Text A. Supporting methods and discussion.
Supporting text provides detailed information about primer design, supporting statistical methods and discussion about sampling effect, contamination, deamination, mutations, and migration.

Primer design
Primers (see Table B in S1 File) used in the study were designed with Primer3 (http://primer3.sourceforge.net/) using mtDNA [GenBank: V00654] and UTY19 [GenBank: AY936543] gene reference sequences.

Success rate of aDNA analyses
From a total of 77 ancient cattle samples subjected to mtDNA analysis, mtDNA amplification succeeded in 51 samples, of which six yielded only partial mtDNA sequences (Table A in S1 File). Table B in S1 File summarises the average amplification success and fragment lengths for the cattle mtDNA sequences. Forty-five mtDNA samples remained for statistical analyses, five from the Prehistoric, 14 from Medieval, and 26 from Post-Medieval period. The 155-bp sequence of intron 19 in the UTY gene was analysed in 67 samples and seven of them yielded the UTY19 intron sequence. The lower success rate detected in the amplification of Y-chromosomal marker was expected as Y-chromosome can only be found in males and nuclear DNA is harder to retrieve from ancient samples than mtDNA.

Definition of ancient haplogroups and sub-haplogroups
Bayesian MCMC, ML, and RMN analyses confirmed the assignment of 29 ancient haplotypes into taurine haplogroups (Fig. B in S1 File, Fig.1 in main text). To divide haplogroups further into known sub-haplogroups, we studied nucleotide differences at the defining diagnostic positions [1-4]. In total nine haplotypes were assigned to the T3b sub-group and 17 to the T3 (defining position 169 in V00654, Fig. C in S1 File). One sample was assigned to haplogroup T2 (defining positions 16057 [G>C transversion], 16185, and 16255) (Fig. C in S1 File). Two of these T2 diagnostic mutations (transitions at positions 16185 and 16255) defined one sample with partial information to haplogroup T2 (Fig. C in S1 File). One sample (H01 in Fig. C in S1 File) was assigned to belong to either haplogroup T or Q (defining nucleotide positions 16255 and 13005). Transversion C>G at position (15953) in the additional 77 bp D-loop fragment (positions 15936-16012 in V00654) confirmed the sample to belong to haplogroup Q (Fig. C in S1 File).

A Prehistoric Estonian sample assigned to haplotype H02 could not be ascribed to any of the known T subclades above. Diagnostic markers (defining positions 169, 16255, 16050, and 16113 in V00654) within the D-loop indicated that H02 belongs to the recently found sub-haplogroup T1f, having the same reversion at the diagnostic site (@16113) according to Bonfiglio et al. [5]. Within the region analysed here (486 + 181 bp) H02 differs by one mutation (a transition at position 16302) from two known sub-haplogroup T1f sequences [JN817329.1] and [JN817343.1] [5].

Additional methods; construction of phylogenetic three
The most appropriate model of DNA substitution among 88 candidate models on a Maximum
Likelihood (ML) tree under the Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC) and corrected AIC(c) was determined with jModeltest v2.1 [6]. Hasegawa-Kishino-Yano model with invariant sites (I) and gamma distributed rates (G) (HKY+I+G) with a gamma value of 0.6420 was the best fit model according to BIC and was also suggested as a second best model by AIC and AIC(c). According to AIC alone, the best-fit model of DNA sequence evolution was a Kimura 3-parameter model with unequal base frequencies (uf), invariant sites, and gamma distributed rates (TPM1uf+I+G) with a gamma value of 0.6800.

Genetic distances for the 45 ancient cattle mtDNA sequences were estimated using ML analysis with a HKY+G+I substitution model and a gamma parameter of 0.6420. To generate an initial tree for the ML analysis, a model averaged phylogeny was calculated in jModelTest v2.1 from 88 candidate models using BIC as a selection criterion, a confidence interval of 1.00, and with a 50% majority rule in the 1.00 confidence interval. ML Bootstrap values were calculated with 1000 replicates using PhyML 3.0 [7]. The tree was drawn using FigTree 1.3.1. (http://tree.bio.ed.ac.uk/software/figtree/). The sequence of Bos indicus [FJ971088] was used as an out-group in the phylogenetic analysis of haplotypes. Reference sequences for taurine haplogroups T1 [EU177841, EU177843-EU177848], T2 [EU177849-EU177859, EU177861], T3 [EU177816-EU177820, EU177824-EU177830, EU177832, EU177836 -EU177839], T1’2’3 [EU177840], T5 [EU177863 -EU177865], Q [FJ971081, FJ971082, EU177866], and R [FJ971086-FJ971087] were also included.

The ML tree topology was confirmed by Bayesian Markov Chain Monte Carlo (MCMC) analyses using MrBayes 3.2 [8]. Bayesian MCMC analyses were conducted using theHKY+G+I model. Three million generations in four independent MCMC analyses were conducted with sampling every 100 generations and the first 25 % was discarded as burn-in. When the potential scale reduction factor values approached 1.0 and the average standard deviation of split frequencies fell close to 0.01, Markov chain stationary was considered to be reached.

Post-Mortem degradation and contamination
The post mortem degradation of DNA by endogenous nucleases as well as physical oxidative and hydrolytic damages may cause errors in PCR especially in very old specimens (tens of thousands years) [9]. Samples included in the current study derived mostly from the last few hundred years with the oldest samples from the Late Bronze Age (800-600 BC). All the ancient samples included in the statistical analyses were repeatable with no signs of deamination or contamination. The ancient cattle sequences showed reasonable molecular behaviour as they were assigned to previously found taurine T and Q mega-haplogroups with most of the haplotypes having counterparts in modern cattle (discussed in the main text). In addition, post-mortem degradation of DNA should affect nucleotides and sugar-phosphate back bone of the DNA strand [9] over the whole length of the strand, not only at the diagnostic motifs. Therefore it is unlikely that haplotypes detected in the current study would be a result of post mortem degradation.

Sampling effect, newborn haplotypes, selection or migration?
Major concern was taken to take representative sample from ancient N-EBSR cattle and minimize the possibility to sample close relatives (Table A in S1 File). Ancient samples from all excavation sites where more than one individual was analysed showed variation in mtDNA haplotypes. The ancient bulls in this study were from different excavation sites and time periods, and thus it is unlikely that they were close relatives. Two exceptions are a pair of Post-
Medieval bulls from Pietarsaari, Finland (BtPie1 and BtPie2, Table A in S1 File), but in this case both paternal lines Y1 and Y2 were detected.

We realize that the sampling effect and heterochronic nature of the data may affect the results. However, the time span of sample cohorts in this study was quite narrow: around 300 years for Medieval and Post Medieval periods, which corresponds to around 60 generations and 1900 years for the Prehistoric period. The longer time period in the Prehistoric cohort is due to the inclusion of two Bronze Age samples. As all the haplotypes in the Prehistoric cohort were different (Hd=1, Table 1 in main text) a summary of the genetic diversity gave similar statistical results for the total Prehistoric cohort as for the 300 years long Iron Age period. Moreover, the time period from the end of the Post-Medieval period to the present is around 200 years. Thus, when sampling the same N-EBSR, modern cohort corresponds to changes that occurred during the last 200 years. These time frames are too short for a major accumulation of new haplotypes by mutations as shown in the median joining network (Fig. 1 in main text), where the new haplotypes detected at later time periods do not form star-like patterns around any older haplotypes, as expected if they were produced by new mutations. In addition, the bias between uncorrected and heterochrony corrected nucleotide diversity estimates were marginal (Table 1 in main text).

A sampling effect may drop out rarer haplotypes in each temporal cohort, including modern samples, which may result in stochastic fluctuations in the distribution of haplotypes between temporal periods. The expected result of a sampling effect is therefore a decrease in the diversity of each sample especially in the smallest sample sets. In this data, a \(\chi^2\) -test was performed to statistically test the possibility that results were due to a sampling effect. Significant results rejected the null hypothesis of equal frequencies between periods, and in fact revealed an opposite pattern. Due to a temporal increase in the proportion of one haplotype, and a decrease in others (Fig. 2b in main text, see results), smaller data sets of ancient cohorts displayed higher diversity with more haplogroups observed compared to modern N-EBSR cattle population (see results in main text).

Selection of breeding animals or stochastic events in breeding populations may result to increase of certain haplotypes. In this data, artificial selection may have affected the haplotype diversity of the modern cohort, as the selection for specialised breeds started around 1900 when the herd books were established. Families with desired characters may be linked to certain haplotypes. In historical periods, selection of breeding animals may have happened more by change (i.e. genetic drift). For example, the most severe starvation in N-EBSR history in 1695-1697 AD likely caused a strong population bottleneck in all domestic animals. During these three exceptionally cold years, one third of the local human population died of starvation and a large proportion of the livestock was eaten [10]. After this kind of stock loss, any surviving animal was likely used for breeding. Whether the selection is intended or caused by drift, the signatures detected from population genetics would be similar, e.g. increase of the frequency of certain haplotype(s), as detected in this study (see the main text).

