



# 6000 years of ancient foodways in NE Baltics: biomolecular methods and social implications

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Centre for the Human Past, Talks of the Past Open Seminar

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Drawing: Jaana Ratas



# Talk outline

## How do we know what people ate?

- Introduce the main methods of biomolecular dietary analysis
  - **Stable Isotope Analysis (SIA)** from bone collagen
  - **Lipid/Organic Residue Analysis (LRA/ORAs)** from pottery
  - **Protein analysis** from skeletal remains and pottery
- 6000 years of ancient foodways in the E Baltic
  - Major trends & cool tweaks 😊



ARCHEMY

**Pots and bones, lipids and proteins:**  
biomolecular archaeology for ancient dietary studies

# Main sources/proxies for dietary analyses

Pottery



Skeletal remains



Ecofacts: animal and plant remains



Tools



Grinding stones



Sickles

Fishing gares

Coprolites



Tars

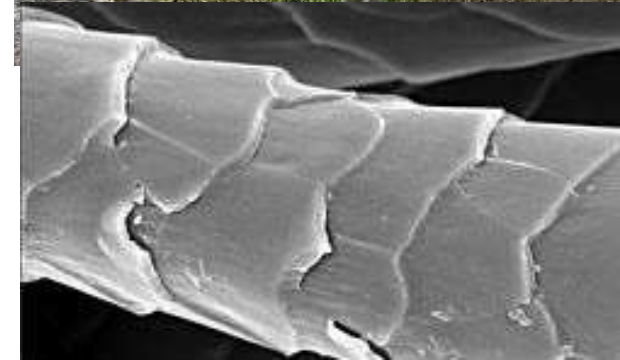
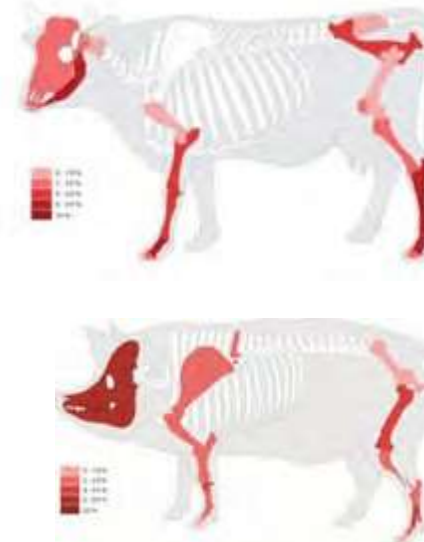


Sediment cores



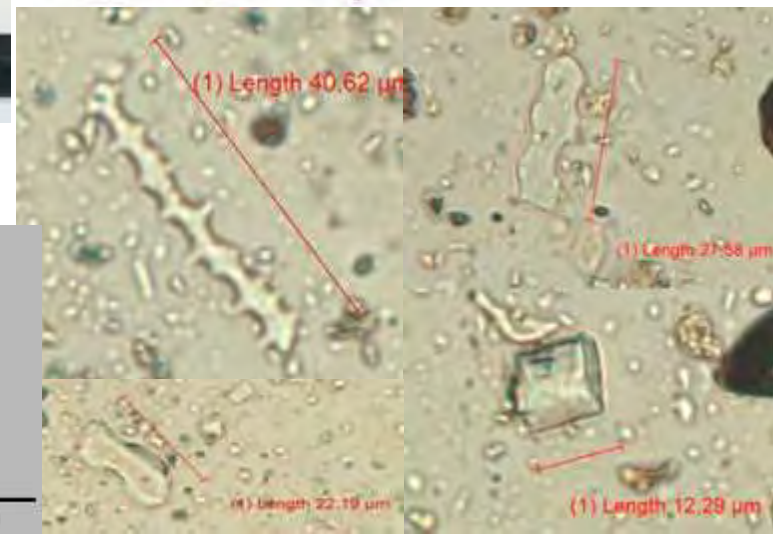
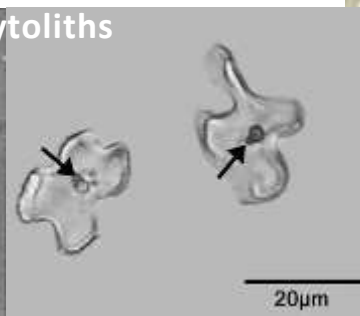
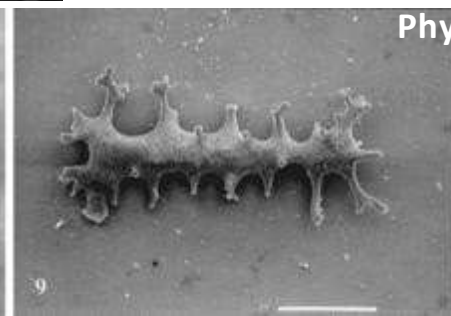
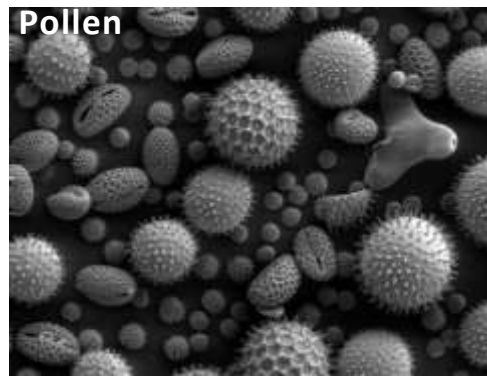
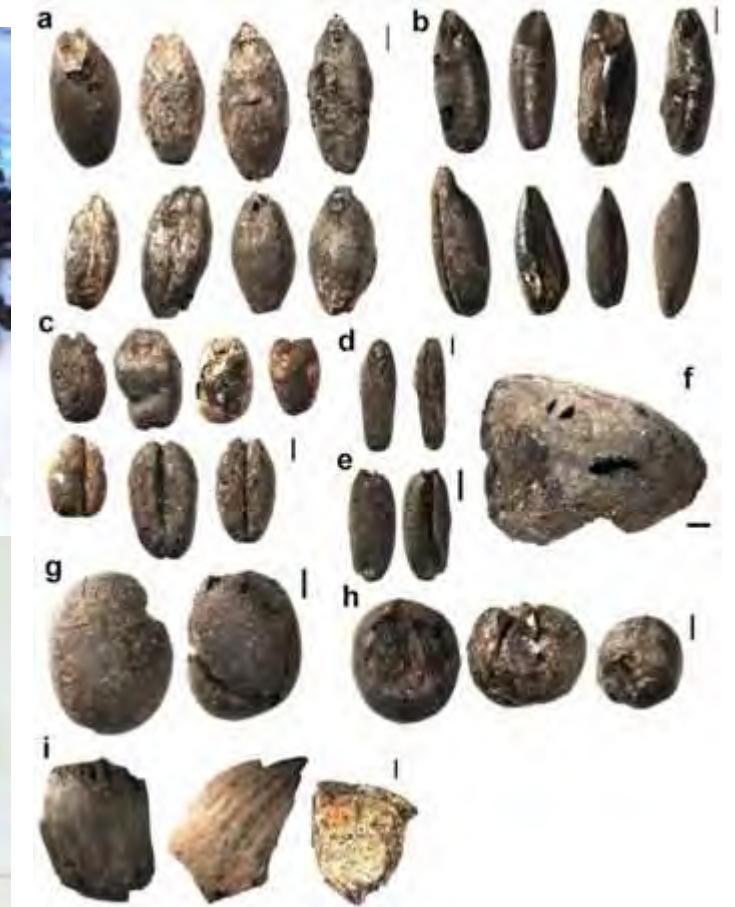
# Animal bones

- Morphological ID:
  - Species ID
    - NISP – *number of identified species*
    - MNI – *minimal number of individuals*
  - Age & sex of animals
- Cut-marks, slaughtering practices
- Micro- & macro remains



# Plant remains

- Morphological ID:
  - Species ID
- Processing marks
  - Grinding, soaking, heating
- Micro- & macro remains



# (Ancient) biomolecules

**Lipids**

Oils, fats,  
waxes, steroids

Fatty acids,  
sterols, TAGs,  
DAGs, etc.

