Fra Big Bang til moderne menneske

Fossilt DNA – et vindue til fortiden

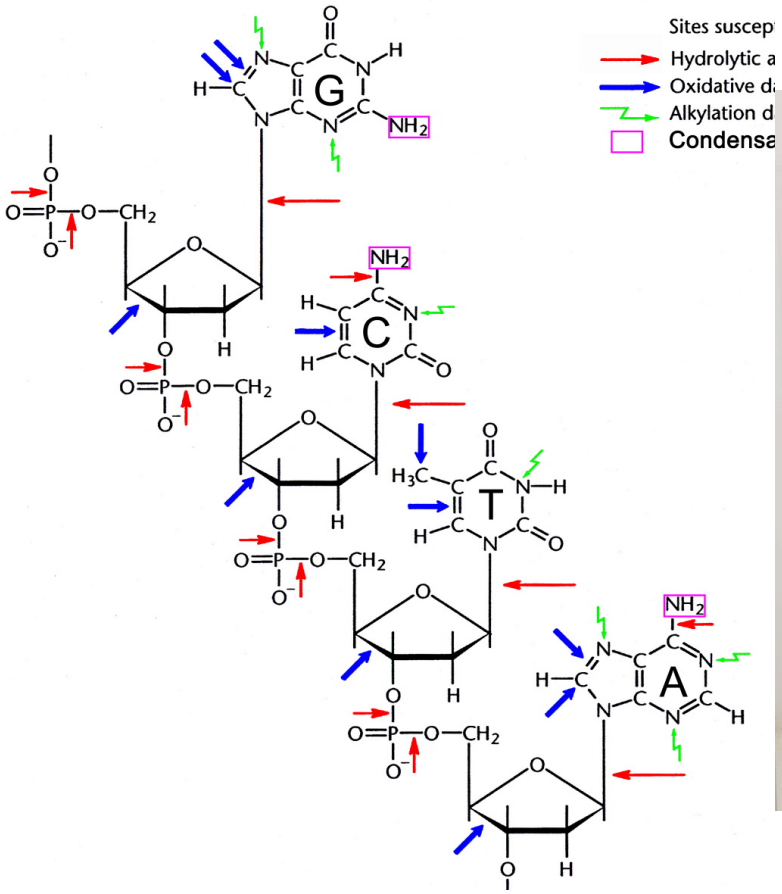
Morten Allentoft

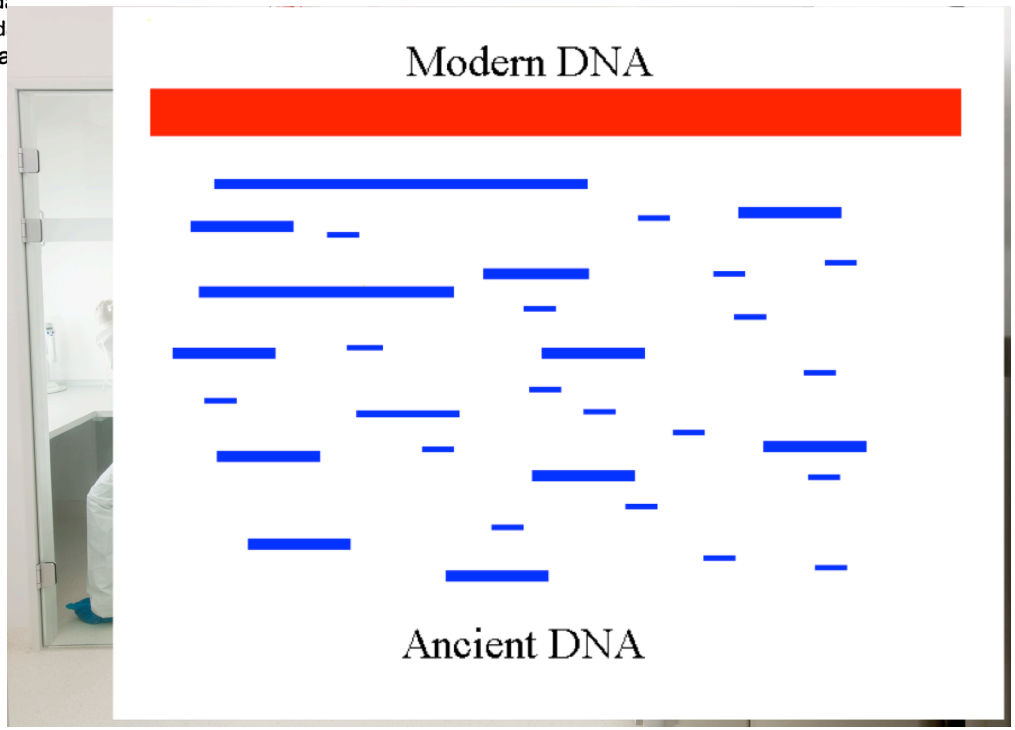
Centre for GeoGenetics

Hvad er fossilt DNA?

- meget ødelagt

- Høj forureningsrisiko



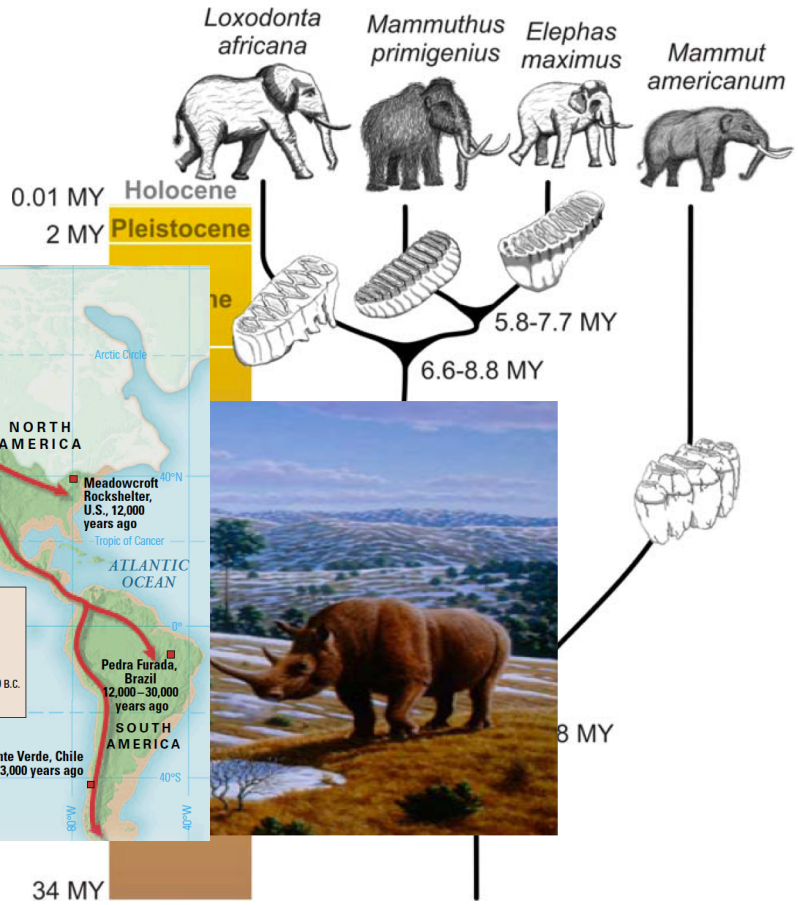


Hvorfor gider vi bøvle med det?