After considering the stochastic fluctuation due to a sampling effect and the possibility of new haplotypes evolving by mutations within the time frame of this data, the most plausible explanation for the observed temporal changes in this data is migration. The haplotypes detected in each period likely arrived to N-EBSR from other locations rather than evolving there. The temporal increase in frequency of certain haplotypes may be due to bottlenecks and/or artificial selection of breeding animals.
References in Supporting Information

1. Troy CS, MacHugh DE, Bailey JF, Magee DA, Loftus RT, Cunningham P, et al. Genetic evidence for Near-Eastern origins of European cattle. Nature. 2001;410: 1088-1091.

2. Achilli A, Olivieri A, Pellecchia M, Uboldi C, Colli L, Al-Zahery N, et al. Mitochondrial genomes of extinct aurochs survive in domestic cattle. Curr Biol. 2008;18: 157-158.

3. Achilli A, Bonfiglio S, Olivieri A, Malusa A, Pala M, Hooshiar Kashani B, et al. The multifaceted origin of taurine cattle reflected by the mitochondrial genome. PLoS One 2009 Jun 01. doi: 10.1371/journal.pone.0005753

4. Kantanen J, Edwards CJ, Bradley DG, Viinalass H, Thessler S, Ivanova Z, et al. Maternal and paternal genealogy of Eurasian taurine cattle (Bos taurus). Heredity. 2009;103: 404-415.

5. Bonfiglio S, Ginja C, De Gaetano A, Achilli A, Olivieri A, Colli L, et al. Origin and spread of Bos taurus: New clues from mitochondrial genomes belonging to haplogroup T1. PLoS One. 2012 Jun 07. doi: 10.1371/journal.pone.0038601

6. Posada D. jModelTest: Phylogenetic model averaging. Mol Biol Evol. 2008;25: 1253-1256.

7. Guindon S, Dufayard JF, Lefort V, Anisimova M, Hordijk W, Gascuel O. New algorithms and methods to estimate maximum-likelihood phylogenies: Assessing the performance of PhyML 3.0. Syst Biol. 2010;59: 307-321.

8. Ronquist F, Teslenko M, van der Mark P, Ayres DL, Darling A, Hohna S, et al. MrBayes 3.2: Efficient Bayesian phylogenetic inference and model choice across a large model space. Syst Biol. 2012;61: 539-542.

9. Hofreiter M, Serre D, Poinar HN, Kuch M, Paabo S. Ancient DNA. Nat Rev Genet. 2001;2: 353-359.

10. Muroma S. Suuret kuolonvuodet 1696-1697. In: Karonen P, editor. “Pane leipään puolet petäjäistää” – nälkä ja pulavuodet Suomen historiassa. University of Jyväskylä: Suomen historian julkaisuja 19; 1994. pp. 25-42.

11. Pihlman A. Åbo Akademin päärakennuksen tontin kaivaukset osana Turun kaupunkiarkeologiaa. In: Seppänen L, editor. Kaupunkia pintaa syvemmältä – Arkeologisia näkökulmia Turun historiaan. Turku: Archaeologia Medii Aevi Finlandiae 9; 2003. pp. 69-76.

12. Niukkanen M. Sirpaleita suurvalta-ajan Helsingistä. Hämeenlinna: Karisto Oy; 2002.

13. Vuorinen J. Rakennukset ja rakentajat Raisio Ihalassa rautakauden lopulla ja varhaisella keskiajalla. Doctoral dissertations, University of Turku, Annales Universitatis Turkuensis C 281; 2009. Available: http://urn.fi/URN:ISBN:978-951-29-3900-8

14. Schultz EL. Mikkeli Moisio Latokallio / Moisionpelto ja Mikkelin Mlk Kyyhkylä / Porrassalmenpelto. Finnish National Board of Antiquities, Department of Archaeology; 1993.

15. Uotila K. Hautausmaan kaivaukset vuosina 2005-2007. In: Uotila K, editor. Naantalin luostarin rannassa. Stranden vid Nådendals kloster. Eura: Kåkenhus - kirjat nro 3; 2011. pp. 183-200.
16. Kallio T. Oulu, Oulun kadut: Oikokatu, Kajaaninkatu, Torikatu, Ojakatu, Saaristonkatu, Franzenin puisto. Katutöiden arkeologinen valvonta. Finnish National Board of Antiquites, Department of Monuments and Sites; 2005.

17. Kallio-Seppä T. Oulu, Lyseo 1/11/1. Kaupunkiarkeologinen koekaivaus 27.4.-21.5.2007. Finnish National Board of Antiquites, Department of Monuments and Sites; 2007.

18. Oikarinen T. Pietarsaari, 2/2-7-10, Lassfolkin kortteli (PSL-08). Kaupunkiarkeologinen pelastuskaivaus 19.5.-8.8.2008. Finnish National Board of Antiquites, Department of Monuments and Sites; 2009.

19. Poutiainen H. Sysmä Ilhananiemi. Arkeologinen koekaivaus rautakautisella muinaisjäännösalueella. Lahti City Museum and Päijät-Häme Provincial Museum; 2000.

20. Herva VP. Kaupunkiarkeologinen pelastuskaivaus, Tornion Keskikatu 29-35. University of Oulu, Archaeological laboratory; 2002.

21. Alenius T, Laakso V. Palaeoecology and archaeology of the village of Uukuniemi, Eastern Finland. Acta Borealia. 2006;23: 145-165. doi: 10.1080/08003830601026834

22. Koivisto A. Haminan kortteliin 23 koekaivaukset vuonna 2008. Finnish National Board of Antiquites, Department of Monuments and Sites; 2008.

23. Schultz E, Schultz H. Hämeenlinna Varikkoniemi – Eine späteisenzeitliche-frühmittelalterliche Kernsiedlung in Häme. Die Ausgrabungen 1986-1990. Suomen Museo: Suomen Muinaismuistoyhdistys; 1992;99: 41-85.

24. Gustavsson K. Franciskanerkloster på Kökar. Nytt ljus över medeltiden i Skärgårdshavet. Historisk Tidskrift för Finland. 1994;79: 494-518.

25. Pihlman A, Saloranta E, Ainasoja M, Hukantaival S, Lompolo V, Martiskainen H. Turku II, Pinella. Kaupunkiarkeologinen tutkimus 2010. Archives of Museum Center of Turku; 2010.

26. Hyttinen M. Tornio Suensaari YIT:N tontti (II/2/4). keskikatu 12. Kaupunkiarkeologiset koekaivaukset 24.5.-4.6.2010 ja kaivaukset 7.6.-7.7.2010. Finnish National Board of Antiquites, Department of Monuments and Sites; 2010.

27. Lang V. The bronze and early iron ages in Estonia. Estonian archaeology 3. Tartu: Tartu University Press; 2007.

28. Haak A. Archaeological investigations at Viljandi castle of the Teutonic Order and in medieval Viljandi. In: Tamla Ü, editor. Arheoloogilised välitööd Eestis = Archaeological Fieldwork in Estonia 2003. Tallinn: Muinsuskaitseamet; 2004. pp. 107-122.

29. Jaanits L, Laul S, Lõugas V, Tõnisson E. Eesti esialdus. Tallinn: Eesti Raamat; 1982.

30. Tamla T. Seliše Pada. Eesti Teadust Akaemia Toimetised. 1983;32: 302-306.

31. Tõnisson E. Eesti muinaslinnad. Muinasaja teadus. 2008;20: 266-269.

32. Valk H. Excavations in the ruins of Vastseliina Castle and on the hillforts of Urvaste and Hinniala. In: Tamla Ü, editor. Arheoloogilised Välitööd Eestis=Archaeological fieldwork in Estonia 2001. Tallinn: Muinsuskaitseamet; 2007. pp. 49-67.

33. Saksa A, Belsky S, Kurbatov A, Polyakova N, Suhonen N. New archaeological excavations in Viipuri. Results of field investigations of the 1998 - 2001 seasons and current research problems of urban history. Fennoscandia Archaeologica. 2002;19: 3-30.
34. Lehtosalo-Hilander PL. Luistari/I. The Graves. Helsinki: Suomen muinaismuistoyhdistyksen aikakauskirja 82:1; 1982.

35. Herva V. Oulu Pikisaari, historiallisien ajan kaivaustutkimus 15.-26.5.2006. University of Oulu: Archaeological laboratory; 2006.

36. Miettinen M. Pihtiputaan Hämeensaari. Uutta tietoa Keski-Suomen historiasta. In: Purhonen P, editor. Lapinraunioita ja Hiidenkiukaita. Finnish National Board of Antiquites: Department of Monuments and Sites; 1993. pp. 52-64.

37. Ruohonen J. Hirvensalmi Vahvajärvi Lampuunlahti. Arkeologisten tarkastusten historia 2010. Archives of Department of Archaeology, University of Turku; 2010.

