G	A A	A G	A A	A A	A A	A A	A G	A A	A G	A A	A A	A G	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A G	A A	A A	A A	A A	A A	A A	A A	G G	A A	A A	A A	A A	A G	A G	A G	G G	A A	A G	A G	A G	A A	A G	A G	A A	A G	A G	G G	A G	A G	A G	A G	G G	A G	A A	A G	A G	A G	A A	A A	G G	A G	A G	A A	A G	A A	A G	G G	A G	A G	G G	A G	A G	A A	A G
57544878	C C	T C	T T	T C	T C	T T	T T	T T	C C	T T	T T	T T	T T	T C	T T	T T	T T	T C	T T	T T	T C	T C	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T C	T T	T T	T C	T T	C C	T C	T C	T C	T T	T T	T T	T C	T C	T C	T T	T T	T C	T C	T C	T C	T C	T C	T T	T C	T C	T T	T C	T T	T T	T C	T C	T C	T T	T C	T C	C C	T T	T T	C C	T T	T C	T T	T T	T C	T C	T C	T T	T T	T C	T C
57593207	T T	T T	T A	T T	T T	T T	T A	T T	T T	T A	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T A	T T	T T	T A	T T	T T	T A	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T T	T A	T A	T T	A A	T T	T A	T A	T A	T A	T A	T T	T T	T A	T T	T A	T T	T T	T T	T T	T T	T A	T T	T T	T T	T T	T T	T T	T A	T A	T T	T T	A A	T T	T A	T T	T A	A A	T A	T T	T A	T A	T A
57899114	A A	G A	- -	G A	G A	G G	G A	G G	A A	G A	G G	G G	G G	G A	G G	G G	G G	G A	G G	G G	G A	G A	G A	G G	G G	G A	G G	G G	G A	G G	G G	G A	G A	G G	G G	G A	G G	A A	G A	G A	G A	G G	G A	G G	A A	A A	G A	G A	G A	A A	A A	G A	G A	G G	G A	G G	G A	G A	G G	G A	G G	G G	G A	G A	G A	G G	G A	G A	A A	G A	G G	A A	G A	G A	G A	G G	G A	G A	G A	G G	G A	A A	G A
57954222	C C	C T	C T	C C	T T	C C	C T	C C	T T	C T	C C	C T	C C	T T	C C	C C	C T	C C	C C	C C	C C	C C	C T	C C	C C	C T	C C	C C	T T	C C	C C	C T	C T	C C	C C	C T	T T	C C	T T	T T	C C	T T	C T	C T	T T	T T	C T	C T	C T	T T	C C	C T	C T	C T	C T	T T	C T	C C	C C	C T	T T	C T	C C	C T	C T	C T	T T	C T	T T	C T	C T	C C	C T	C T	C T	C T	C T	T T	T T	T T	C T	C T	C T
58019928	T T	T C	T C	T T	T C	T T	T C	T T	C C	T C	T T	T C	T T	C C	T T	T T	T C	T T	T T	T T	T T	T T	T C	T T	T T	T C	T T	T T	C C	T T	T T	T C	T C	T T	T T	T C	T C	T T	T C	C C	T T	T C	C C	T C	C C	C C	T C	C C	C C	C C	T C	T C	T C	T C	T C	C C	T C	T C	T C	C C	C C	C C	T T	T C	T C	T C	C C	T C	T C	C C	T C	T T	C C	T C	T C	C C	T C	T C	C C	C C	T C	T C	T C
58217723	C C	T C	T C	T C	C C	T T	T C	T T	C C	T C	T T	T T	T T	T C	T T	T T	T T	T C	T T	T T	T C	T C	T C	T T	T T	T C	T T	T T	T C	T T	T T	T C	T C	T T	T T	T C	T T	C C	T C	T C	T C	T T	T T	T T	T C	C C	T C	T T	T T	C C	T C	T C	T C	T T	T C	T T	T C	T C	T T	T C	T T	T T	T C	T C	T C	T T	T C	T C	T C	T C	T T	C C	T T	T C	T T	T T	T C	T C	T T	T T	T T	C C	T C
Dog ID	MLD105	MLD083	MLD033	MLD079	MLD027	MLD081	MLD037	MLD117	MLD029	MLD085	MLD028	MLD078	MLD030	MLD031	MLD035	MLD082	MLD066	AHT_D	MLD034	MLD084	MLD142	MLD088	MLD002	MLD222	MLD234	MLD032	MLD070	MLD455	MLD113	MLD064	MLD124	MLD025	MLD112	MLD023	MLD022	MLD438	MLD291	MLD151	MLD039	MLD443	MLD061	MLD114	MLD115	MLD024	MLD436	MLD435	MLD446	MLD103	MLD445	MLD269	MLD087	MLD102	MLD130	MLD354	AHT11063	MLD265	MLD415	MLD345	MLD413	AHT11044	AHT11058	MLD104	MLD219	MLD343	AHT11056	AHT11062	MLD369	MLD132	MLD127	MLD424	AHT11057	MLD201	MLD288	MLD453	MLD214	MLD235	MLD106	MLD134	MLD153	MLD370	MLD405	MLD242	MLD366