- Studier på uddøde arter

- Fortidens biodiversitet

- Vores egen historie



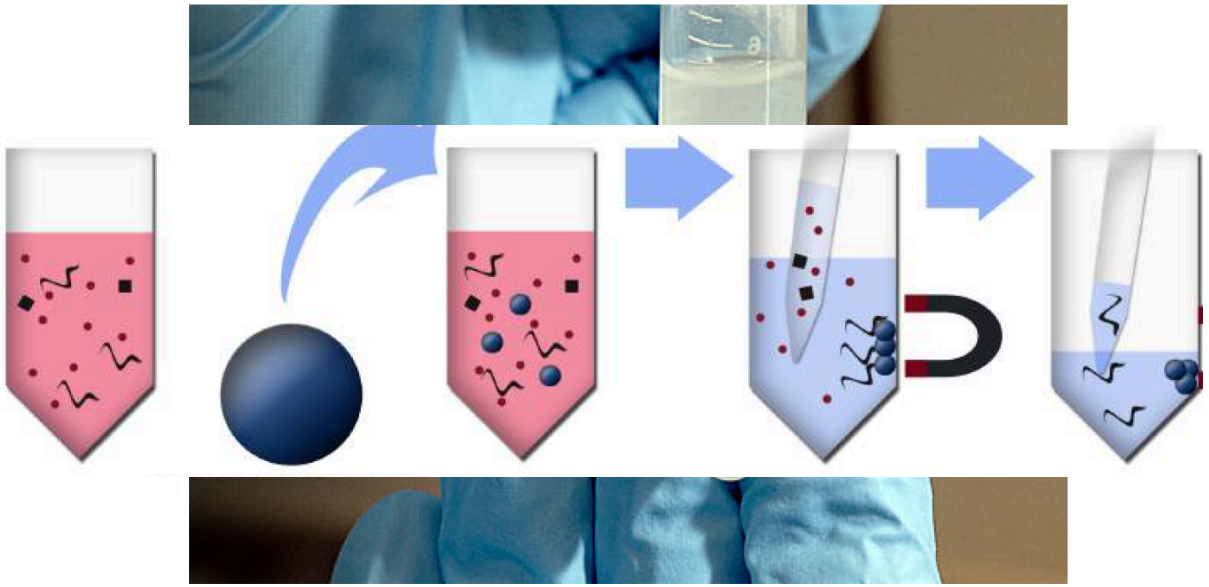
Arbejdsgang

1) Indsamling

Arbejdsgang

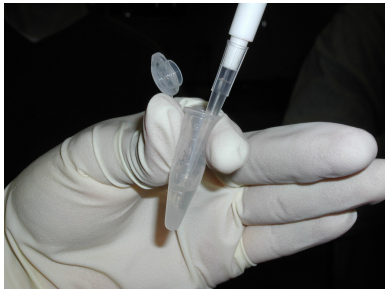
1) Indsamling

2) Ekstraktion



Next Generation DNA sekventering

DNA ekstrakt



Et par dage senere:
milliarder af DNA sekvenser

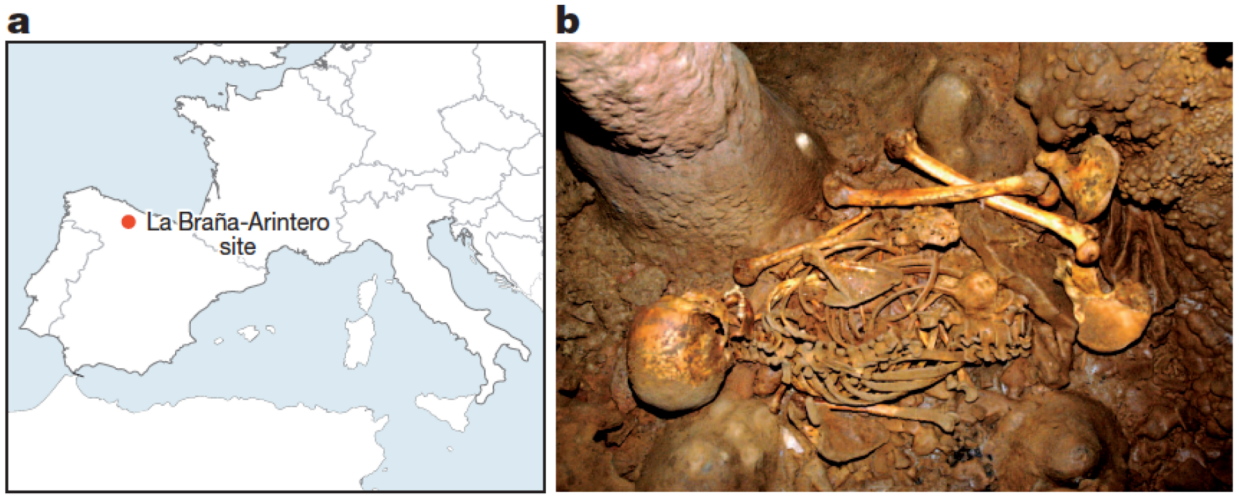
Fossilt DNA og Europas forhistorie

Det første genom fra jægerstenalderen

Nature **507** (2014)

Derived immune and ancestral pigmentation alleles in a 7,000-year-old Mesolithic European

Iñigo Olalde[1]*, Morten E. Allentoft[2]*, Federico Sánchez-Quinto[1], Gabriel Santpere[1], Charleston W. K. Chiang[3], Michael DeGiorgio[4,5], Javier Prado-Martinez[1], Juan Antonio Rodríguez[1], Simon Rasmussen[6], Javier Quilez[1], Oscar Ramírez[1], Urko M. Marigorta[1], Marcos Fernández-Callejo[1], María Encina Prada[7], Julio Manuel Vidal Encinas[8], Rasmus Nielsen[9], Mihai G. Netea[10], John Novembre[11], Richard A. Sturm[12], Pardis Sabeti[13,14], Tomàs Marquès-Bonet[1,15], Arcadi Navarro[1,15,16,17], Eske Willerslev[2] & Carles Lalueza-Fox[1]



Data fra La Brana manden:

- Fantastisk DNA bevaring: 50% humant DNA

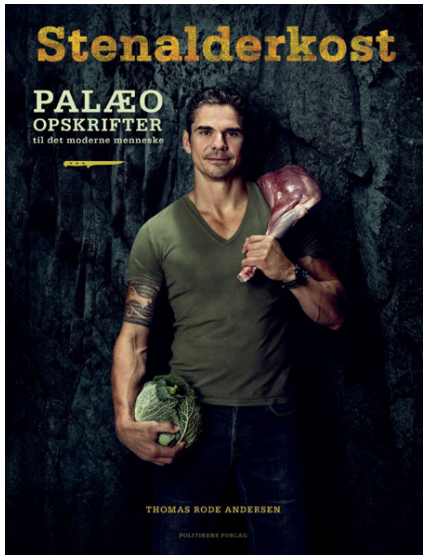
- 2.158.245.715 humane DNA sekvenser

- Et komplet genom med 3.4X dækning

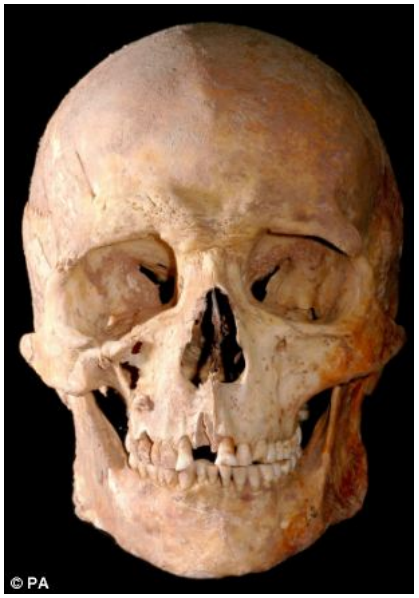
Et par observationer:

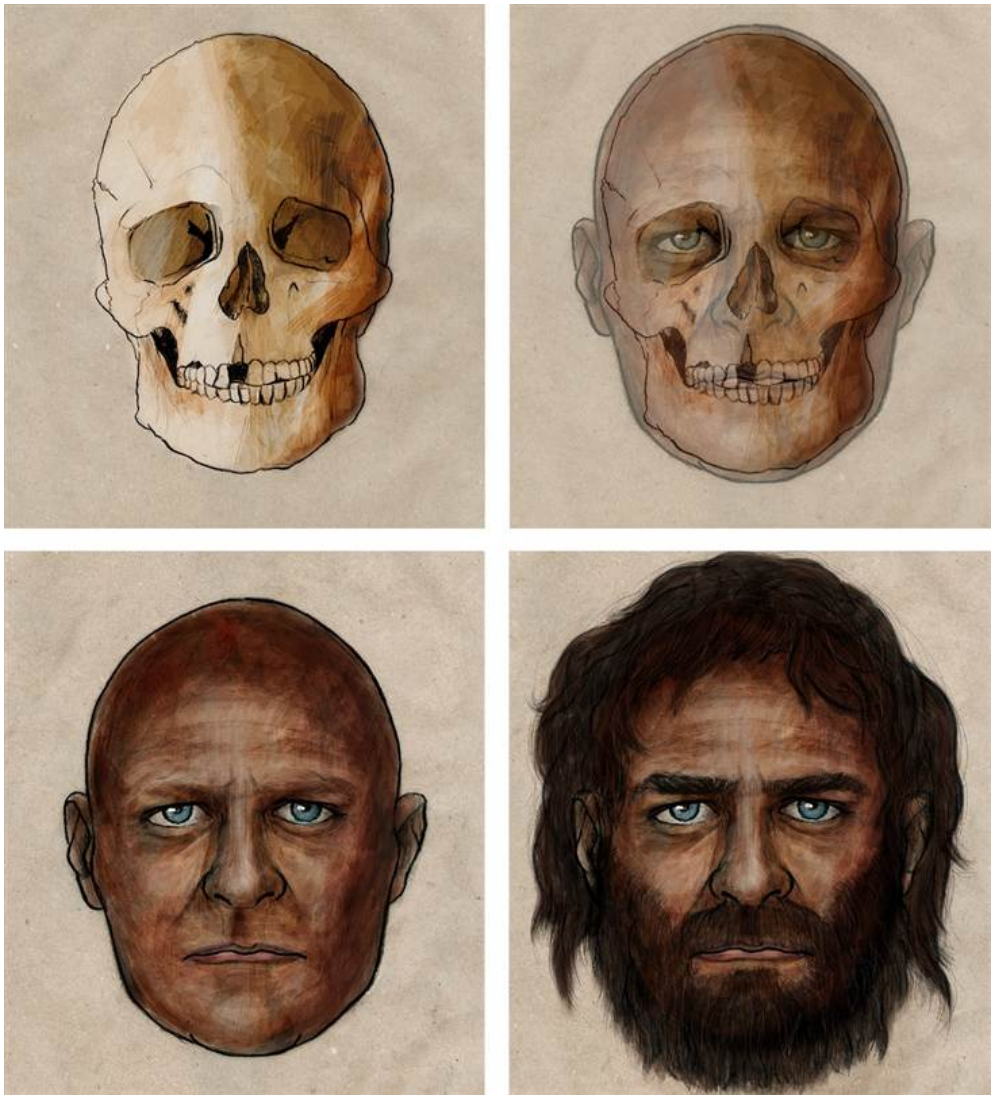
- C variant på position -13910 i *MCM6* genet