38. Hautio M. Lieto Vanhalinna, Aittamäki. Kaivausraportti. Myöhäisrautakausisen polttoentäkalmiston tasokaivaus. Archives of Archaeological department, University of Turku; 1994.

39. Antikainen A. Vesilahti, Hinsala, Tonttimäki. Rautakausisen kalmiston kaivaus 28.7.–31.8. 1986. Archives of Archives of Archaeology, University of Turku; 1987.

40. Schultz EL. Helsinki Vartiokylä Linnavuori. Keski-Apulaisen puolustusvarustuksen kaivaus. Archives of Helsinki City Museum; 2003.

41. Lahti E. Enontekiön Markkina. Markkinapaikan elämää arkeologisen tutkimuksen perusteella. MA Thesis, Department of Archaeology, University of Helsinki; 2004.

42. Leppäaho J. Mikkelinpitäjän Invaliidikoti Kyyhkylän (ent. Kyyhkylän kartano) Poritassaalmen pellolla oleva rautakausinen kalmisto. Finnish National Board of Antiquites: Department of Monuments and Sites; 1939.

43. Uotila K. Turun Aboa Vetus -museon (Rettigin palatsin) kaivaukset vuosina 2009-2010. SKAS 2011. pp. 3-14.

44. Poutiainen H. Sulkava Itlahden Hovi Keskipelto. Rautakausisen muinaisjäännöksen koekaivaus kesäkuussa 1992. Finnish National Board of Antiquites: Department of Monuments and Sites; 1993.

45. Kumpulainen M, Miettinen M. Pihtipudas Niemenharju 1 Niemi. Finnish National Board of Antiquites: Department of Monuments and Sites; 2008.

46. Luoto K. Sastamala Vehmaa (Vehmaa) kylätonttun pelastuskaivaus 2009. Archives of Pirkanmaa Provincial Museum; 2010.

47. Peets J, Allmäe R, Maldre L. Archaeological investigations of Pre-Viking Age burial boat in Salme village at Saaremaa. Arheoloogilised välitööd Eestis = Archeological fieldwork in Estonia 2010 Tallinn: Muinsuskaitseinspektsioon; 2011: 29-48.

48. Valk H. Aruanne arheoloogilistest kaevamistest Viljandi Jaani kiriku kommunikatsioonidetrassil. Tallinn: Manuscript in the archaeology archive of Tartu University; 1991.

49. Valk H. Aruanne arheoloogilistest uurimistöödest Viljandis Suusahüppemää piirkonnas 04.08.-06.09. Tallinn: Manuscript in the archaeology archive of Tartu University; 1999.

50. Vaba A, Valk H. Prehistoric settlements in Viljandi. New evidence. In: Tamla Ü, editor. Arheoloogilised välitööd Eestis=Archaeological field works in Estonia 2001. Tallinn: Muinsuskaitseinspektsioon; 2002. pp. 82-90.
51. Haak A, Valk H. Archaeological investigations of medieval and post-medieval Viljandi. In: Tamla Ü, editor. Arheoloogilised välitööd Eestis=Archaeological field works in Estonia 2001. Tallinn: Muinsuskaitseinspeksioon; 2002. pp. 91-104.

52. Valk H. Excavations in Viljandi: New data about the final period of Iron Age and the besieging of 1223. In: Tamla Ü, editor. Arheoloogilised välitööd Eestis=Archaeological field works in Estonia 2002. Tallinn: Muinsuskaitseamet; 2003. pp. 56-70.

53. Bonfiglio S, Achilli A, Olivieri A, Negrini R, Colli L, Liotta L, et al. The enigmatic origin of bovine mtDNA haplogroup R: Sporadic interbreeding or an independent event of *Bos primigenius* domestication in Italy? PLoS One 2010 Dec 28. doi: 10.1371/journal.pone.0015760

54. Telldahl Y, Svensson E, Götherström A, Storå J. Typing late prehistoric cows and bulls - osteology and genetics of cattle at the Eketorp Ringfort on the Öland island in Sweden. PLoS One 2011 Jun 22. doi: 10.1371/journal.pone.0020748

55. Svensson E, Götherström A. Temporal fluctuations of Y-chromosomal variation in *Bos taurus*. Biol Lett. 2008;4: 752-754.

56. Götherström A, Anderung C, Hellborg L, Elburg R, Smith C, Bradley DG, et al. Cattle domestication in the Near East was followed by hybridization with aurochs bulls in Europe. Proc Biol Sci. 2005;272: 2345-2350.

57. Edwards CJ, Ginja C, Kantanen J, Pérez-Pardal L, Tresset A, Stock F, et al. Dual origins of dairy cattle farming - evidence from a comprehensive survey of European Y-chromosomal variation. PLoS One. 2011 Jan 06. doi: 10.1371/journal.pone.0015922

58. Svensson EM, Häslar S, Nussbaumer M, Rehazek A, Omrak A, et al. (2014) Medieval cattle from Bern (Switzerland): An archaeozoological, genetic and historical approach. Schweiz Arch Tierheilkd 156: 17-26.
Excavation sites for Ancient cattle samples in Finland, Estonia, and Vyborg in Western Russia from the Late Bronze Age (in black triangle), Late Iron Age (in black dot), Medieval (in grey square), and Post-Medieval (in white dot) periods are indicated; only the excavation sites of the samples included in the statistical analyses are shown (for more information see the main text).
Fig. B. Maximum Likelihood tree of mtDNA haplotype sequences found within ancient cattle and modern reference sequences. Branch topography supported by bootstrap values (on top of the branch) and Bayesian posterior probabilities (under the branch) greater than 50% are indicated. The number of ancient samples sharing the haplotype is given in parentheses. Major haplogroups (T1, T2, T3, T5, Q and R) are defined by inclusion of 43 modern reference haplotypes. The tree is rooted with a sequence of zebu (*Bos indicus*).
Fig. C. mtDNA haplotypes found in 31 Finnish, 8 Russian and 7 Estonian ancient cattle.
Vertical numbers indicate the SNP positions relative to the reference sequence [GenBank:V00654].
Sequences were amplified from 12 911 to 13 091 and from 16031 to 178. Only the variable sites are indicated. A dot (.) indicates base similar to reference sequence. A question mark indicates a position not amplified. NA indicates position, haplotypes and haplogroups not analysed. Thirty haplotypes are indicated as H01-H30. Finally the frequency of each haplotype is given.
Table A. Ancient samples studied in this article.
Identity codes used in present aDNA analysis (Sample ID) and radiocarbon analyses (Hela-codes), archaeological site (Site), town (Location) where samples were excavated and museum ID, bone type, and sex according to osteological analysis. Radiocarbon date (Radiocarbon date BP (± 1σ)) and calibrated date (with confidence interval of 95%) or dating by the context (DBC) and corresponding historical period (Dating). Only unclear contexts were radiocarbon dated (see text for details). Success rate in sequence analysis of the mtDNA D-loop (mtDNA) and Y-chromosomal UTY19 marker (UTY19). Total number of extractions (N extracts), PCR reactions (PCR), amplicons (N amplicons), and aDNA laboratories (aDNA laboratory) for each sample. Samples not analysed (-).