**Carbohydrates**

Starch, sugars, cellulose

**Proteins**

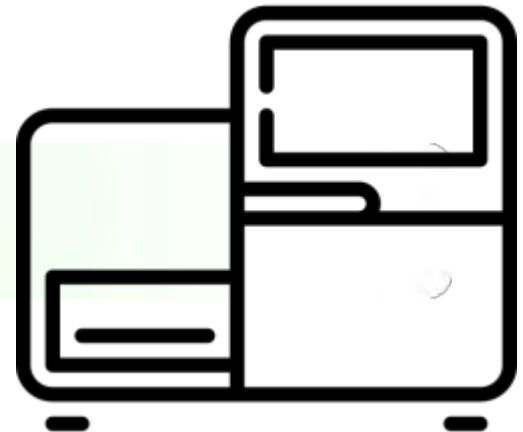
Amino acids →  
Peptides

Collagen

**DNA**  
*RNA*

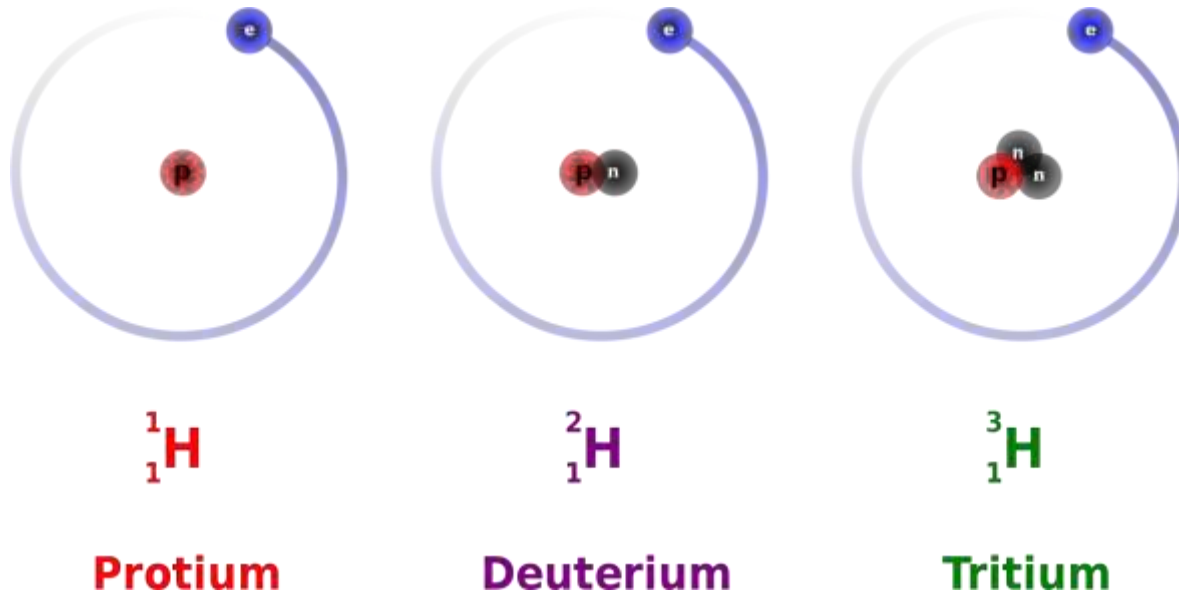
**Isotopes**

**Mass spectrometry**

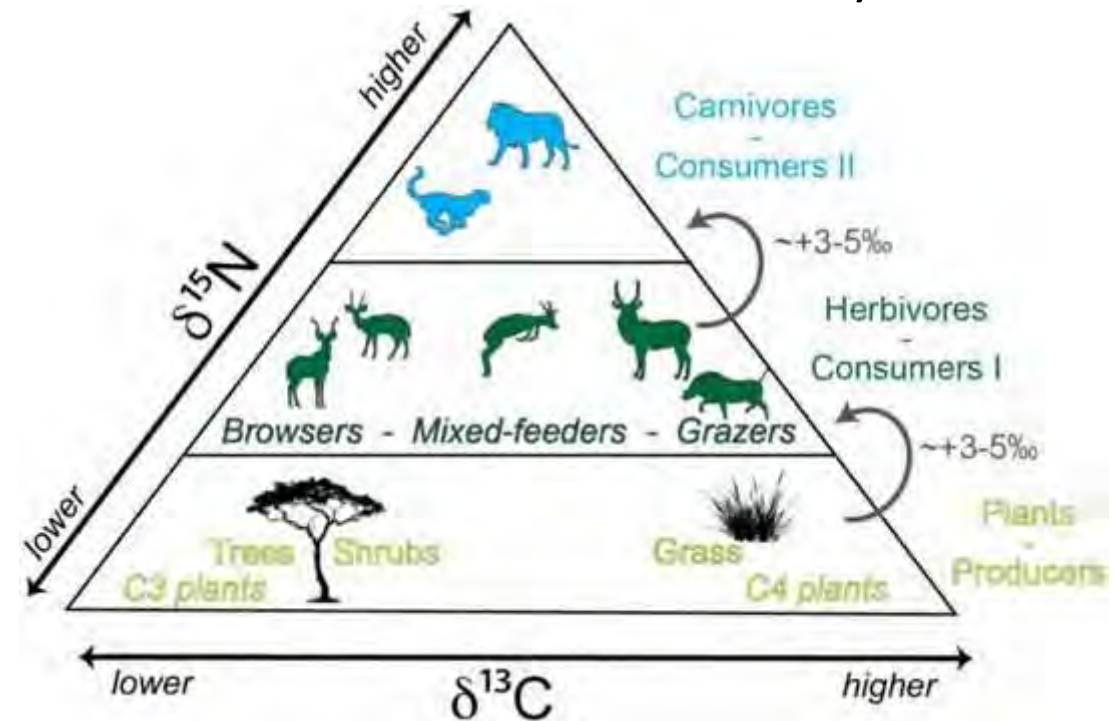


# Isotopes

- Derivates of one and the same element which differ by the **number of neutrons** in their atom (number of protons and electrons is the same)