Supplementary Fig. 1



Cases (EORD)								Phenotype	Controls (LORD + Normal)																										
28		1		1		1		No. of dogs	4		3		3		2		2		2		2		2		2		1		1		1		1		23
a	a	b	c	a	-	-	-	Haplotype ID	a	b	a	a	a	d	b	b	c	c	b	c	b	d	a	f	a	e	d	d	b	g	b	f	a	g	- -
A	A	A	A	A	A	A	A	55.66	A	A	A	A	A	G	A	A	A	A	A	A	A	G	A	G	A	A	G	G	A	G	A	G	A	G	Minor haplotypes
T	T	T	T	T	T	T	T	55.76	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	C	T	T	T	C	
G	G	G	A	G	G	G	A	55.86	G	G	G	G	G	A	G	G	A	A	G	A	G	A	G	A	G	A	A	A	G	G	G	A	G	G	
G	G	G	G	G	G	G	G	55.94	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	A	G	G	G	G	G	A	G	A	G	A	
A	A	G	G	A	G	G	G	56.11	A	G	A	A	A	A	G	G	G	G	G	G	G	A	A	A	A	G	A	A	G	G	G	A	A	G	
G	G	A	G	G	A	G	G	56.28	G	A	G	G	G	G	A	A	G	G	A	G	A	G	G	G	G	G	G	G	A	A	A	G	G	A	
G	G	G	G	G	G	G	G	56.29	G	G	G	G	G	A	G	G	G	G	G	G	G	A	G	A	G	G	A	A	G	G	G	A	G	G	
T	T	T	C	T	T	T	C	56.36	T	T	T	T	T	T	T	T	C	C	T	C	T	T	T	T	T	T	T	T	T	T	T	T	T	T	
C	C	T	C	C	C	C	C	56.38	C	T	C	C	C	C	T	T	C	C	T	C	T	C	C	T	C	T	C	C	T	T	T	T	C	T	
A	A	G	G	A	A	A	G	56.46	A	G	A	A	A	A	G	G	G	G	G	G	G	A	A	A	A	A	A	A	G	G	G	A	A	G	
T	T	G	G	T	G	T	G	56.46	T	G	T	T	T	G	G	G	G	G	G	G	G	G	T	T	T	G	G	G	G	G	G	T	T	G	
A	A	A	G	A	A	A	G	56.51	A	A	A	A	A	A	A	A	G	G	A	G	A	A	A	A	A	G	A	A	A	G	A	A	A	G	
C	C	G	C	C	G	C	C	56.62	C	G	C	C	C	G	G	G	C	C	G	C	G	G	C	G	C	G	G	G	G	G	G	G	C	G	
								CFA15 (Mb)																											

Supplementary Fig. 2