| Sample ID | Location       | Site            | Museum ID* | Bone type | Sex       | Radiocarbon date       | Dating      | mtDNA | UTY19 | N extracts | PCR | N amplicons | aDNA laboratory** |
|-----------|----------------|-----------------|------------|-----------|-----------|------------------------|-------------|-------|-------|------------|-----|-------------|-------------------|
| BtAA1     | Turku, Finland | Åbo Akademi     | TMM 21816:14 | Metacarpal | Female    | DBC                   | Post-Medieval | Yes   | No    | 2          | 15  | 20          | SU, MTT, HU        |
| BtAA2     | Turku, Finland | Åbo Akademi     | TMM 21816:14 | Metacarpal | Female    | DBC                   | Post-Medieval | Yes   | No    | 2          | 13  | 20          | SU, MTT, HU        |
| BtAA3     | Turku, Finland | Åbo Akademi     | TMM 21816:104 | Metacarpal | Female    | DBC                   | Medieval     | Yes   | No    | 3          | 23  | 20          | SU, MTT, HU        |
| BtAA4     | Turku, Finland | Åbo Akademi     | TMM 21816:104 | Metacarpal | Male      | DBC                   | Medieval     | Yes   | Yes, Y2 | 3          | 26  | 27          | SU, MTT, HU        |
| BtAA5, Hela-2590 | Turku, Finland | Åbo Akademi | TMM 21816:513B | Metacarpal | Female    | 606 ± 30 BP, 1296-1406 cal AD | Medieval     | Yes   | No    | 3          | 17  | 25          | SU, MTT, HU        |
| BtAA6, Hela-2589 | Turku, Finland | Åbo Akademi | TMM 21816:513B | Metacarpal | Female    | 740 ± 30 BP, 1223-1291 cal AD | Medieval     | Yes   | No    | 2          | 17  | 19          | SU, MTT, HU        |
| BtHel1    | Helsinki, Finland | Snellmaninkatu | KM2000002:2 | Metacarpal | Female    | DBC                   | Post-Medieval | Yes   | No    | 3          | 17  | 25          | SU, MTT, HU        |
| BtHel2    | Helsinki, Finland | Snellmaninkatu | KM2000002:2229 | Metacarpal | Female    | DBC                   | Post-Medieval | Yes   | No    | 2          | 14  | 20          | SU, MTT, HU        |
| BtM2, Hela-2546 | Raisio, Finland | Mulli           | TYA* 631:410a | Metatarsal |          | 984 ± 30 BP, 991-1058 cal AD (50.1%), 1076-1155cal AD (45.3%) | Iron Age    | Yes   | No    | 4          | 18  | 26          | SU, MTT, HU        |
| BtMik1, Hela-2550 | Mikkeli, Finland | Moisio Latokartano [14] | KM 28014:38 | Tooth |          | 567 ± 30 BP, 1305-1365cal AD (55.4%), 1384-1425 cal AD (40.0%) | Medieval (context: Iron) | Yes   | No    | 2          | 13  | 17          | SU, MTT, HU        |
| BtNaal1, Hela-2580 | Naantali, Finland | Luostari | KM 2005034:196 context 986 | Metacarpal |          | 431 ± 30 BP, 1420-1496cal AD (91.7%), 1601-1615cal AD (3.7%) | Medieval     | Yes   | No    | 3          | 17  | 26          | SU, MTT, HU        |
| BtOul1    | Oulu, Finland   | Kajaaninkatu     | KM 20004081:78 | Calcaneus |          | DBC                   | Post-Medieval | Yes   | Yes, Y2 | 3          | 36  | 24          | SU, MTT, HU        |
| BtOul2    | Oulu, Finland   | Lyseo           | KM 2007031:373 | Radius |          | DBC                   | Post-Medieval | Yes   | No    | 3          | 26  | 15          | SU, MTT, HU        |
| BtPie1    | Pietarsaari, Finland | Lassfolk | KM 2008051:398 | Metacarpal | Male      | DBC                   | Post-Medieval | Yes   | Yes, Y2 | 3          | 36  | 24          | SU, MTT, HU        |
| BtPie2    | Pietarsaari, Finland | Lassfolk | KM 2008051:3987 | Metacarpal | Unsure    | DBC                   | Post-Medieval | Yes   | Yes, Y1 | 3          | 26  | 28          | SU, MTT, HU        |
| Sample ID | Location       | Site                  | Museum ID* | Bone type | Sex       | Radiocarbon date | Dating          | aDNA       | mtDNA | UTY19 | N extracts | PCR | N amplicons | aDNA laboratory** |
|-----------|----------------|-----------------------|------------|-----------|-----------|------------------|----------------|------------|-------|-------|------------|-----|-------------|------------------|
| BrSys1, Hela-2549 | Sysmä, Finland | Ihanaemi [19]          | KM 3292:552 | Talus   |           | 637 ± 30 BP, 1284-1330cal AD (40.5%), 1340-1390cal AD (54.9%); Medieval | Yes             | unreadable | 3       | 27     | 18         | SU | MTT, HU     |                  |
| BrTor1    | Tornio, Finland | Keskitaku [20]         | KM 2002081: SY7010 | Metacarpal | Female    | DBC | Post-Medieval | Yes, No | 3       | 13     | 22         | SU | MTT, HU     |                  |
| BrTor2    | Tornio, Finland | Keskitaku [20]         | KM 2002081: SY7010 | Metacarpal | Female    | DBC | Post-Medieval | Yes, No | 2       | 16     | 19         | SU | MTT, HU     |                  |
| BrUuk1, Hela-2583 | Uukuniemi, Finland | Papinniem [21]      | KM 2001058:187 | Metacarpal |           | 238 ± 30 BP, 1527-1554 cal AD (4.4%), 1632-1682 cal AD (50%), 1738-1753 cal AD (1.8%), 1762-1803 cal AD (30.6%), 1937-1955 cal AD (8.6%); Post-Medieval | Yes, unreadable | 3       | 28     | 29         | SU | MTT, HU     |                  |
| BrUuk3, Hela-2581 | Uukuniemi, Finland | Papinniem [21]      | KM 98040:413 | Metacarpal | Female    | 350 ± 30 BP, 1457-1633cal AD; Post-Medieval | Yes             | unreadable | 2       | 18     | 23         | SU | MTT, HU     |                  |
| BrHam2    | Hamina, Finland | Korttel 23 (kasarnu) [22] | KM 20008042:170 | Humerus |           | DBC | Post-Medieval | Yes, No | 3       | 16     | 20         | MTT | HU         |                  |
| BrHame1, Hela-2690 | Hameenlinna, Finland | Varikkoniemi [23] | KM 2742:1254 | Pd 4 max | | 985 ± 30 BP, 990-1066cal AD (51.2%), 1075-1155 cal AD (44.2%); Iron Age | Yes             | No       | 2       | 13     | 22         | MTT | HU         |                  |
| BrKok1, 2592 | Kökar, Åland, Finland | Kloster [24] | ÅM 640 | Metatarsal | | 324 ± 30 BP, 1479-1645cal AD; Post-Medieval | Yes             | No       | 3       | 13     | 18         | MTT | HU         |                  |
| BrKok2, Helia-2591 | Kökar, Åland, Finland | Kloster [24] | ÅM 640 | Metatarsal | | 384 ± 30 BP, 1443-1524cal AD (64.8%), 1558-1631cal AD (30.6%); Post-Medieval | Yes             | No       | 3       | 15     | 21         | MTT | HU         |                  |
| BrKok3    | Kökar, Åland, Finland | Kloster [24] | ÅM 640 | Metatarsal | | DBC | Post-Medieval | Yes             | Yes, Y2  | 3       | 17     | 25         | MTT | HU         |                  |
| BrKok4    | Kökar, Åland, Finland | Kloster [24] | ÅM 677:542 | Metatarsal | | DBC | Post-Medieval | Yes             | No       | 3       | 26     | 15         | MTT | HU         |                  |
| BrPin10   | Turku, Finland   | Pinella [25]           | TMM 22600: M252.216 | Ct      | | DBC | Medieval       | Partial         | No       | 3       | 22     | 8          | MTT |            |                  |
| BrTor3    | Tornio, Finland  | YTT [26]               | KM 2010045: 1426 | Metacarpal | Female    | DBC | Post-Medieval | Yes             | No       | 2       | 16     | 20         | MTT | HU         |                  |
| BrTor4    | Tornio, Finland  | YTT [26]               | KM 2010045: 1475 | Metacarpal | Female    | DBC | Post-Medieval | Yes             | No       | 3       | 26     | 32         | MTT | HU         |                  |
| BrTor5    | Tornio, Finland  | YTT [26]               | KM 2010045:1689 | Metacarpal |           | DBC | Post-Medieval | Yes, Yes, Y2 | 2       | 21     | 15         | MTT |            |                  |
| BrTor6    | Tornio, Finland  | YTT [26]               | KM 2010045:1689 | Metacarpal |           | DBC | Post-Medieval | Yes             | No       | 2       | 17     | 19         | MTT | HU         |                  |
| BaAsv1    | Asva, Island of Saaremaa, Estonia | Settlement site [27] | AI 4366 | Metatarsal | | DBC | Late Bronze Age | Yes             | No       | 2       | 24     | 24         | MTT | HU         |                  |
| BrOrd1    | Viljandi, Estonia | Order castle [28]      | VM 10922 | Tooth, Molar | | DBC | Medieval       | Yes             | No       | 2       | 12     | 18         | MTT | HU         |                  |
| BrOte1    | Otepää, Estonia  | Hillfort [20]          | AI 4036 | Mandible | | DBC | Medieval       | Yes             | No       | 2       | 12     | 18         | MTT | HU         |                  |