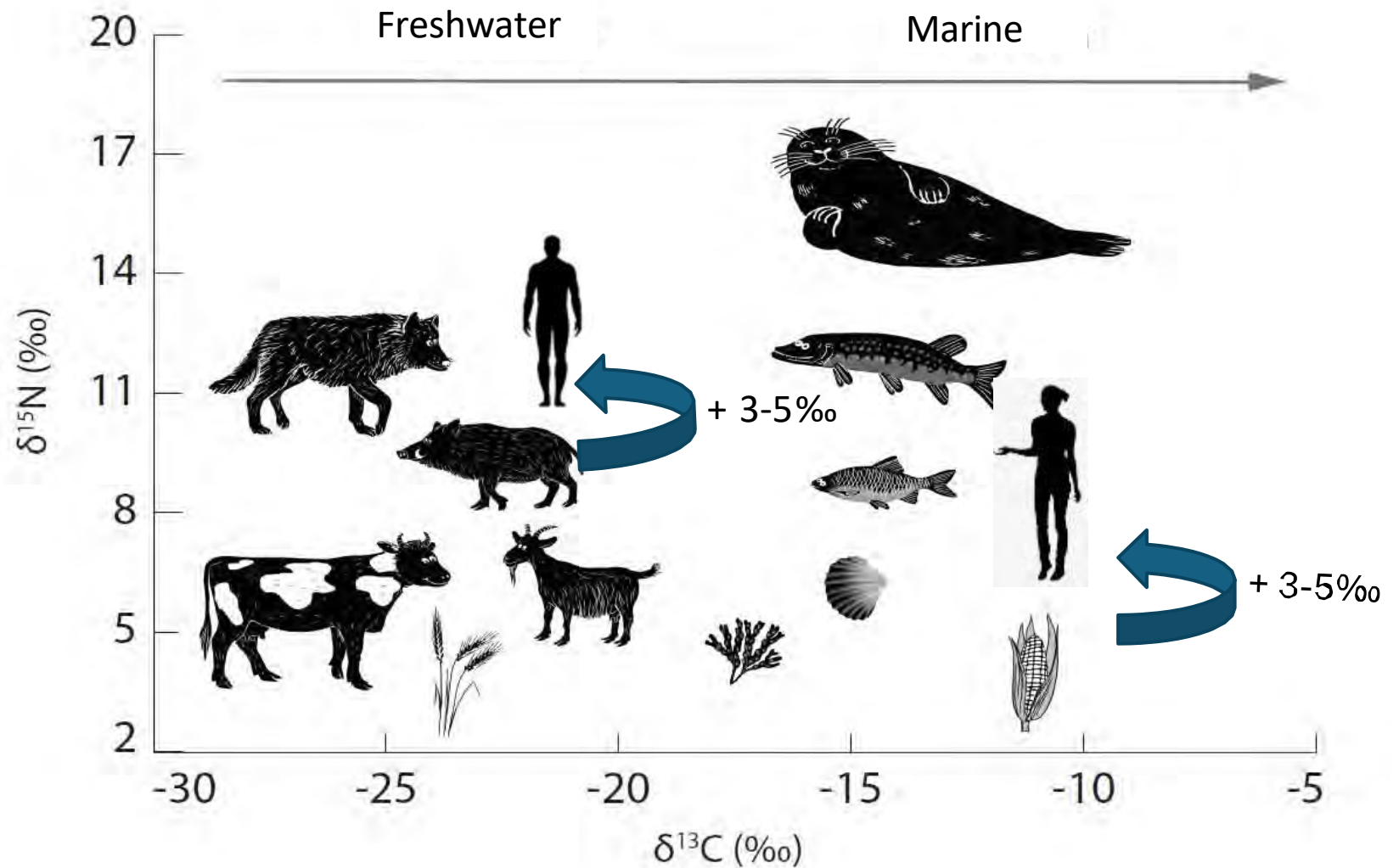
Wikimedia Commons



- Stable isotope = non-radioactive, stable in time

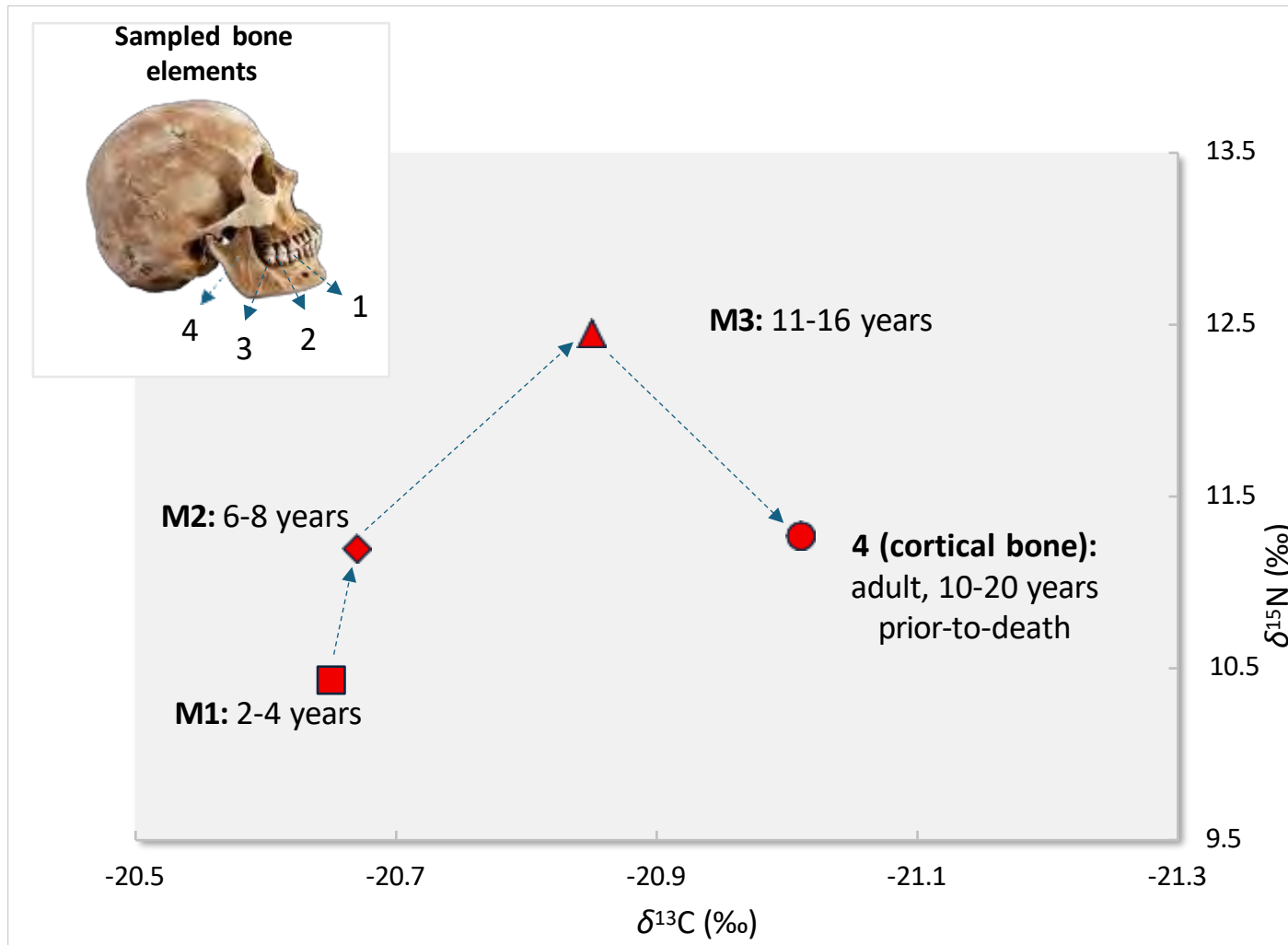
Lüdecke et al. 2022,  
[10.3389/fevo.2022.958032](https://doi.org/10.3389/fevo.2022.958032)