- Kun 5 kopier af *AMY1* genet

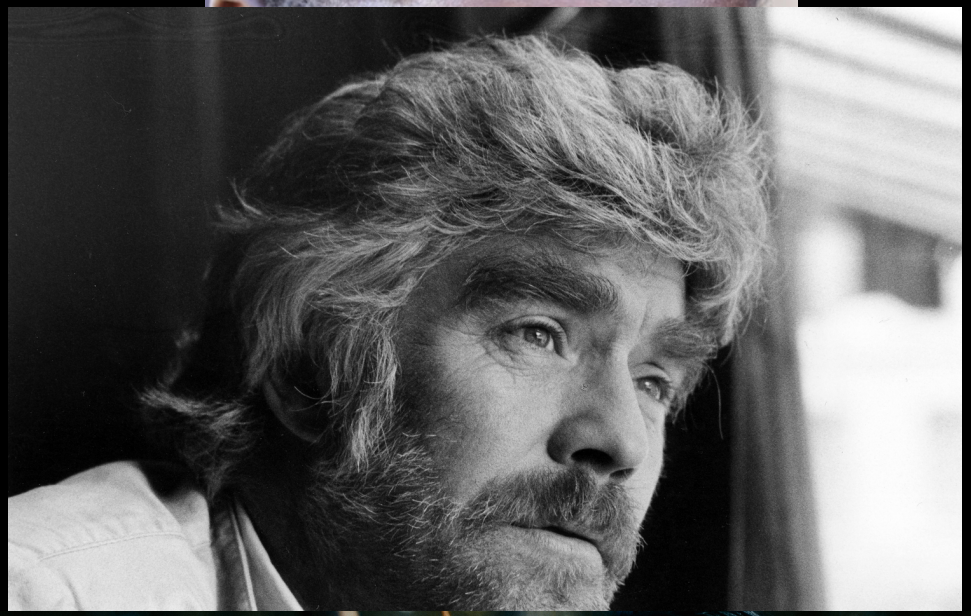


The cave man look



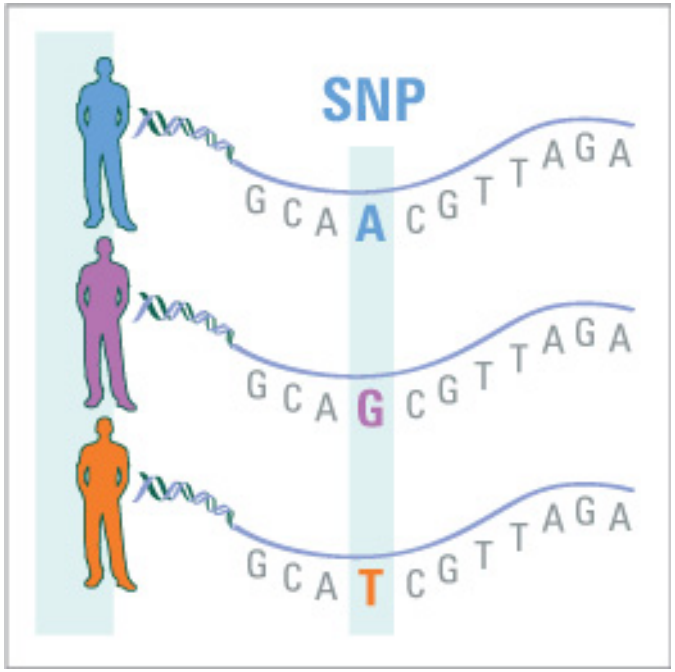


- Brunt hår
- meget mørk hud
- ikke-brune øjne

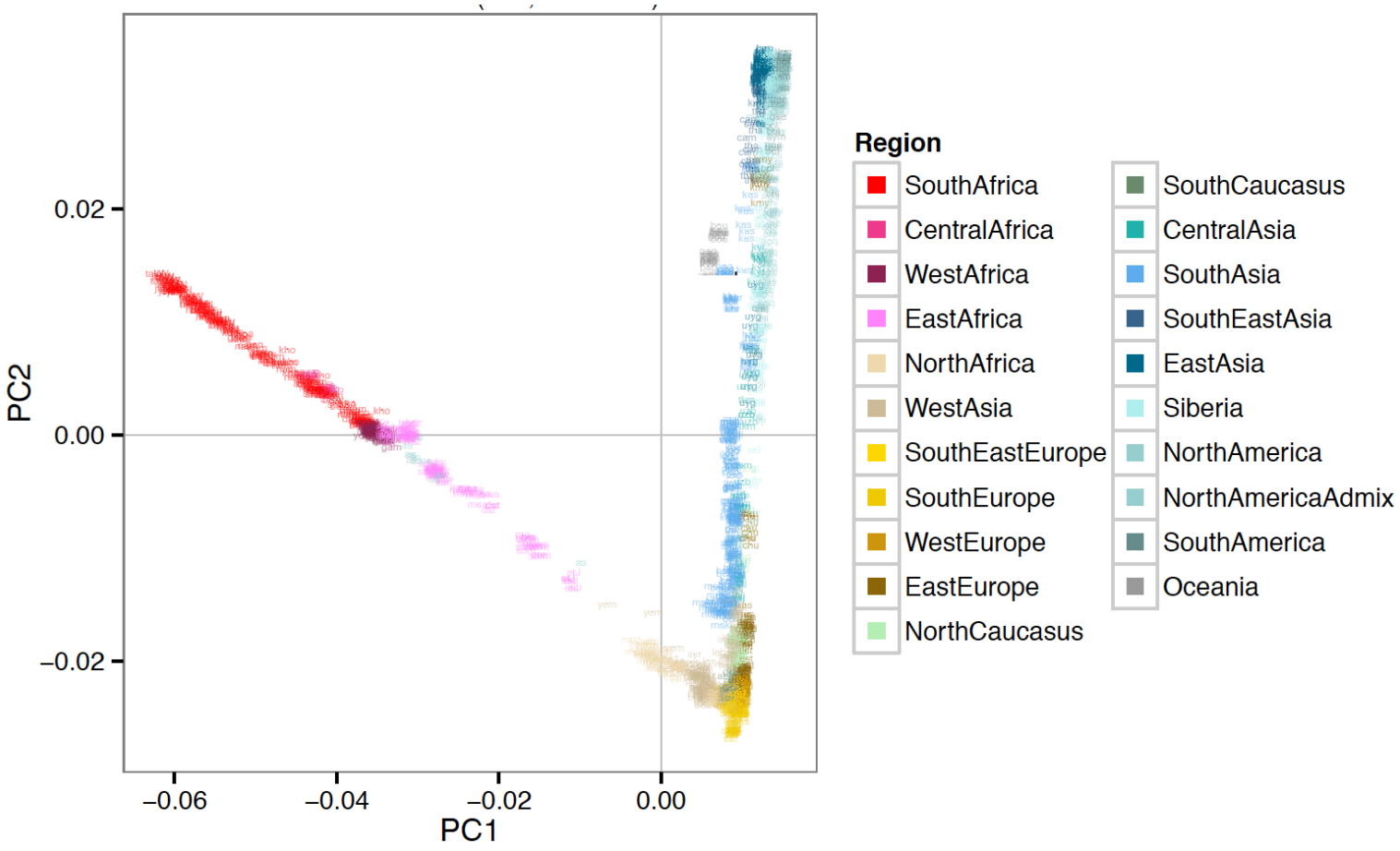


Lidt populationsgenetik

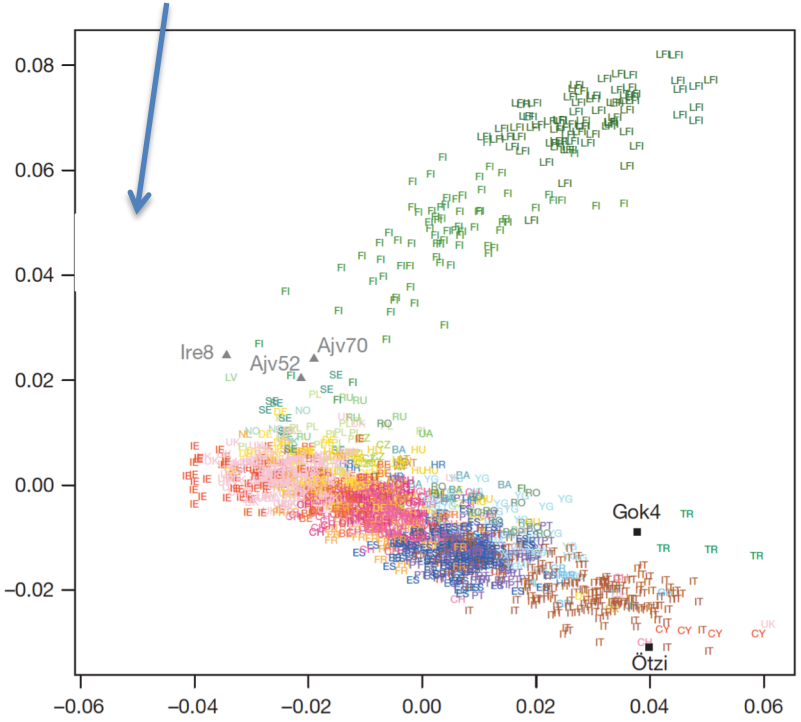
Reference data: 600,000 SNP's fra modern befolkningsgrupper