| Sample ID | Location          | Site                      | Museum ID* | Bone type | Sex | Radiocarbon date | Dating        | mtDNA | UTY19 | N extracts | PCR | N amplicons | aDNA laboratory** |
|-----------|-------------------|---------------------------|------------|-----------|-----|------------------|---------------|-------|-------|------------|-----|-------------|-------------------|
| BtPad1    | Pada, Estonia     | Settlement site           | AI 5200    | Tooth, Molar | N   | DBC              | Iron Age      | Yes   | No    | 3          | 19 | 25          | MTT, HU           |
| BrRid1    | Ridala, Island of Saaremaa, Estonia | Fortified settlement site | AI 4261    | Metatarsal  | N   | DBC              | Late Bronze Age | Yes   | No    | 2          | 12 | 20          | MTT, HU           |
| BrSoon1   | Soontegana, Estonia | Hillfort                 | PIMu 2 / A 2434 | Metacarpal | No  | DBC              | Iron Age      | Unrepeatable | No | 3    | 20          | 19 | MTT, HU     |
| BrVast1   | Vastseelina, Estonia | Castle                   | TU 1435    | Metatarsal  | No  | DBC              | Post-Medieval | Yes   | No    | 2          | 14 | 24          | MTT, HU           |
| BrVast2   | Vastseelina, Estonia | Castle                   | TU 1499    | Tooth, Molar | N   | DBC              | Post-Medieval | Yes   | No    | 3          | 12 | 20          | MTT, HU           |
| BrVuip1   | Vyborg, Russia    | Vyborg                   | RAS, Level 13 | Metatarsal | N   | DBC              | Medieval      | Yes   | No    | 2          | 12 | 15          | MTT, HU           |
| BrVuip2   | Vyborg, Russia    | Vyborg                   | RAS, Level 14 | Metatarsal | N   | DBC              | Medieval      | Yes   | No    | 2          | 13 | 15          | MTT, HU           |
| BrVuip3   | Vyborg, Russia    | Vyborg                   | RAS, Level 14 | Metatarsal | N   | DBC              | Medieval      | Yes   | No    | 2          | 12 | 16          | MTT, HU           |
| BrVuip4   | Vyborg, Russia    | Vyborg                   | RAS, Level 13 | Metatarsal | N   | DBC              | Medieval      | Yes   | Yes, Y2| 3          | 28 | 32          | MTT, HU           |
| BrVuip5   | Vyborg, Russia    | Vyborg                   | RAS, Level 13 | Metatarsal | N   | DBC              | Medieval      | Yes   | No    | 3          | 15 | 22          | MTT, HU           |
| BrVuip6   | Vyborg, Russia    | Vyborg                   | RAS, Level 2 | Metatarsal  | N   | DBC              | Post-Medieval | Yes   | No    | 3          | 11 | 20          | MTT, HU           |
| BrVuip7   | Vyborg, Russia    | Vyborg                   | RAS, Level 2 | Metatarsal  | N   | DBC              | Post-Medieval | Yes   | No    | 3          | 16 | 18          | MTT, HU           |
| BrVuip8   | Vyborg, Russia    | Vyborg                   | RAS, Level 2 | Metatarsal  | N   | DBC              | Post-Medieval | Yes   | No    | 2          | 13 | 16          | MTT, HU           |
| BrLui1    | Eura, Finland     | Luistari                 | KM 23346:461, 462 (grave 494) | Tooth  | N   | DBC              | Iron Age      | No    | No    | 2          | 9  | 0           | SU                |
| BrM1, Hela-2545 | Raisio, Finland | Mulli | TYA^m 619:903a | Metatarsal | N   | 990 ± 30 BP, 988-1054 cal AD (57.0%), 1079-1154 cal AD (38.4%) | Iron Age | No    | No    | 2    | 7  | 0           | SU                |
| BrM3, Hela-2547 | Raisio, Finland | Mulli | TYA^m 619:950a | Metatarsal | N   | 953 ± 30 BP, 1023 1155 cal AD | Iron Age | No    | No    | 2    | 9  | 0           | SU                |
| BrM4, Hela-2548 | Raisio, Finland | Mulli | TYA^m 619:864d | Metatarsal | N   | 990 ± 30 BP, 988-1054 cal AD (57.0%), 1079-1154 cal AD (38.4%) | Iron Age | No    | No    | 2    | 9  | 0           | SU                |
| BrOul3    | Oulu, Finland     | Pikkaahti                | KM 2006047:62, SY 5 | Calcaneus | N   | DBC              | Post-Medieval | No    | No    | 2    | 9  | 0           | SU                |
| BrPih1, Hela-2579 | Pihtipudas, Finland | Hämeensaari | KM 27198:39 | Tibia | N   | 323 ± 30 BP, 1479-1645 cal AD | Post-Medieval | No    | No    | 2    | 9  | 0           | SU                |
| BrUuk2, Hela-2582 | Uukuniemi, Finland | Papinniemi | KM 2001058:189 | Metacarpal | N   | NA, DBC          | Post-Medieval | No    | No    | 2    | 9  | 0           | SU                |
| BrHi1, Hirvensalmi, Valvajärvi, Lampuunlahti | No ID, collected Rib | 363 ± 30 BP, Post- | No    | No    | 2    | 9  | 0           | MTT                |
| Sample ID | Location | Site | Museum ID* | Bone type | Sex | Radiocarbon date | Dating | aDNA |
|-----------|----------|------|------------|-----------|-----|-----------------|--------|------|
| Hela-2588 | Finland  |      | [37]       | from surface |     | 1449-1529 cal AD (50.1%), 1544-1634 cal AD (45.3%) | Medieval | MTT |
| BtLie1, Hela-2587 | Lieto, Finland | Aittamäki | [38] | TYA 597:102 | Metatarsal | 1814 ± 44 BP, 84-263 cal AD (83.8%), 277-330 cal AD (11.6%) | Iron Age | MTT |
| BtVes1, Hela-2578 | Vesilahden, Finland | Hinsala, Tonttimäki | [39] | TYA 335:330 | Phalanx 2 | MODERN | Modern (context: Iron) | MTT |
| BtVar2 | Helsinki, Finland | Vartiokylä | [40] | KM 33374:1010 | Metatarsal | DBC | Medieval | MTT |
| BtEra1 | Enontekiö, Finland | Markkina | [41] | KM 32131:1025 | Humerus | DBC | Post-Medieval | MTT |
| BtVar1 | Helsinki, Finland | Vartiokylä | [40] | KM 33374:1018 | Metatarsal | DBC | Medieval | MTT |
| BtMik2 | Mikkeli, Finland | Porrasalmenpelto | [42] | KM 10629: 50 | Pd4 mand | DBC | Iron Age | MTT |
| BtMik4 | Mikkeli, Finland | Porrasalmenpelto | [42] | KM 10629:70 | Phalanx 1 | DBC | Iron Age | MTT |
| BtPin1 | Turku, Finland | Pinella | [25] | TMM 22600: M252, 217 | Ct | DBC | Medieval | MTT |
| BtAbo18 | Turku, Finland | Aboa Vetus | [43] | KM20100001.71 S 1139 luode 2 | Mandible | DBC | Medieval | MTT |
| BtHäm2 | Hämeenlinna, Finland | Varikkoniemuri | [23] | KM27424: 1254 | Phalanx 1 | DBC | Iron Age / Early Medieval | MTT |
| BtSal1 | Sulkava, Finland | Keskipelto | [44] | KM27658:8 | Pars petrosa | DBC | Iron Age | MTT |
| BtPin4 | Turku, Finland | Pinella | [25] | TMM 23600: M215, 143 | Metacarpal Male | DBC | Medieval | MTT |
| BtPin8 | Turku, Finland | Pinella | [25] | TMM 22600: M240, 168 | Metacarpal | DBC | Medieval | MTT |
| BtHam1 | Hamina, Finland | Korttel 23 (kasarni) | [22] | KM 20000824: 170 | Humerus | DBC | Post-Medieval | MTT |
| BtPh2 | Pihlajamaa, Finland | Niemi | [45] | KM27198:39 | Phalanx 1 | DBC | Post-Medieval | MTT |
| BtSas1 | Sastamala, Finland | Vehmaankyläntunturi | [46] | KM 2000904 | Metacarpal | DBC | Post-Medieval | MTT |
| BtSall | Salme, Island of Saaremaa, Estonia | Boat burial (Salme1) | [47] | SM 10601 | Humerus | DBC | Iron Age, Pre-Viking Age | MTT |
| BtJaa1 | Viljandi, Estonia | St John’s Church | [48] | VM 10258 | Tooth, Molar | DBC | Medieval | MTT |
| BtKiv1 | Viljandi, Estonia | Kivimägi | [49] | VM 10742 | Tooth, Molar | DBC | Iron Age | MTT |
| BtVilm1 | Viljandi, Settlement site | VM 10847 | Tooth, Molar | DBC | Iron Age | Partial | MTT |
| Sample ID | Location   | Site                 | Museum ID* | Bone type    | Sex | Radiocarbon date | Dating      | mtDNA | UTY19 | N extracts | PCR | N amplicons | aDNA laboratory** |
|-----------|------------|----------------------|------------|--------------|-----|------------------|-------------|-------|-------|------------|-----|-------------|-------------------|
| BtLos1    | Viljandi,  | Lossi street         | VM 10848   | Metatarsal   | DBC | Medieval         | Partial No  | No    | 1     | 10         | 6   | MTT         |                   |
|           | Estonia    | [51]                 |            |              |     |                  |             |       |       |            |     |             |                   |
| BtSuu1    | Viljandi,  | Ski-jumping hill     | VM 10877   | Tooth, Molar | DBC | Iron Age         | No No       | 2     | 10    | 0          | MTT | MTT         |                   |
|           | Estonia    | [52]                 |            |              |     |                  |             |       |       |            |     |             |                   |