# Bone SIA: You are what you eat + 3-5‰!!!



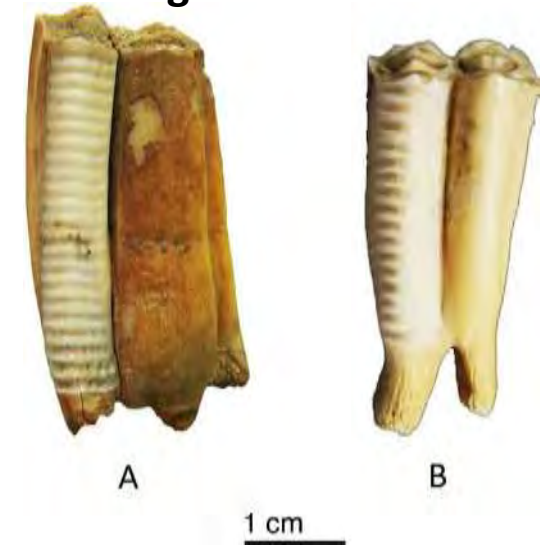


# Dietary biographies



Graph: Mari Tõrv

Incremental sampling ->  
higher resolution results



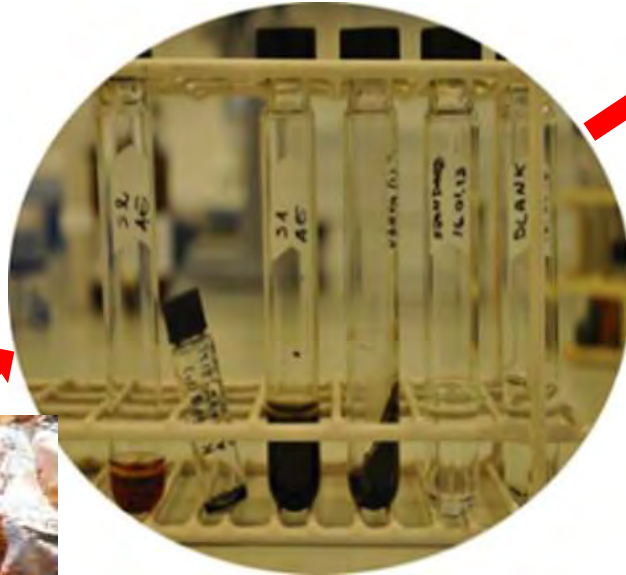
Miller et al. 2018, [10.3791/58002](https://doi.org/10.3791/58002)