PCA af nuværende befolkninger

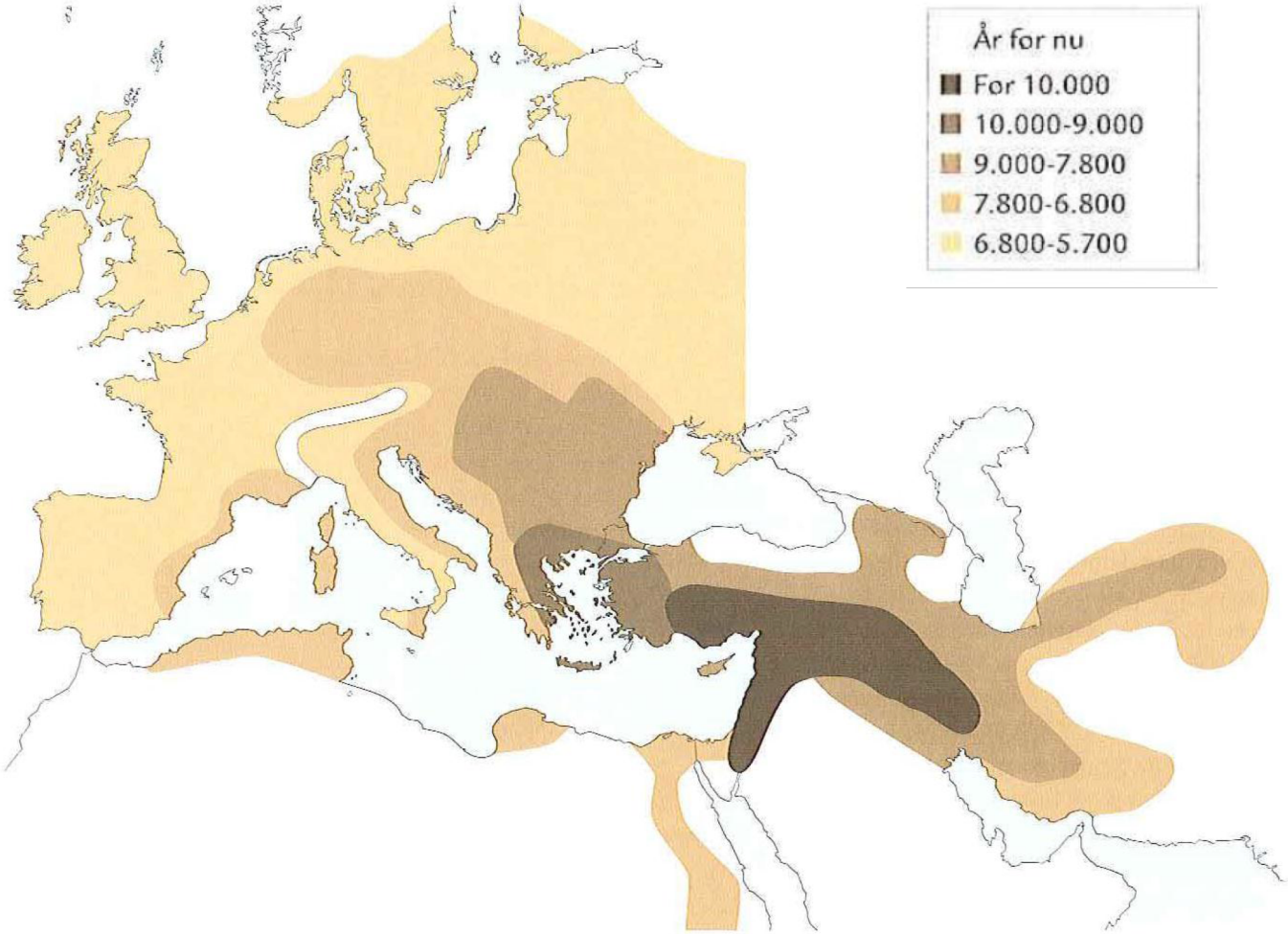


PCA af Europa



Han er ikke vores direkte stamfader!

Et par tusinde år senere...
Landbrug begynder at sprede sig henover Europa

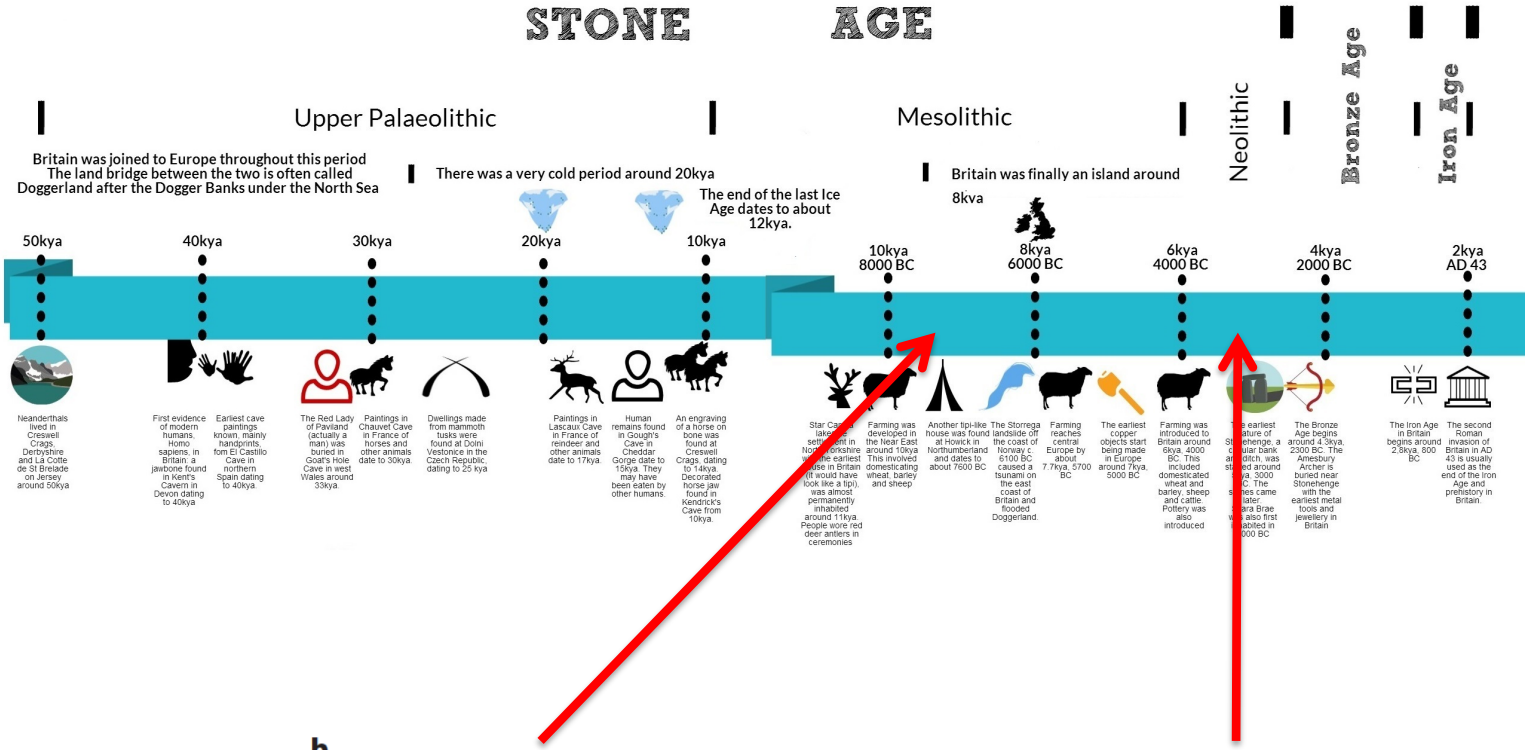


Hvad forårsager disse ændringer?