*Museums abbreviations: AI = Institute of History, Tallinn University, Estonia, VM = Museum of Viljandi, Estonia, PäMu = Pärnu Museum, Estonia, TU = University of Tartu, Estonia, SM = Saaremaa Museum, Estonia, RAS = Institute of History of Material Culture, Russian Academy of Sciences, St Petersburg, Russia, KM = The National Board of Antiquities, Finland, KMAV = Samples are held at the Aboa Vetus Museum, Turku, Finland, ÅM = Ålands Museum, Finland, TMM = The Museum Centre of Turku, Finland, TYA = Archives of Department of Archaeology, University of Turku, Finland, TYAMR = Samples are held at the Museum of Raisio (Harkko), Finland

**Laboratories participating in aDNA analyses: SU= Stockholm University, Sweden, MTT= Agrifood research Finland, Finland, and HU= Helsinki University, Finland.
Table B. Summary of primers.

Primers, annealing temperatures (AT), fragment lengths, nucleotide positions for amplification start and average amplification success in aDNA analysis in 77 ancient samples. Nucleotide positions showing the mtDNA and UTY19 gene amplifications are given according to sequences of [GenBank:V00654] and [GenBank:AY936543], respectively.

| Fragment       | Primer                                   | AT | Fragment length | Start Position (according to V00654) | Average amplification success |
|----------------|------------------------------------------|----|-----------------|--------------------------------------|------------------------------|
| D-loop fragment 1 | For 5’CATTAATTATATGCCCCATGC 3’<br>Rev 5’ CTAGCGGGTTGCTGGTTTC 3’ | 58 | 188             | 16 009<br>16 178                      | 52 %                         |
| D-loop fragment 2 | For 5’ TCACGAGCTTAATTACCATGC 3’<br>Rev 5’ TATGTGTGAGCATGGGCTGA 3’ | 60 | 219             | 16 152<br>13                      | 57 %                         |
| D-loop fragment 3 | For 5’ AGACATCTCGATGGACTAATGG 3’<br>Rev 5’ TGTCCTGTGACCATTGACTG 3’ | 60 | 212             | 16 325<br>179                      | 56 %                         |
| D-loop SNP T5   | For 5’CCGTTTCTATCCCCCTCACAG3’<br>Rev 5’AAAAGGCGTGGGTACAGATG3’ | 55 | 221             | 12 891<br>13 092                   | 66 %                         |
| **Bos Taurus UTY19** | For 5’AGCTCCAGAATATTTTCACCTGACT3’<br>Rev 5’GAAGGCAATGAGAGGACGACA3’ | 55 | 155             | 312 (in AY936543)<br>442 (in AY936543) | *                            |

* amplification success not indicated, as the sex of all of the samples were unknown
Table C. Distribution of ancient mtDNA haplotypes found in the present and previous studies.

Haplotypes shared between ancient cattle data, from this study, and the same region (245 bp) available in previous studies. The total number of samples in each study is shown (N). The distribution of the haplotypes is also presented in Fig.1; where the remaining, unshared haplotypes are shown in white (other haplotypes). Analyses of modern data can be found following the references given in the right column.

|                  | H05 | H06 | H11 | H17 | H24 | H26 | H09 | H10 | H14 | H20 | H25 | H30 | H12 | H01 | H03 | H22 | H19 | H23 | H29 | H15 | H27 | H16 |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| **North-East Baltic Sea Region** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Prehistory       | 5   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | This study |
| Medieval         | 14  | 4   | 1   | 1   | 2   |     |     |     |     |     |     |     |     |     |     | 1   |     |     |     |     |     |     |     |     | 3   | 1   | This study |
| Post Medieval    | 26  | 9   | 1   | 1   | 2   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   |     |     |     |     |     |     |     |     |     |     |     |     | This study |
| Northern Finncattle | 8   | 4   |     |     |     |     |     |     |     |     |     |     |     |     |     | 1   |     |     |     |     |     |     |     |     |     |     | [4] |
| Western Finncattle | 7   | 3   |     |     |     |     |     |     |     |     |     |     |     |     |     | 2   |     |     |     |     |     |     |     |     |     |     | [4] |
| Eastern Finncattle | 25  | 18  | 1   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4,53] |
| Estonian Red     | 5   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
| Estonian Native  | 4   | 4   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
| **Scandinavia**  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Jutland breed    | 9   | 4   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1   | [4] |
| Danish Red       | 9   | 3   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
| Blacksided Trondheim | 5   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 3   |     | [53] |
| Telemark         | 5   | 3   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [53] |
| Vestland Red Polled | 5   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [53] |
| Swedish Red-and-White | 5   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
| Fjall Cattle     | 6   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
| Swedish Mountain Cattle | 4   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
| Swedish Red Polled | 15  | 5   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 2   | [4,53] |
| Ringamala Cattle | 7   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
| Bohus Poll       | 6   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4] |
|                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                         | N  | H26 | H29 | H30 | H31 | H32 | H33 | H34 | H35 | Reference |
|-------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|
| **Vane Cattle**         | 5  |     |     |     |     |     |     |     |     | [4]       |
| **West Europe**         |    |     |     |     |     |     |     |     |     |           |
| Faroe Islands Cattle    | 14 | 11  |     |     |     |     |     |     |     | [4]       |
| Swedish Holstein-Friesian | 5 |     |     |     |     |     |     |     |     | [4]       |
| Finnish Holstein-Friesian | 7 | 5   |     |     |     |     |     |     |     | [4]       |
| Finnish Ayrshire        | 7  | 5   |     |     |     |     |     |     |     | [4]       |
| Jersey                  | 18 | 7   |     |     |     |     |     |     |     | [53]      |
| Italian Friesian        | 190| 65  | 1   |     |     |     |     |     |     | [2,53]    |
| Holstein                | 2  |     |     |     |     |     |     |     |     | [53]      |
| Estonian Holstein-Friesian | 1 |     |     |     |     |     |     |     |     | [4]       |
| **South Europe**        |    |     |     |     |     |     |     |     |     |           |
| Simmental               | 9  | 1   |     |     |     |     |     |     |     | [53]      |
| Swiss Brown             | 1  | 1   |     |     |     |     |     |     |     | [53]      |
| Limousine               | 53 | 11  | 1   |     |     |     |     |     |     | [5,53]    |
| Betizuak                | 2  | 1   |     |     |     |     |     |     |     | [2]       |
| Agerolese               | 37 | 2   |     |     |     |     |     |     |     | [5,53]    |
| Burlina                 | 1  | 1   |     |     |     |     |     |     |     | [53]      |
| Cabannina               | 43 | 14  | 2   |     |     |     |     |     |     | [2,53]    |
| Calvana                 | 29 | 15  |     |     |     |     |     |     |     | [5,53]    |
| Chianina                | 323| 69  | 2   |     |     |     |     |     |     | [2,5,53]  |
| Cinisara                | 78 | 13  |     |     |     |     |     |     | 3   | [2,5,53]  |
| Grey Alpine             | 45 | 13  |     |     |     |     |     |     |     | [53]      |
| Grey Steppe             | 19 | 2   |     |     |     |     |     |     |     | [5,53]    |
| Italian Brown           | 10 | 2   |     |     |     |     |     |     |     | [5,53]    |
| Italian Podolian        | 84 | 22  |     |     |     |     |     |     | 2   | [5,53]    |
| Italian Red Pied        | 126| 31  | 2   | 1   |     |     |     |     |     | [5,53]    |
| Breed       | N  | H26 | H09 | H10 | H14 | H20 | H25 | H30 | H12 | H01 | H03 | H22 | H19 | H23 | H29 | H15 | H27 | H16 | Reference |
|-------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| Marchigiana | 150|     | 30  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [5,53] |
| Maremmana   | 28 | 5   |     | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [2,5,53] |
| Modicana     | 14 | 9   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [2,5,53] |
| Mucca Pisana | 33 | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [53]   |
| Ottonese    | 7  | 3   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [53]   |
| Pettiazza   | 36 | 15  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [2,53] |
| Piedmontese  | 72 | 23  |     | 3   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     | [2,53] |
| Reggiana    | 40 | 4   |     |     | 1   | 2   |     |     |     |     |     |     |     |     |     |     |     |     | [5,53] |
| Rendena     | 2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1   | [2,53] |
| Romagnola   | 231| 36  |     |     |     |     | 1   |     |     |     |     |     | 1   |     |     |     |     | 3   | [5,53] |
| Valdostana  | 54 | 9   | 1   | 1   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [2,53] |
| Bianca Val Padana | 4 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [53]   |
| Garfagnina  | 2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [53]   |
| Savoiarda   | 2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [53]   |
| Podolica    | 2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [3]    |
| **South-East Europe** | | | | | | | | | | | | | | | | | | | | |
| Busa        | 8  | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4]    |
| Bulgarian Grey | 30 | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 7   | [53]   |
| Podolian    | 11 | 4   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4]    |
| Greek       | 1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [2]    |
| **East Europe** | | | | | | | | | | | | | | | | | | | | |
| Byelorussian Red | 8 | 4   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4]    |
| Ukrainian Grey | 8  | 8   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | [4]    |
| Ukrainian Whitehead | 10 | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 2   | [4]    |
| **West Russia** | | | | | | | | | | | | | | | | | | | | |
| Kholmogory  | 14 | 8   | 1   |     | 4   |     | 1   |     |     |     |     |     |     |     |     |     |     |     |     | [4]    |
|                   | H05 | H06 | H11 | H17 | H24 | H07 |
|-------------------|-----|-----|-----|-----|-----|-----|
| Yaroslavl         | 10  | 8   | 2   |     |     |     |
| Red Gorbatov      | 2   |     |     |     |     | 1   |
| **Near East and Central Asia** |     |     |     |     |     |     |
| Ala-Tau           | 5   | 2   |     |     |     | 1   |
| Iraqi             | 9   | 1   |     |     |     |     |
| Iranian           | 7   | 1   |     |     |     |     |
| Bushuev           | 4   |     |     |     |     |     |
| **Middle Russia** |     |     |     |     |     |     |
| Pechora type      | 9   | 6   | 2   |     |     |     |
| Yurino            | 4   | 1   |     |     |     |     |
| Suksun            | 10  | 1   | 2   | 1   |     | 1   |
| Istoben           | 9   | 4   |     | 1   |     |     |
| **Siberia**       |     |     |     |     |     |     |
| Yakutian Cattle   | 24  | 14  | 7   | 2   | 35  | 8   |
|                   |     |     | 22  | 3   | 4   | 4   |
|                   |     |     | 8   | 2   | 22  | 3   |
|                   |     |     | 3   | 4   | 4   | 3   |
|                   |     |     | 2   | 5   | 19  | 10  |
|                   |     |     | 2   |     |     |     |
| **Total**         | 2139| 563 | 7   | 22  | 35  | 12  |
|                   |     |     | 8   | 22  | 3   | 4   |
|                   |     |     | 4   | 4   | 3   | 2   |
|                   |     |     | 2   | 5   | 19  | 10  |
|                   |     |     | 2   |     |     |     |
Table D. Fennoscandian bulls included in temporal analyses.
Y-chromosomal *UTY*19 haplotype (Y1 and Y2) and number of Finnish and Swedish Iron Age, Medieval, and Post-Medieval period, and modern native bulls included in the statistical analyses. The references to original articles are given at right.