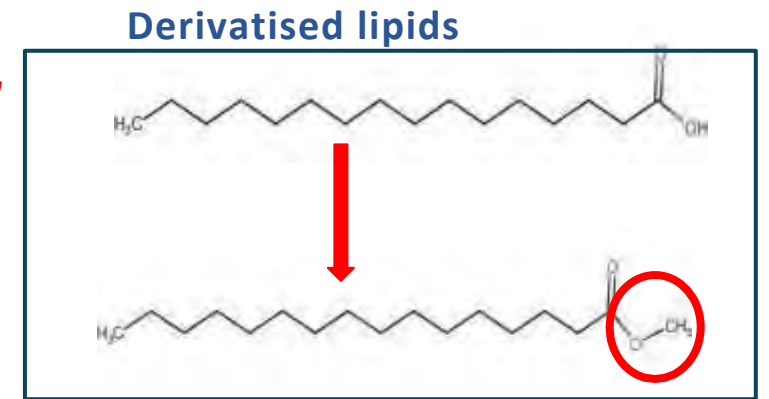
# Pottery ORA



- Pot sherd:
- Food-crust
  - Ceramic powder



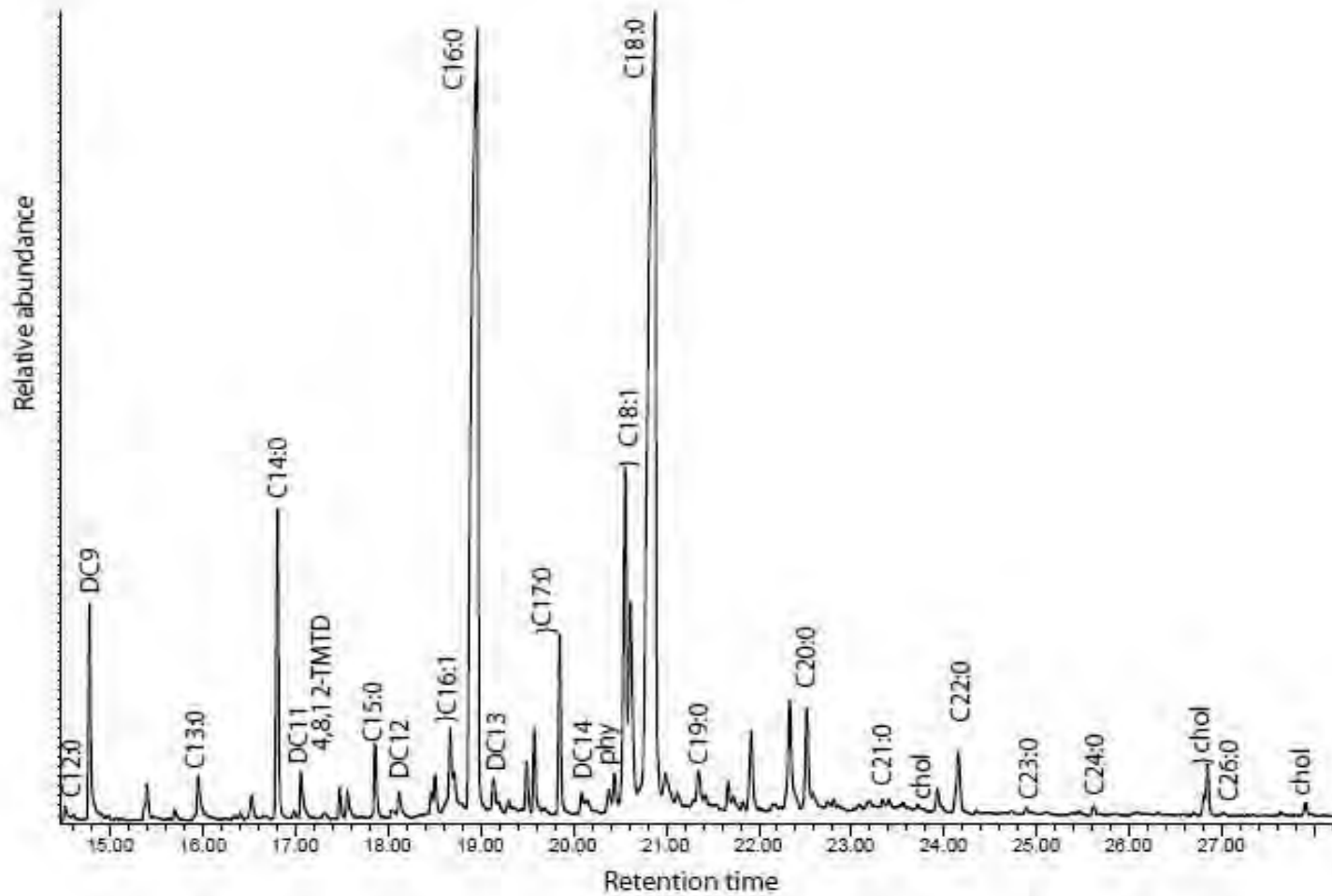
Lipid extraction and derivatisation



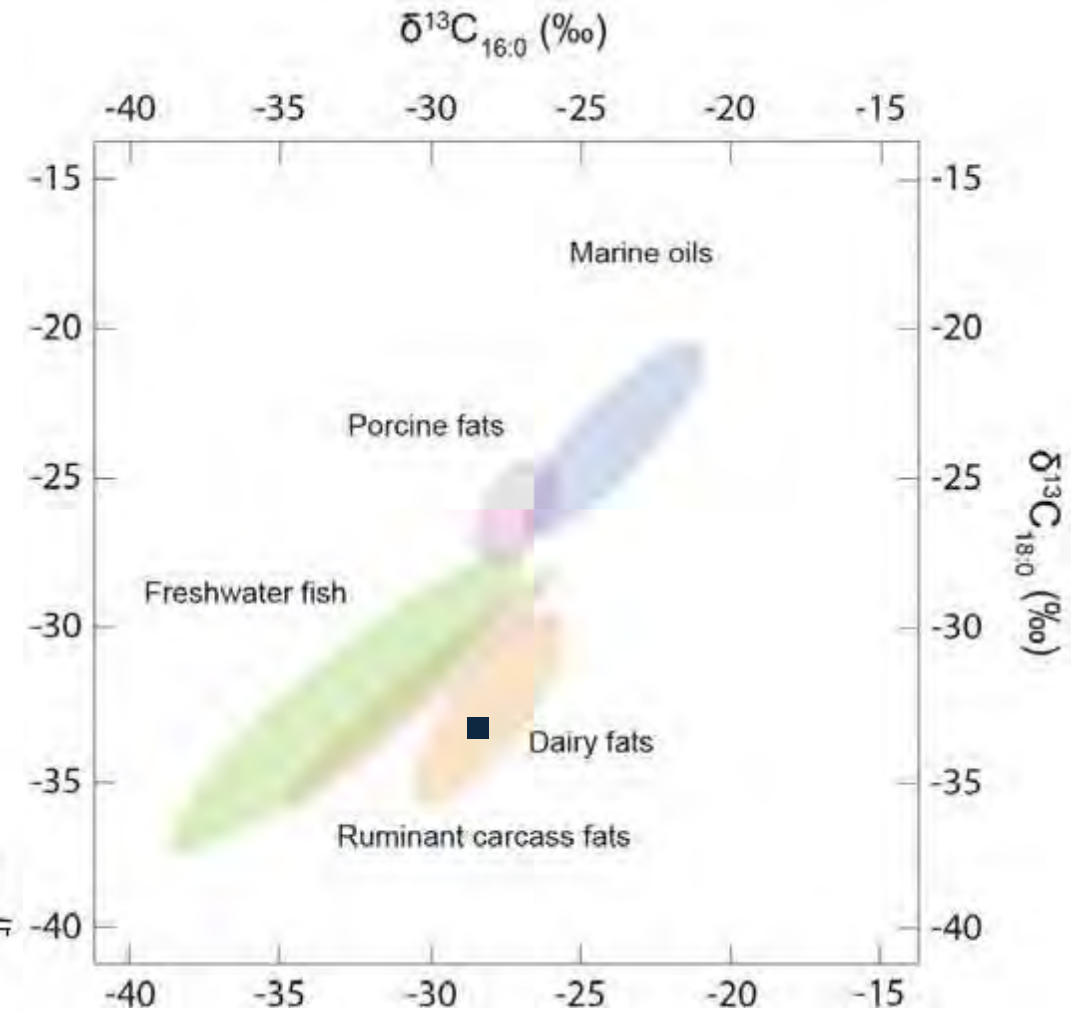
Sample with extracted lipids  
-> GC-MS & GC-C-IRMS analyses