Hypotese 1: De tidlige bønder vandrer ind i Europa og erstatter jæger-samlerne
Hypotese 2: Ingen folkevandring – kun kulturen spredes


Munich
Austria
Switzerland
Liechtenstein
Bern
Zurich
Innsbruck
Salzburg
Graz
Klagenfurt
Slovenia
Zagreb
Croatia
Bosnia and Herzegovina
Sarajevo
Venice
Milan
Bologna
Florence
San Marino
Italy
Rome
Genoa
Turin
Nice
Marseille
Lyon
Geneva
Trieste
Split
Dubrovnik

STONE AGE


Upper Palaeolithic
Mesolithic
Neolithic
Bronze Age
Iron Age
Britain was joined to Europe throughout this period
The land bridge between the two is often called Doggerland after the Dogger Banks under the North Sea
There was a very cold period around 20kya
The end of the last Ice Age dates to about 12kya.
Britain was finally an island around 8kva
50kya
40kya
30kya
20kya
10kya
10kya 8000 BC
8kya 6000 BC
6kya 4000 BC
4kya 2000 BC
2kya AD 43
Neanderthals lived in Creswell Crags, Derbyshire and La Cotte de St Brelade on Jersey around 50kya
First evidence of modern humans, Homo sapiens, in Britain: a jawbone found in Kent's Cavern in Devon dating to 40kya
Earliest cave paintings known, mainly handprints, fom El Castillo Cave in northern Spain dating to 40kya.
The Red Lady of Paviland (actually a man) was buried in Goat's Hole Cave in west Wales around 33kya.
Paintings in Chauvet Cave in France of horses and other animals date to 30kya.
Dwellings made from mammoth tusks were found at Dolni Vestonice in the Czech Republic, dating to 25 kya
Paintings in Lascaux Cave in France of reindeer and other animals date to 17kya.
Human remains found in Gough's Cave in Cheddar Gorge date to 15kya. They may have been eaten by other humans.
An engraving of a horse on bone was found at Creswell Crags, dating to 14kya. Decorated horse jaw found in Kendrick's Cave from 10kya.
Farming was developed in the Near East around 10kya This involved domesticating wheat, barley and sheep
Another tipi-like house was found at Howick in Northumberland and dates to about 7600 BC
The Storrega landslide off the coast of Norway c. 6100 BC caused a tsunami on the east coast of Britain and flooded Doggerland.
Farming reaches central Europe by about 7.7kya, 5700 BC
The earliest copper objects start being made in Europe around 7kya, 5000 BC
Farming was introduced to Britain around 6kya, 4000 BC. This included domesticated wheat and barley, sheep and cattle. Pottery was also introduced
The Bronze Age begins around 4.3kya, 2300 BC. The Amesbury Archer is buried near Stonehenge with the earliest metal tools and jewellery in Britain
The Iron Age in Britain begins around 2.8kya, 600 BC
The second Roman invasion of Britain in AD 43 is usually used as the end of the Iron Age and prehistory in Britain.

a


La Braña-Arintero site

b

nature COMMUNICATIONS

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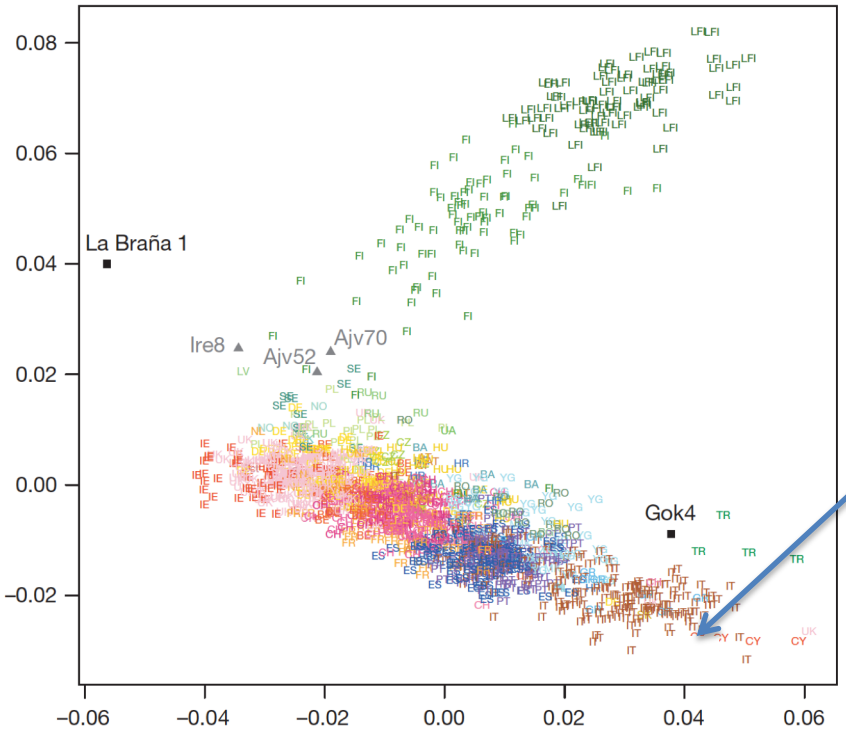
New insights into the Tyrolean Iceman's origin and phenotype as inferred by whole-genome sequencing

Andreas Keller[1,2,*], Angela Graefen[3,*], Markus Ball[4,*], Mark Matzas[5], Valesca Boisguerin[5], Frank Maixner[3], Petra Leidinger[1], Christina Backes[1], Rabab Khairat[4], Michael Forster[6], Björn Stade[6], Andre Franke[6], Jens Mayer[1], Jessica Spangler[7], Stephen McLaughlin[7], Minita Shah[7], Clarence Lee[7], Timothy T. Harkins[7], Alexander Sartori[7], Andres Moreno-Estrada[8], Brenna Henn[8], Martin Sikora[8], Ornella Semino[9], Jacques Chiaroni[10], Siiri Rootsi[11], Natalie M. Myres[12], Vicente M. Cabrera[13], Peter A. Underhill[8], Carlos D. Bustamante[8], Eduard Egarter Vigl[14], Marco Samadelli[3], Giovanna Cipollini[3], Jan Haas[15], Hugo Katus[15], Brian D. O'Connor[16,17], Marc R.J. Carlson[18], Benjamin Meder[15], Nikolaus Blin[4,19], Eckart Meese[1], Carsten M. Pusch[4] & Albert Zink[3]



- Enormt skift i genpuljen = indvandring

- Otzi er (heller ikke) vores direkte forfader!

Det store spørgsmål:

Hvad skete der efter Bondestenalderen?

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ARTICLE

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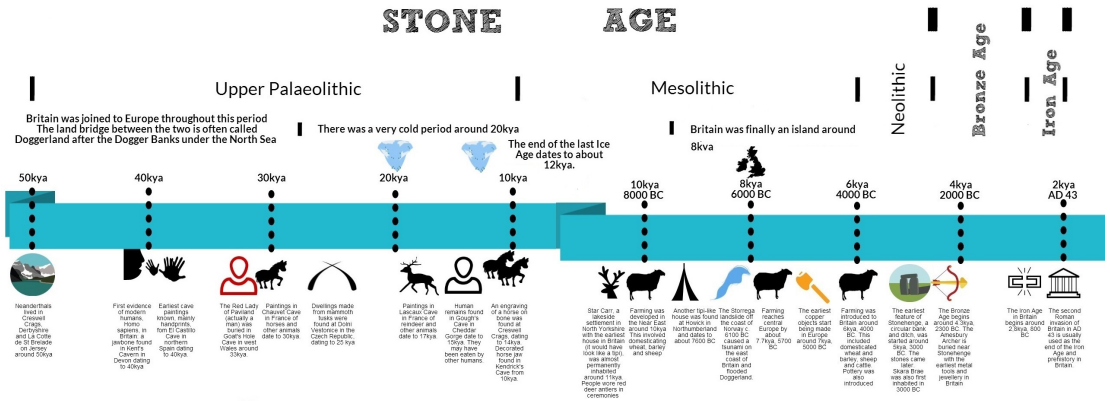
Population genomics of Bronze Age Eurasia

Morten E. Allentoft[1]*, Martin Sikora[1]*, Karl-Göran Sjögren[2], Simon Rasmussen[3], Morten Rasmussen[1], Jesper Stenderup[1], Peter B. Damgaard[1], Hannes Schroeder[1,4], Torbjörn Ahlström[5], Lasse Vinner[1], Anna-Sapfo Malaspinas[1], Ashot Margaryan[1], Tom Higham[6], David Chivall[6], Niels Lynnerup[7], Lise Harvig[7], Justyna Baron[8], Philippe Della Casa[9], Paweł Dąbrowski[10], Paul R. Duffy[11], Alexander V. Ebel[12], Andrey Epimakhov[13], Karin Frei[14], Mirosław Furmanek[8], Tomasz Gralak[8], Andrey Gromov[15], Stanisław Gronkiewicz[16], Gisela Grupe[17], Tamás Hajdu[18,19], Radosław Jarysz[20], Valeri Khartanovich[15], Alexandr Khokhlov[21], Viktória Kiss[22], Jan Kolář[23,24], Aivar Kriiska[25], Irena Lasak[8], Cristina Longhi[26], George McGlynn[17], Algimantas Merkevicius[27], Inga Merkyte[28], Mait Metspalu[29], Ruzan Mkrtchyan[30], Vyacheslav Moiseyev[15], László Paja[31,32], György Pálfi[32], Dalia Pokutta[2], Łukasz Pospieszny[33], T. Douglas Price[34], Lehti Saag[29], Mikhail Sablin[35], Natalia Shishlina[36], Václav Smrčka[37], Vasilii I. Soenov[38], Vajk Szeverényi[22], Gusztáv Tóth[39], Synaru V. Trifanova[38], Liivi Varul[25], Magdolna Vicze[40], Levon Yepiskoposyan[41], Vladislav Zhitenev[42], Ludovic Orlando[1], Thomas Sicheritz-Pontén[3], Søren Brunak[3,43], Rasmus Nielsen[44], Kristian Kristiansen[2] & Eske Willerslev[1]