| Period          | Country       | Y1 | Y2 | Total | Reference      |
|-----------------|---------------|----|----|-------|---------------|
| Iron Age        | Sweden        | 1  | 7  | 8     | [54]          |
| **Total**       |               | 1  | 7  | 8     |               |
| Medieval        | Finland       | 0  | 2  |       | This study    |
| Sweden          | 1             | 34 |    | 36    | [54,55]       |
| **Total**       |               | 1  | 36 | 37    |               |
| Post-Medieval   | Finland       | 1  | 4  |       | This study    |
| Sweden          | 8             | 6  |    | 14    | [55]          |
| **Total**       |               | 9  | 10 | 19    |               |
| Modern native   | Finland       | 20 | 8  |       | [56] and      |
| breeds          |               |    |    |       | [4] as reported in |
|                 | Sweden        | 13 | 0  |       | [56] and      |
|                 |               |    |    |       | [4] as reported in |
| **Total**       |               | 33 | 8  | 41    | [57]          |
| **Total**       |               | 44 | 61 | 105   |               |

*In Kantanen et al. [4] 11 (out of 28) of the Finnish bulls were also sampled and analysed in Götherström et al. [56].
Table E. Distribution of ancient and modern Eurasian Y-haplotypes.

Y-chromosomal haplotype (Y1 and Y2) in 127 modern Eurasian breeds and five ancient cohorts divided into nine geographical regions. The number of samples (N) in each breed or ancient cohort, count, and proportion of Y1 and Y2 are given. The references to original articles are given at right.

| Region                  | Breed/population          | N    | Y1     | Y2     | Reference   |
|-------------------------|---------------------------|------|--------|--------|-------------|
| **East Europe**         |                           |      |        |        |             |
|                         | Black and White           | 10   | 10 (100 %) |     | [55]        |
|                         | Commercial Red            | 10   | 9 (90 %)  | 1 (10 %) | [55]        |
|                         | Latvian Blue (native)     | 9    | 9 (100 %) |     | [57]        |
|                         | Latvian Brown (commercial)| 8    | 8 (100 %) |     | [57]        |
|                         | Light Grey                | 6    | 6 (100 %) |     | [55]        |
|                         | Ukrainian Grey            | 5    | 5 (100 %) |     | [57]        |
|                         | Ukrainian Red Steppe      | 5    | 5 (100 %) |     | [57]        |
|                         | Ukrainian Whiteheaded     | 11   | 5 (45 %)  | 6 (55 %) | [57]        |
|                         | White Bached              | 1    | 1 (100 %) |     | [55]        |
|                         | Total                     | 65   | 53 (82 %) | 12 (18 %) |             |
| **Central Russia**      |                           |      |        |        |             |
|                         | Bestuzheev                | 4    | 4 (100 %) |     | [57]        |
|                         | Istobenskaya              | 9    | 9 (100 %) |     | [57]        |
|                         | Pechorskaya               | 7    | 7 (100 %) |     | [57]        |
|                         | Sukusunskaya              | 5    | 4 (80 %)  | 1 (20 %) | [57]        |
|                         | Total                     | 25   | 24 (96 %) | 1 (4 %)  |             |
| **Near-East & Central Asia** |                       |      |        |        |             |
|                         | Anatolian Black           | 5    | 5 (100 %) |     | [56]        |
|                         | Damascus                  | 3    | 1 (33 %)  | 2 (67 %) | [57]        |
|                         | East Anatolian Red        | 4    | 4 (100 %) |     | [56]        |
|                         | Kalmyk                    | 12   | 12 (100 %) |     | [57]        |
|                         | South Anatolian Red       | 5    | 5 (100 %) |     | [56]        |
|                         | Turkish Grey              | 3    | 3 (100 %) |     | [57]        |
|                         | Total                     | 32   | 31 (97 %) |     |             |
| **Nordic countries**    |                           |      |        |        |             |
|                         | Ancient Finnish cattle    | 7    | 1 (14 %)  | 6 (86 %) | This study  |
|                         | Ancient Swedish cattle     | 57   | 10 (18 %) | 47 (82 %) | [54,55]     |
|                         | Blacksided Troender       | 7    | 7 (100 %) |     | [57]        |
|                         | Danish Red                | 26   | 21 (81 %) | 5 (19 %) | [57]        |
|                         | Doela                     | 4    | 4 (100 %) |     | [57]        |
|                         | Eastern Finncattle        | 9    | 1 (11 %)  | 8 (89 %) | [56,57]     |
|                         | Eastern Red Polled        | 5    | 5 (100 %) |     | [57]        |
|                         | Fjallnara                 | 3    | 3 (100 %) |     | [57]        |
|                         | Icelandic                 | 8    | 8 (100 %) |     | [57]        |
|                         | Jutland (old native)      | 6    | 6 (100 %) |     | [57]        |
|                         | Northern Finncattle       | 3    | 3 (100 %) |     | [56]        |
|                         | Norwegian (commercial, hybrid) | 12   | 12 (100 %) |     | [57]        |
|                         | Swedish Mountain Cattle   | 10   | 10 (100 %) |     | [56,57]     |
|                         | Swedish Red               | 2    | 2 (100 %) |     | [56]        |
| Region                | Breed/population      | N  | Y1          | Y2          | Reference |
|-----------------------|-----------------------|----|-------------|-------------|-----------|
| Swedish Red Pollled   | 5                     | 5  | (100 %)     |             | [56,57]   |
| Telemark              | 2                     | 2  | (100 %)     |             | [57]      |
| Western Finncattle    | 9                     | 9  | (100 %)     |             | [56,57]   |
| Western Fjord         | 6                     | 6  | (100 %)     |             | [57]      |
| Western Red Pollled   | 3                     | 3  | (100 %)     |             | [57]      |
| Total                 | 184                   | 112| (61 %)      | 72 (39 %)   |           |

**Russian Siberia**

| Breed/population       | N  | Y1          | Reference |
|------------------------|----|-------------|-----------|
| Yakutian cattle        | 23 | 23 (100 %)  | [57]      |
| Total                  | 23 | 23 (100 %)  |           |

**South-East Europe**

| Breed/population       | N  | Y1          | Reference |
|------------------------|----|-------------|-----------|
| Ancient Hungary        | 1  | 1 (100 %)   | [55]      |
| Busha                  | 5  | 5 (100 %)   | [57]      |
| Serbian Podolica       | 4  | 4 (100 %)   | [57]      |
| Total                  | 10 | 10 (100 %)  |           |