# Molecular biomarkers and isotopes

GC-MS chromatogram



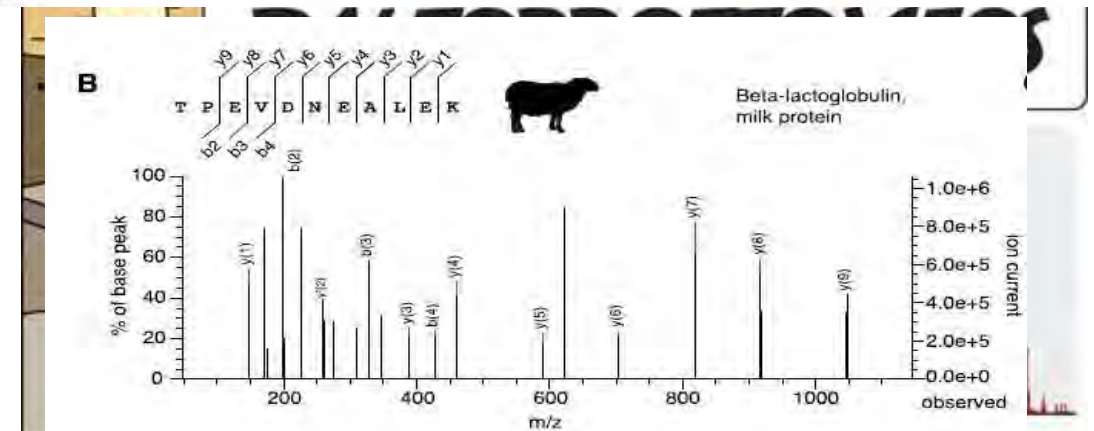
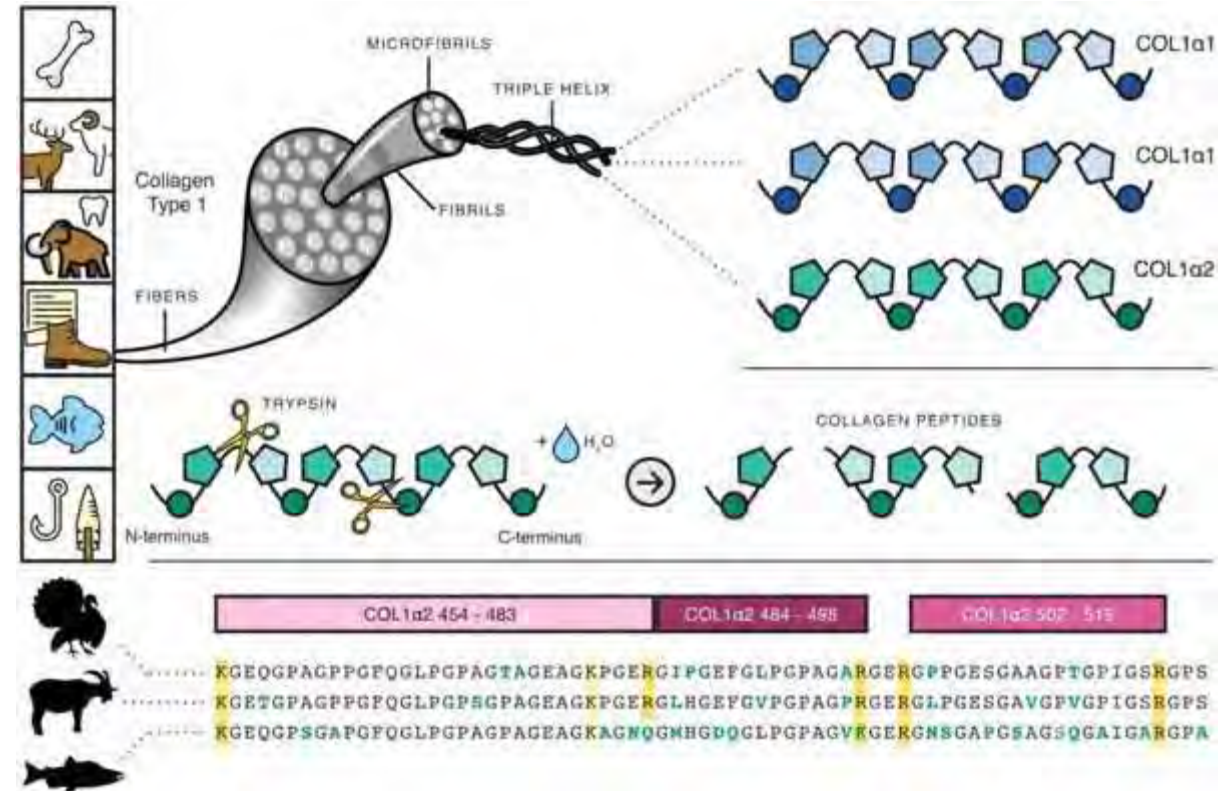
Compound-specific isotopes



# Proteins

- Amino acids -> peptides -> proteins
- **ZooMS** (MALDi-ToF) method for species identification
  - Collagen peptide mass fingerprinting
- **Shotgun proteomics**: non-targeted, i.e. measures all proteins in the sample
  - dietary and disease analysis **down to level of species & tissues!**
- **Sexing** of humans & animals
  - tooth enamel amelogenin: AMELX and AMELY

Richter et al. 2022 PNAS



Warinner et al. 2022, Chem. Rev.