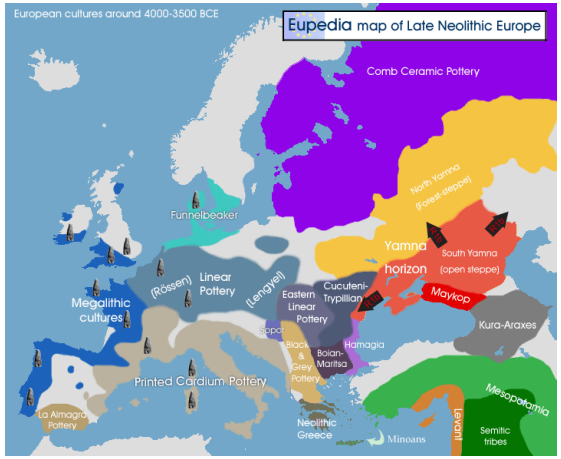
UNIVERSITY OF GOTHENBURG
DEPT OF HISTORICAL STUDIES

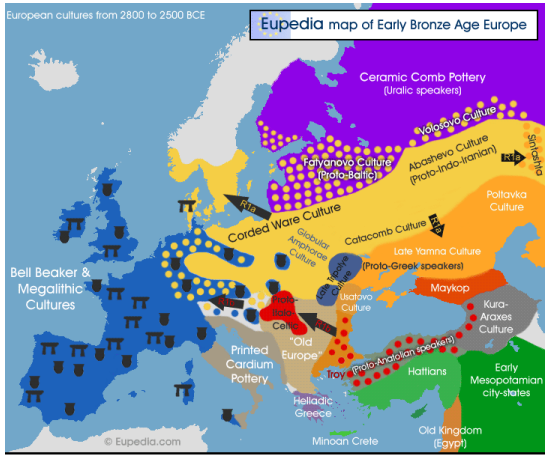
Centre for GeoGenetics

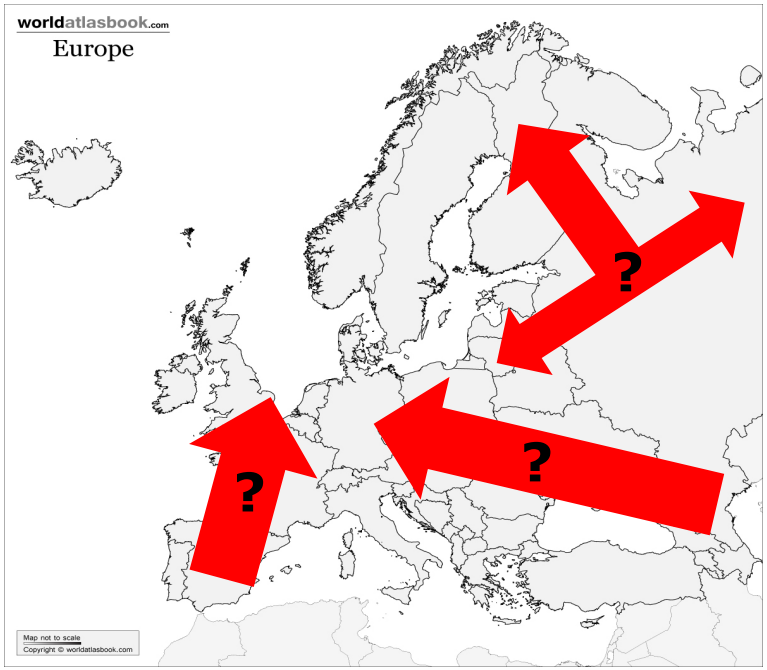
Fossilt DNA fra Bronzealderen...hvorfor?