**South and Central Europe**

| Breed/population       | N  | Y1          | Y2          | Reference |
|------------------------|----|-------------|-------------|-----------|
| Ancient Bern           | 14 | 1 (7 %)     | 13 (93 %)   | [58]      |
| Alentejana             | 36 | 36 (100 %)  |             | [57]      |
| Alistana-Sanabresa     | 12 | 12 (100 %)  |             | [57]      |
| Arouquesa              | 33 | 33 (100 %)  |             | [57]      |
| Asturiana de los Valles| 38 | 32 (84 %)   | 6 (16 %)    | [57]      |
| Asturiana de Montana   | 19 | 18 (95 %)   | 1 (5 %)     | [57]      |
| Avilena Negro Iberica  | 7  | 1 (14 %)    | 6 (86 %)    | [57]      |
| Barrosã                | 33 | 33 (100 %)  |             | [57]      |
| Berrenda               | 5  | 5 (100 %)   |             | [57]      |
| Betizu                 | 17 | 17 (100 %)  |             | [57]      |
| Blonde d’Aquitaine     | 7  | 7 (100 %)   |             | [57]      |
| Braunvieh              | 3  | 3 (100 %)   |             | [56]      |
| Brava de Lide          | 26 | 2 (8 %)     | 24 (92 %)   | [57]      |
| Brunade los Pirineds   | 11 | 11 (100 %)  |             | [57]      |
| Cabannina              | 2  | 2 (100 %)   |             | [57]      |
| Cachena                | 25 | 25 (100 %)  |             | [57]      |
| Charolais              | 37 | 37 (100 %)  |             | [57]      |
| Chianina               | 22 | 22 (100 %)  |             | [57]      |
| De Lida                | 2  | 2 (100 %)   |             | [56]      |
| Ehringer               | 2  | 2 (100 %)   |             | [56]      |
| Fleckvieh              | 3  | 3 (100 %)   |             | [56]      |
| Garvonesa              | 6  | 6 (100 %)   |             | [57]      |
| Gelbvieh               | 4  | 4 (100 %)   |             | [56]      |
| Istrián                | 4  | 4 (100 %)   |             | [57]      |
| Lidia                  | 66 | 66 (100 %)  |             | [57]      |
| Limousin               | 26 | 26 (100 %)  |             | [57]      |
| Mallorquina            | 8  | 8 (100 %)   |             | [57]      |
| Marchigiana            | 11 | 11 (100 %)  |             | [57]      |
| Maremma                | 19 | 19 (100 %)  |             | [57]      |
| Marinha                | 17 | 17 (100 %)  |             | [57]      |
| Maronesa               | 23 | 23 (100 %)  |             | [57]      |
| Menorquina             | 4  | 4 (100 %)   |             | [56]      |
| Region       | Breed/population   | N   | Y1     | Y2     | Reference |
|--------------|--------------------|-----|--------|--------|-----------|
|              | Mertolenga         | 23  | 8 (35 %) | 15 (65 %) | [57]      |
|              | Minhota            | 28  | 28 (100 %) | 28 (100 %) | [57]      |
|              | Mirandesa          | 23  | 23 (100 %) | 23 (100 %) | [57]      |
|              | Montbeliard        | 6   | 6 (100 %) | 6 (100 %) | [57]      |
|              | Morucha            | 5   | 5 (100 %) | 5 (100 %) | [57]      |
|              | Mostrenca          | 21  | 21 (100 %) | 21 (100 %) | [57]      |
|              | Pajuna             | 4   | 1 (25 %) | 3 (75 %) | [57]      |
|              | Parthenaise        | 15  | 4 (27 %) | 11 (73 %) | [57]      |
|              | Piemontese         | 17  | 17 (100 %) | 17 (100 %) | [57]      |
|              | Pinzgaur           | 13  | 13 (100 %) | 13 (100 %) | [57]      |
|              | Pirenaica          | 10  | 10 (100 %) | 10 (100 %) | [57]      |
|              | Podolica           | 13  | 13 (100 %) | 13 (100 %) | [57]      |
|              | Preta              | 29  | 1 (3 %) | 28 (97 %) | [57]      |
|              | Pustertaler        | 13  | 13 (100 %) | 13 (100 %) | [57]      |
|              | Red Holstein       | 3   | 3 (100 %) | 3 (100 %) | [57]      |
|              | Rendena            | 4   | 4 (100 %) | 4 (100 %) | [56]      |
|              | Retinta            | 6   | 6 (100 %) | 6 (100 %) | [57]      |
|              | Romagnola          | 4   | 4 (100 %) | 4 (100 %) | [56]      |
|              | Rotbunte           | 4   | 4 (100 %) | 4 (100 %) | [56]      |
|              | Rubia Gallega      | 44  | 44 (100 %) | 44 (100 %) | [57]      |
|              | Salers             | 20  | 1 (5 %) | 19 (95 %) | [57]      |
|              | Sayaguesa          | 8   | 8 (100 %) | 8 (100 %) | [57]      |
|              | Schawarzbunte-HF   | 4   | 4 (100 %) | 4 (100 %) | [56]      |
|              | Simmental          | 20  | 1 (5 %) | 19 (95 %) | [57]      |
|              | Swiss Brown        | 14  | 14 (100 %) | 14 (100 %) | [57]      |
|              | Tarentaise         | 18  | 18 (100 %) | 18 (100 %) | [57]      |
|              | Tudanca            | 10  | 10 (100 %) | 10 (100 %) | [57]      |
|              | Tyrolean Grey      | 19  | 19 (100 %) | 19 (100 %) | [57]      |
|              | Total              | 940 | 121 (13 %) | 819 (87 %) |           |

**West Europe**

| Region               | Breed/population   | N   | Y1     | Y2     | Reference |
|----------------------|--------------------|-----|--------|--------|-----------|
| Aberdeen Angus       | 37                 | 37  | 37 (100 %) | 37 (100 %) | [57]      |
| Angler               | 14                 | 14  | 14 (100 %) | 14 (100 %) | [57]      |
| Angus                | 4                  | 3   | 3 (75 %) | 1 (25 %) | [56]      |
| Ayrshire             | 22                 | 22  | 22 (100 %) | 22 (100 %) | [57]      |
| Belgian Blue         | 21                 | 21  | 21 (100 %) | 21 (100 %) | [57]      |
| Belgian Red          | 4                  | 4   | 4 (100 %) | 4 (100 %) | [57]      |
| British White        | 21                 | 17  | 17 (81 %) | 4 (19 %) | [57]      |
| Dexter               | 4                  | 4   | 4 (100 %) | 4 (100 %) | [57]      |
| Dutch Belted         | 8                  | 3   | 3 (38 %) | 5 (63 %) | [57]      |
| Fries                | 5                  | 5   | 5 (100 %) | 5 (100 %) | [56]      |
| Friesian             | 4                  | 4   | 4 (100 %) | 4 (100 %) | [56]      |
| Friesian-Dutch       | 8                  | 8   | 8 (100 %) | 8 (100 %) | [57]      |
| Galloway             | 11                 | 11  | 11 (100 %) | 11 (100 %) | [57]      |
| German Original Black Pied-West | 3        | 3   | 3 (100 %) | 3 (100 %) | [57]      |
| Groningen Whitehead  | 11                 | 11  | 11 (100 %) | 11 (100 %) | [57]      |
| Guernsey             | 4                  | 4   | 4 (100 %) | 4 (100 %) | [56]      |
| Region                  | Breed/population         | N  | Y1     | Y2     | Reference |
|-------------------------|--------------------------|----|--------|--------|-----------|
|                         | Hereford                 | 31 | 30 (97 %) | 1 (3 %) | [57]      |
|                         | Highland                 | 13 | 13 (100 %) |        |           |
|                         | Holstein Friesian        | 65 | 65 (100 %) |        | [57]      |
|                         | Jersey                   | 28 | 28 (100 %) |        | [57]      |
|                         | Lakenvalder              | 5  | 2 (40 %)  | 3 (60 %) | [56]      |
|                         | Lowland                  | 2  | 2 (100 %)  |        | [56]      |
|                         | Meuse-Rhine-Yssel        | 13 | 13 (100 %) |        | [57]      |
|                         | Normand                  | 46 | 46 (100 %) |        | [57]      |
|                         | Red Holstein             | 1  | 1 (100 %)  |        | [57]      |
|                         | Shorthorn                | 19 | 19 (100 %) |        | [57]      |
|                         | Total                    | 404| 334 (83 %) | 70 (17 %) |           |
| **West Russia**         |                          |    |         |        |           |
|                         | Kholomogorskaya          | 6  | 6 (100 %)  |        | [57]      |
|                         | Yaroslavskaya            | 3  | 3 (100 %)  |        | [57]      |
|                         | Total                    | 9  | 9 (100 %)  |        |           |
| **Total data**          |                          | 1692| 654 (39 %) | 1038 (61 %) |           |