# 6000 years of ancient foodways in NE Baltics



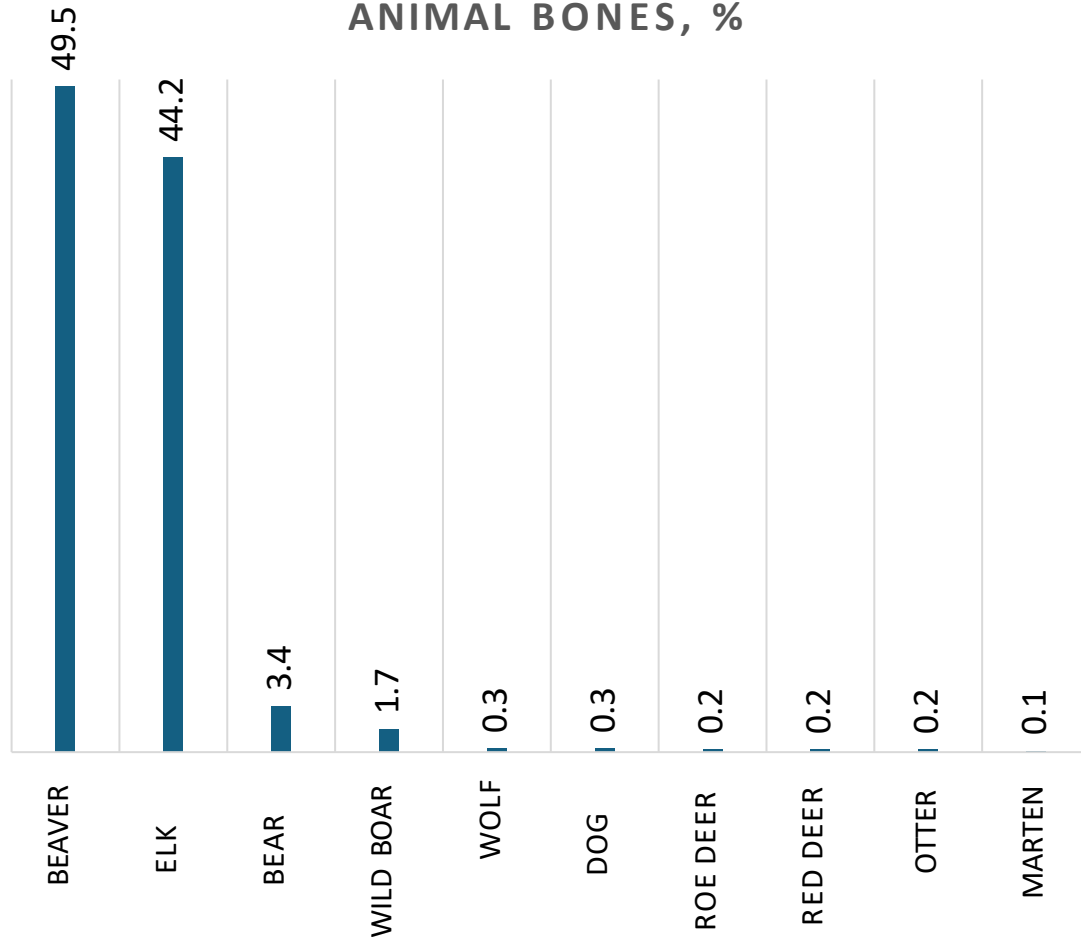
Earliest  
foodways



Drawing: Jaana Ratas

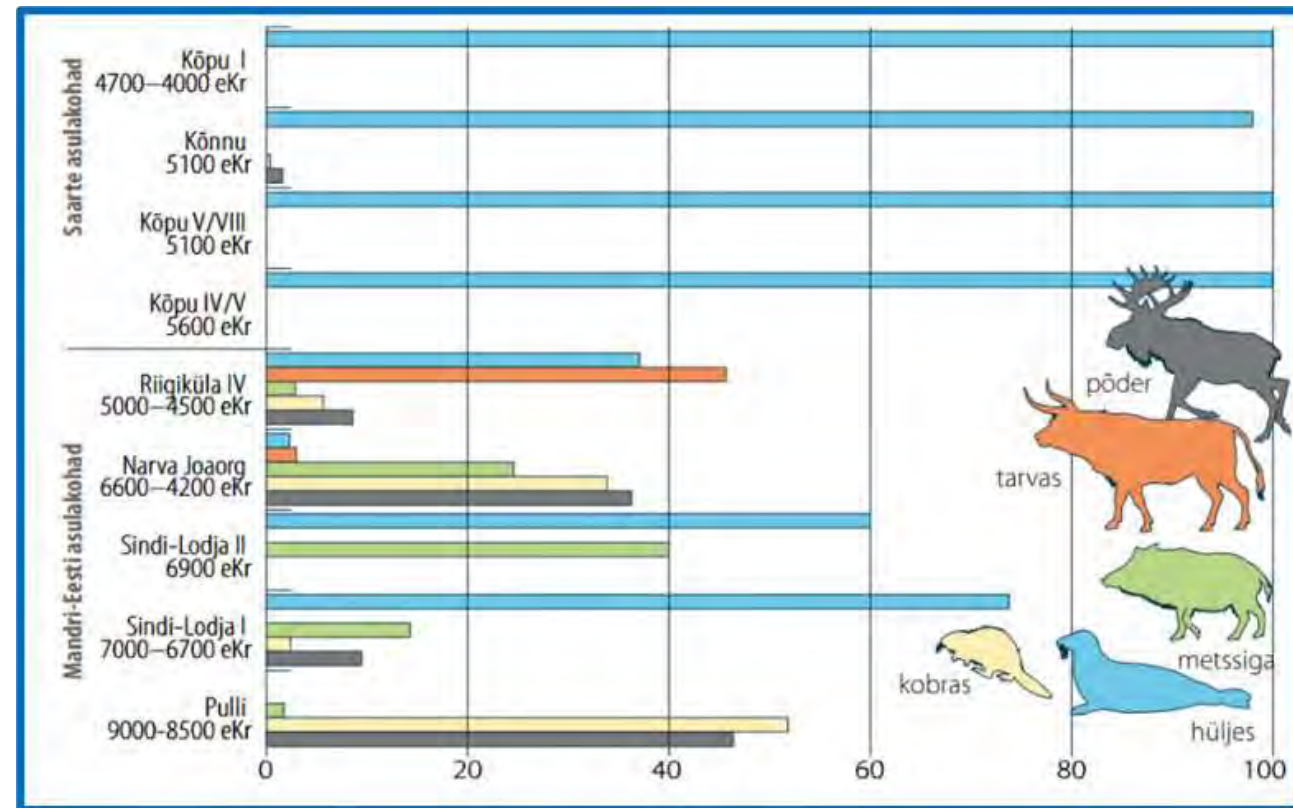
# Earliest inhabitants: Mesolithic (9000-3900 BCE)

PULLI SETTLEMENT (CA 9000 BC)  
ANIMAL BONES, %

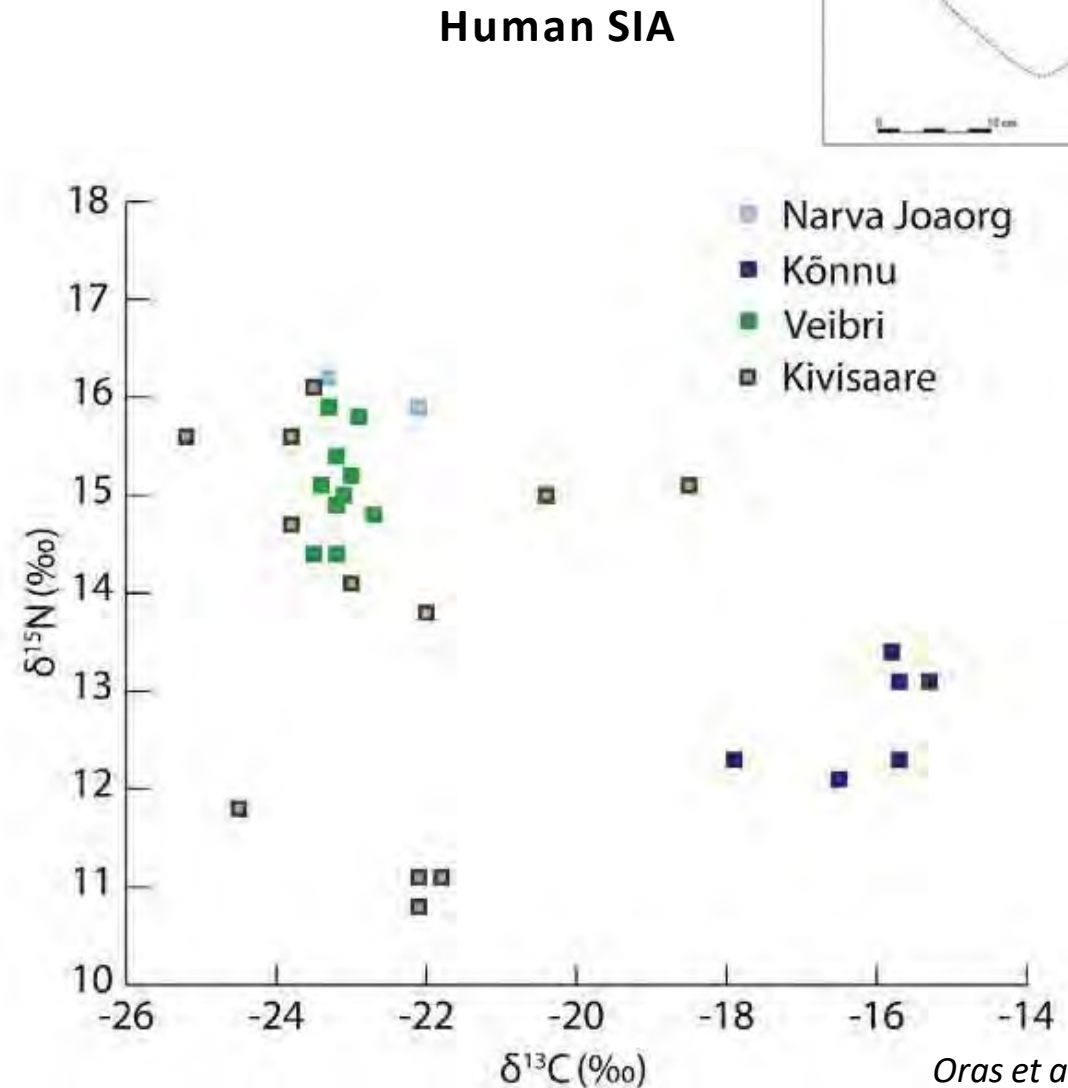
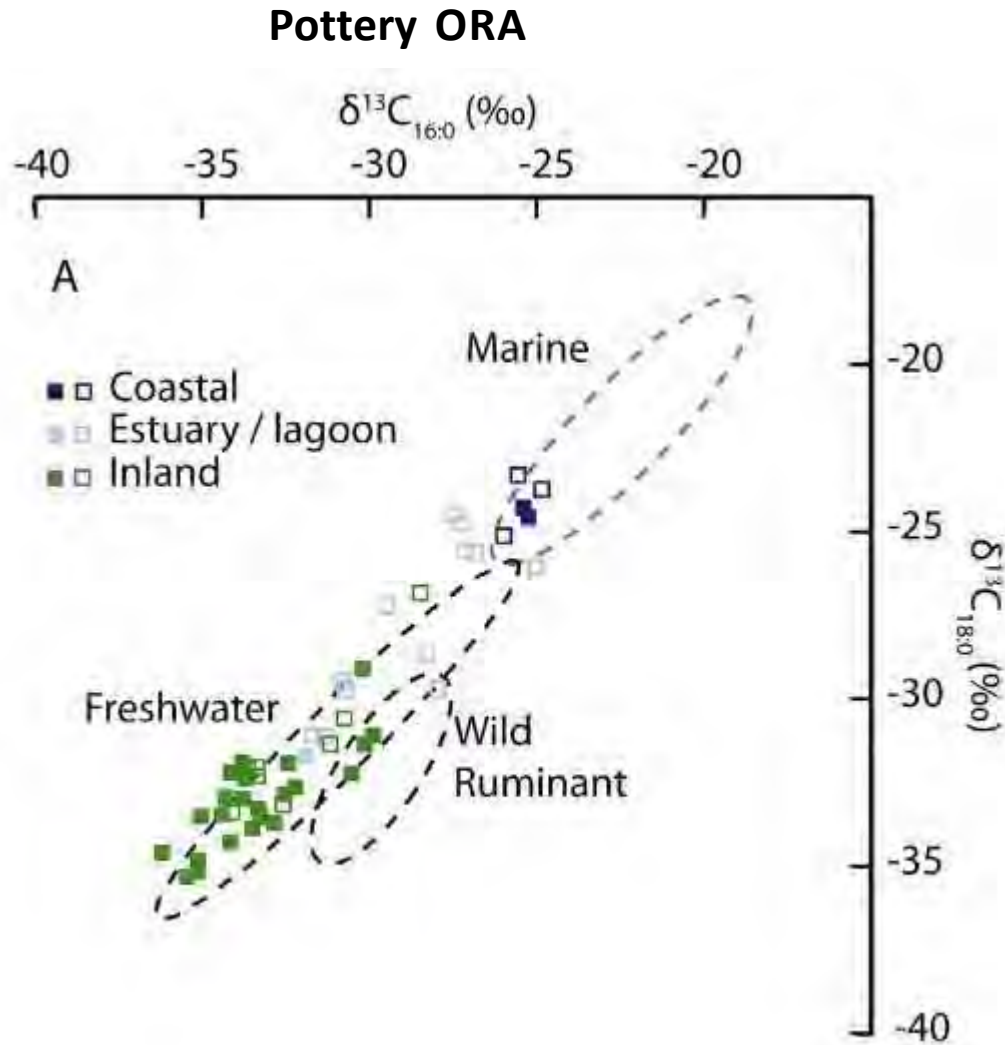