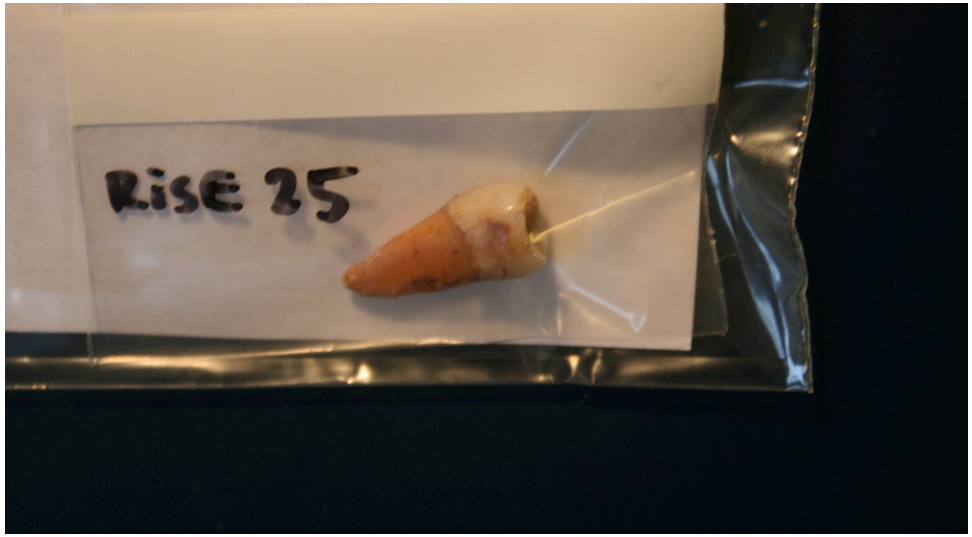


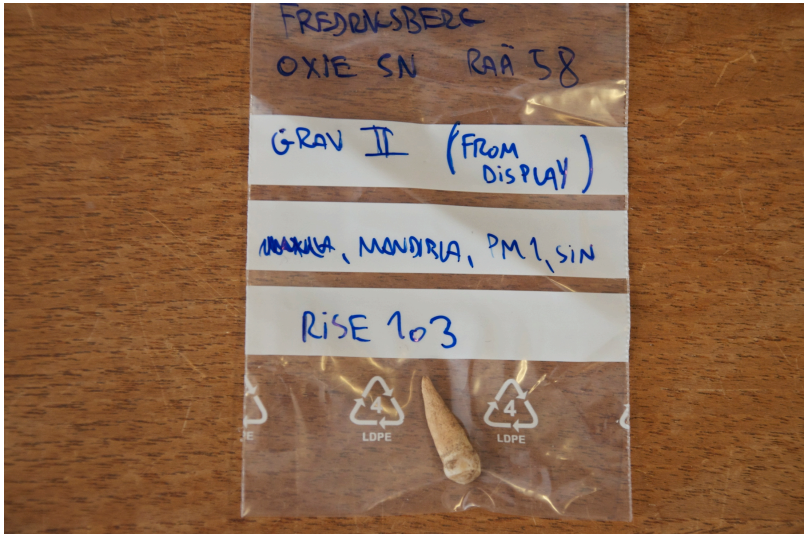
Mange forskellige kulturer opstår



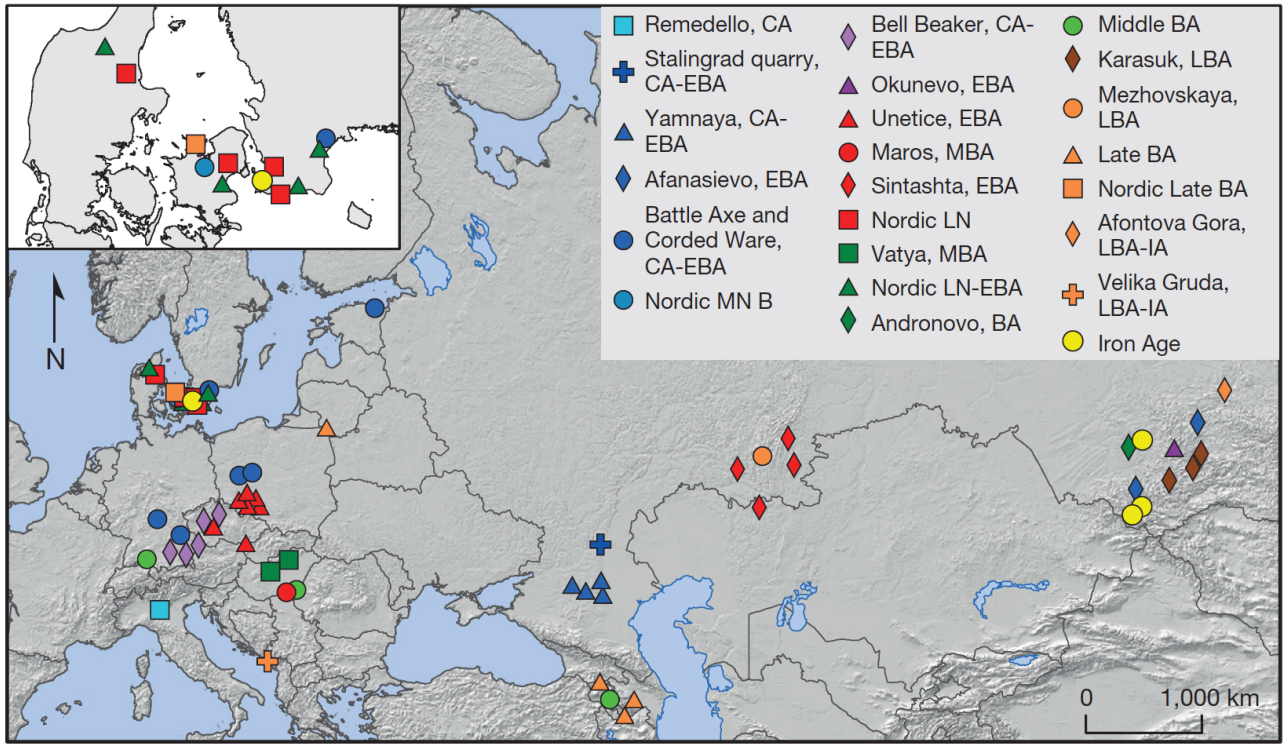


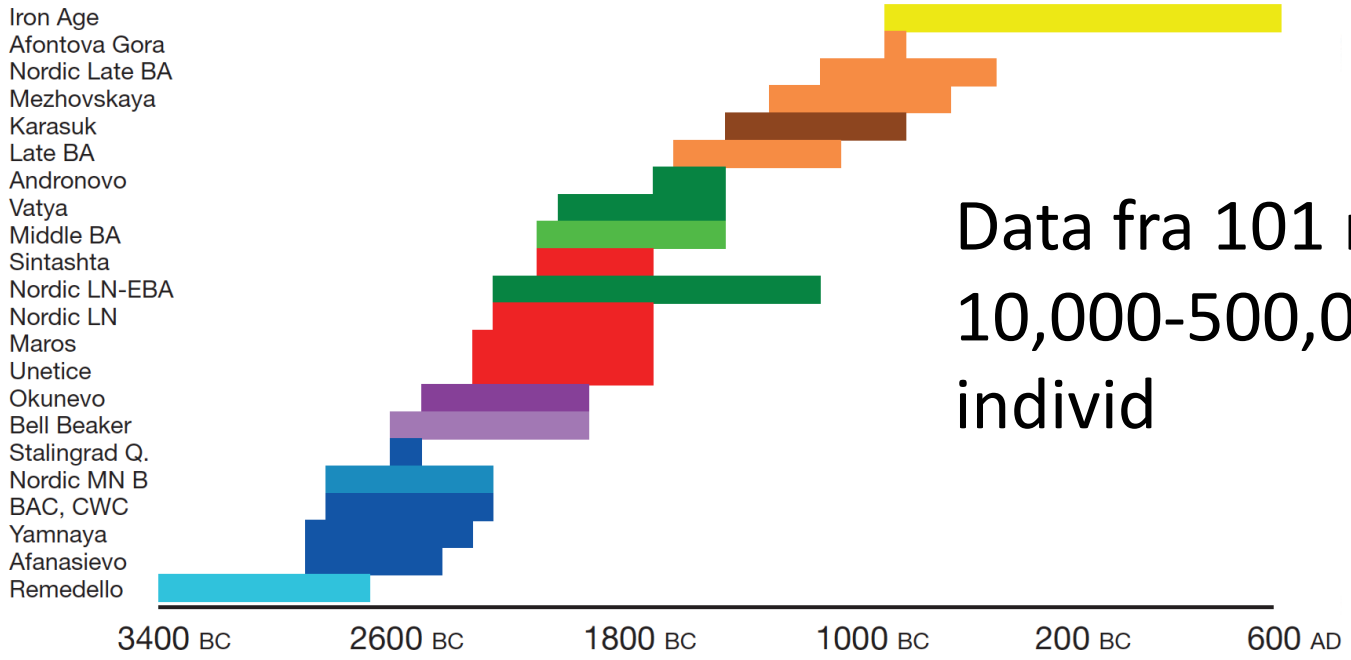






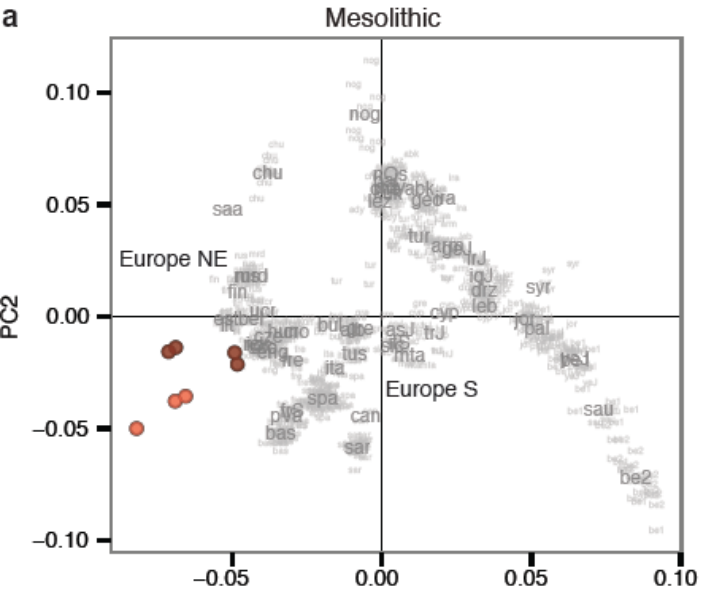
Tænder fra 600 skeletter

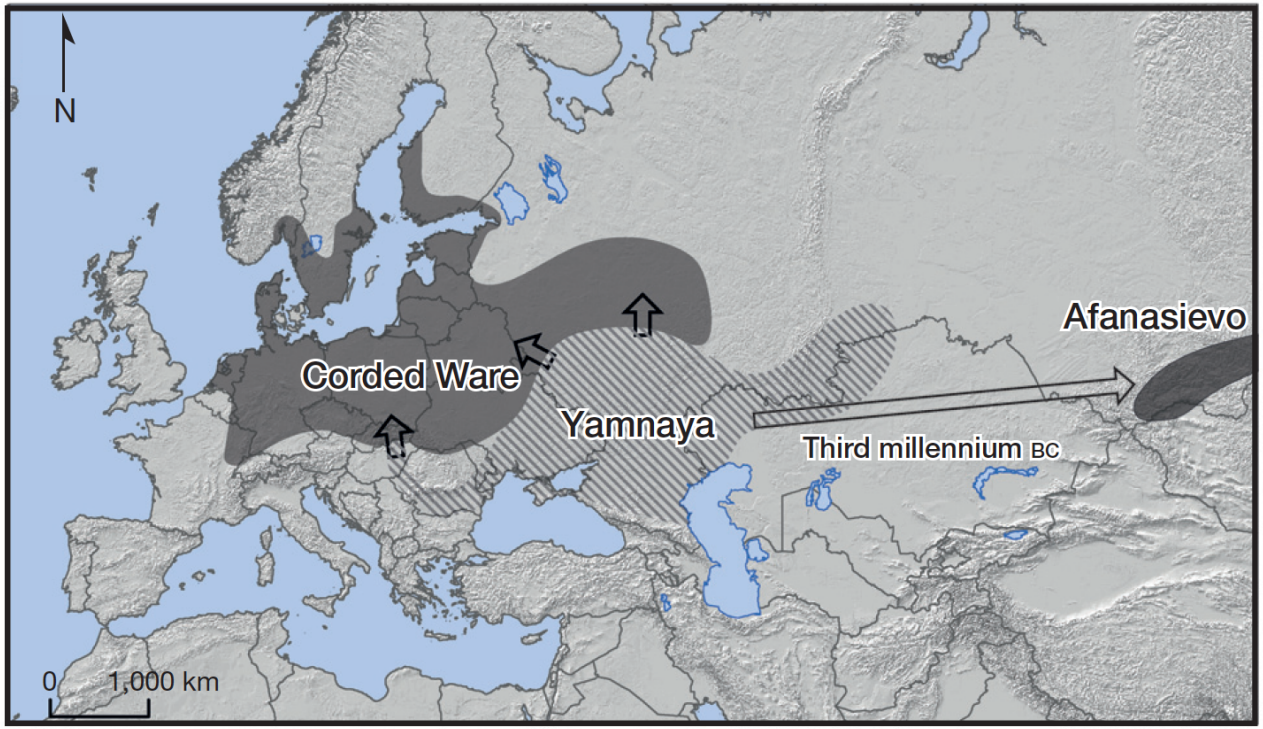




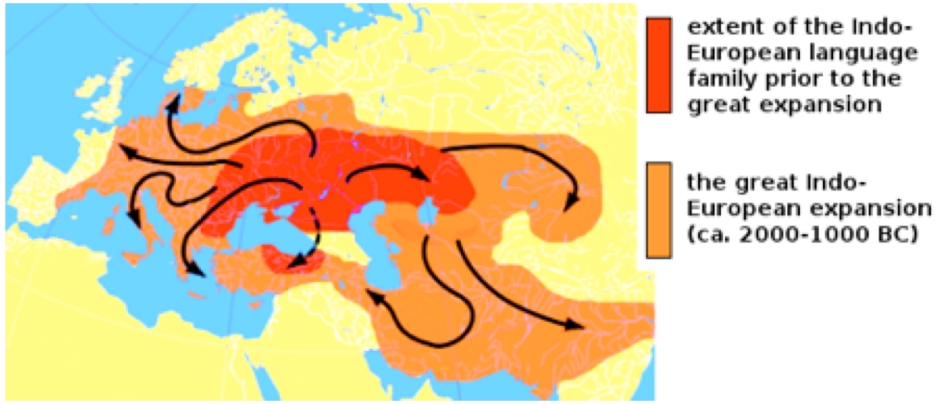
Data fra 101 mennesker: 10,000-500,000 SNP's per individ

Europa gennem tid





Spredning af de indo-europæiske sprog



Yamnaya: hyrdefolk fra stepperne

Opsummering:

- Den europæiske befolkning blev dannet genetisk ved mindst tre folkevandringer, og disse tre genetiske komponenter udgør det meste af den DNA-variation, der findes i Europa i dag:

- Jægerstenalderfolket

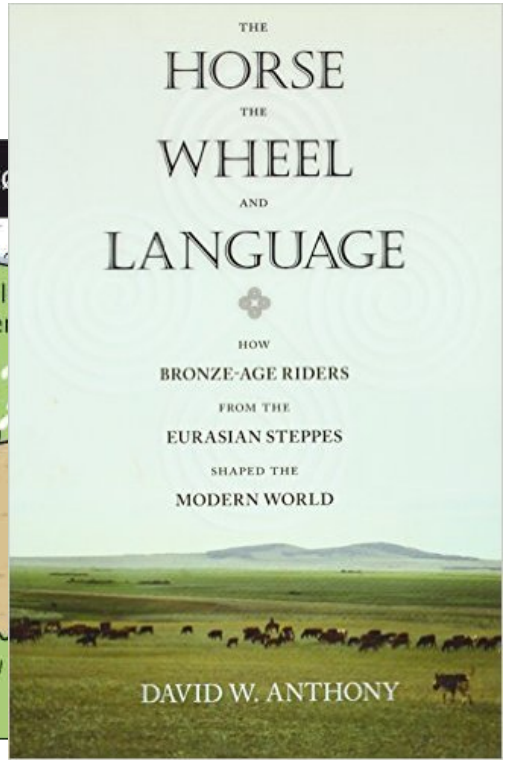
- Bondestenalderfolket (DNA fra Mellemøsten)

- Bronzealderfolket (DNA fra stepperne)

- Yamnaya-migrationen etablererer Europa genetisk

- 30-50% Yamnaya DNA i os alle

- Men hvorfor denne vandringslyst?



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Contents lists available at SciVerse ScienceDirect

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journal homepage: http://www.elsevier.com/locate/jas

Demography and the intensity of cultural activities: an evaluation of Funnel Beaker Societies (4200–2800 cal BC)

Martin Hinz [a,*], Ingo Feeser [a], Karl-Göran Sjögren [b], Johannes Müller [a]

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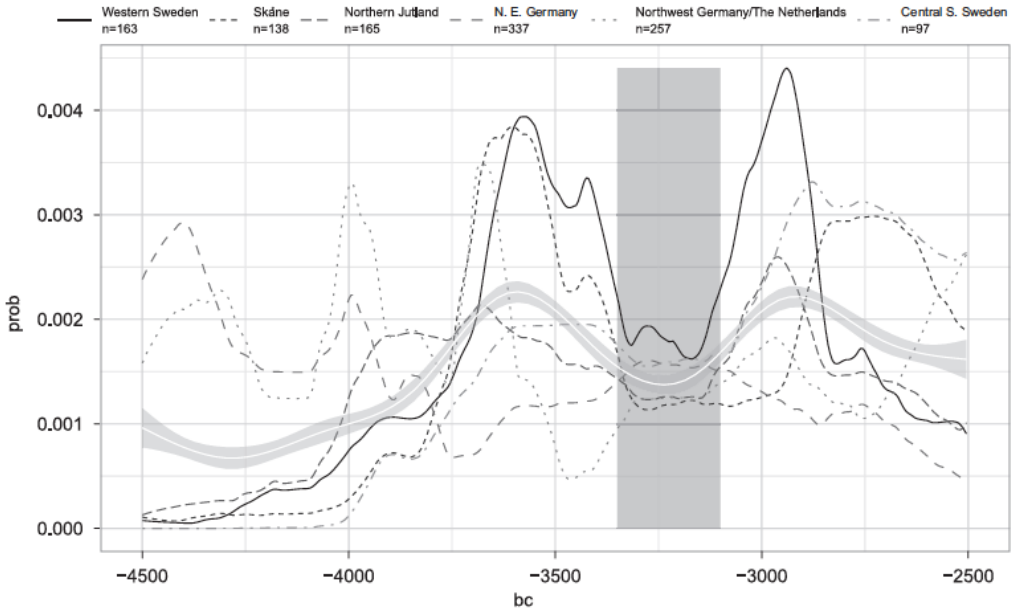
[b] Institutionen för historiska studier, Göteborgs Universitet, Box 200, 405 30 Göteborg, E 218, Sweden



ARTICLE

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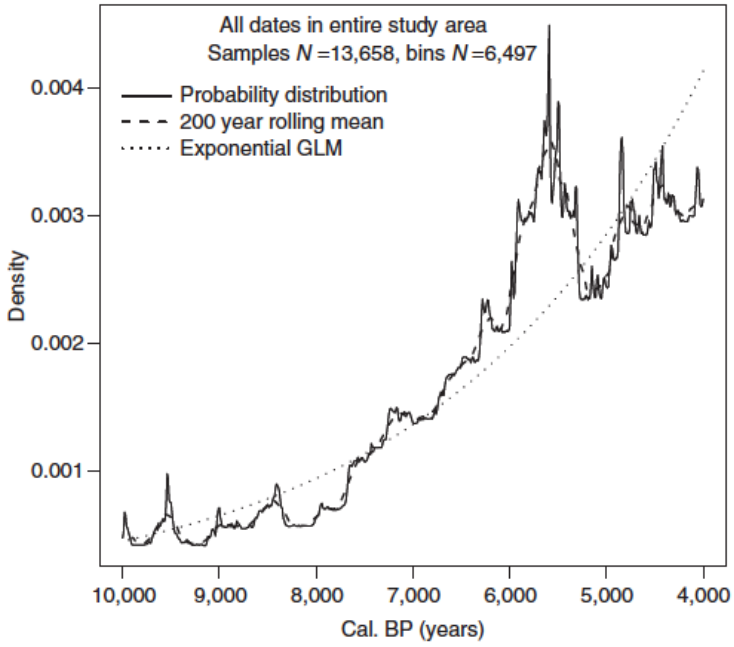
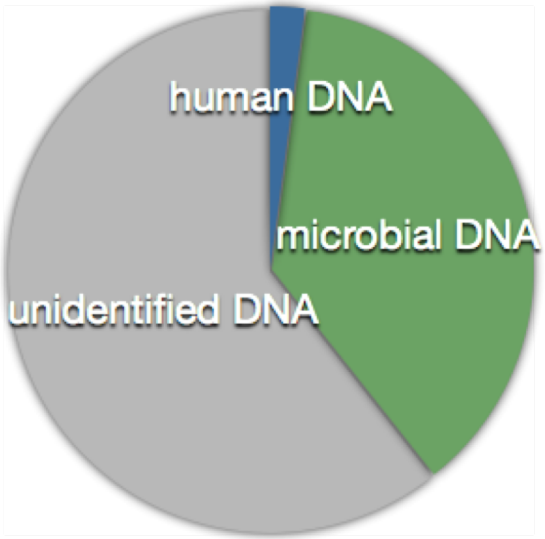
Regional population collapse followed initial agriculture booms in mid-Holocene Europe

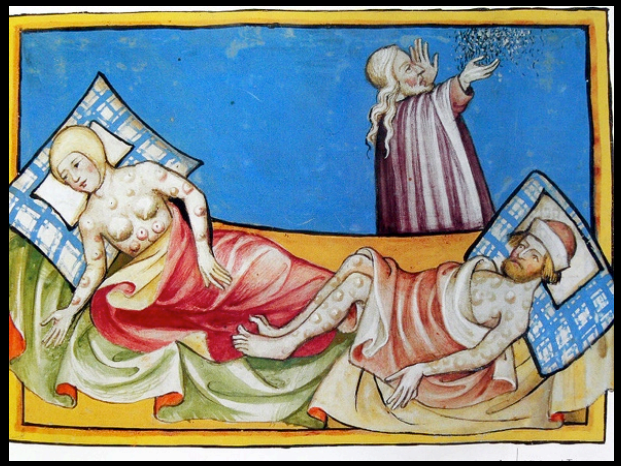
Stephen Shennan[1], Sean S. Downey[1,2], Adrian Timpson[1,3], Kevan Edinborough[1], Sue Colledge[1], Tim Kerig[1], Katie Manning[1] & Mark G. Thomas[3]



ancient DNA



Yersenia pestis




07/11/2012

Article

Early Divergent Strains of *Yersinia pestis* in Eurasia 5,000 Years Ago

Simon Rasmussen,[1,18] Morten Erik Allentoft,[2,18] Kasper Nielsen,[1] Ludovic Orlando,[2] Martin Sikora,[2] Karl-Göran Sjögren,[3] Anders Gorm Pedersen,[1] Mikkel Schubert,[2] Alex Van Dam,[1] Christian Moliin Outzen Kapel,[4] Henrik Bjørn Nielsen,[1] Søren Brunak,[1,5] Pavel Avetisyan,[6] Andrey Epimakhov,[7] Mikhail Viktorovich Khalyapin,[8] Artak Gnuni,[9] Aivar Kriiska,[10] Irena Lasak,[11] Mait Metspalu,[12] Vyacheslav Moiseyev,[13] Andrei Gromov,[13] Dalia Pokutta,[3] Lehti Saag,[12] Liivi Varul,[10] Levon Yepiskoposyan,[14] Thomas Sicheritz-Pontén,[1] Robert A. Foley,[15] Marta Mirazón Lahr,[15] Rasmus Nielsen,[16] Kristian Kristiansen,[3] and Eske Willerslev[2,17,*]