**FISH?**

Pike skeleton  
from Kunda

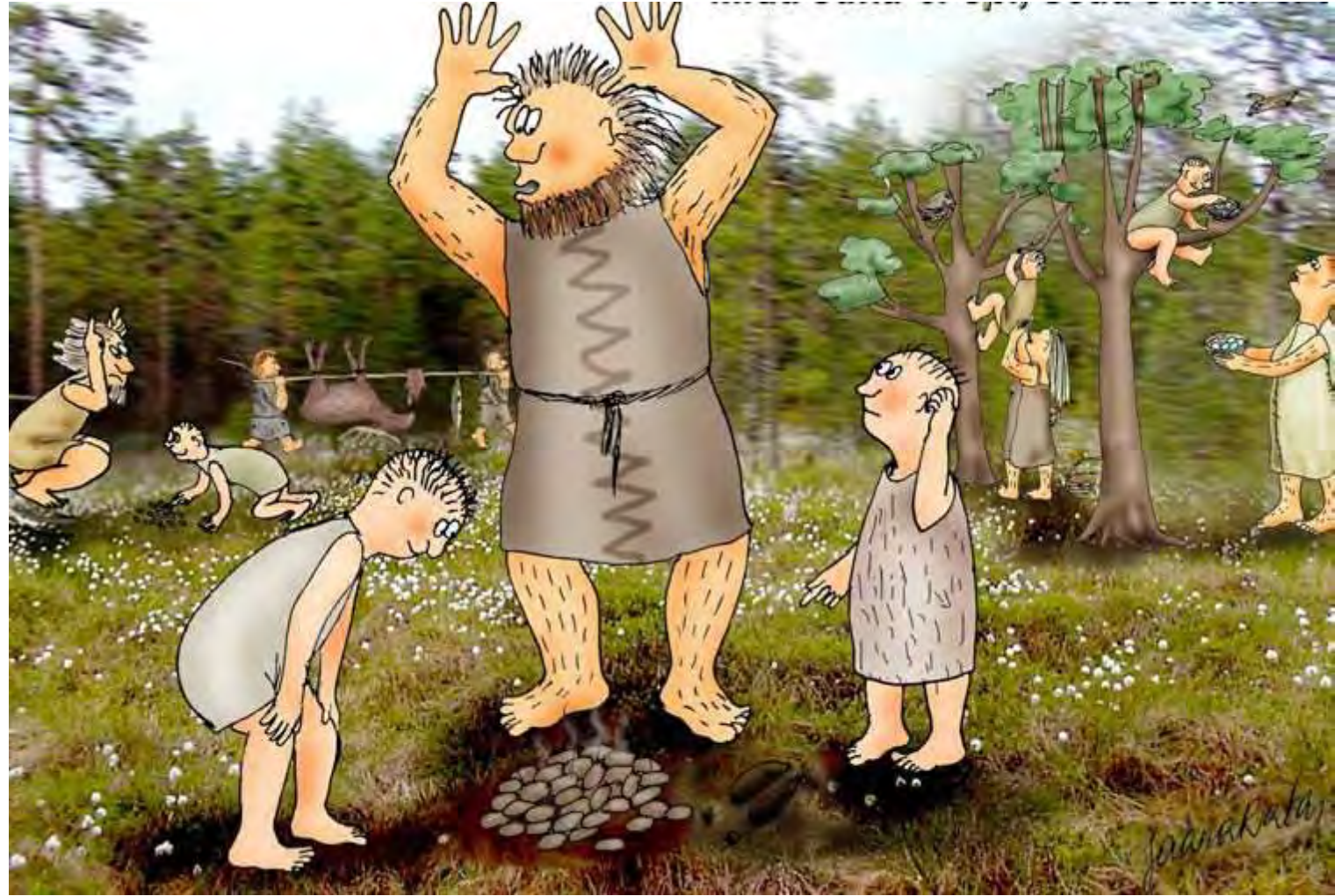


# Earliest pottery (5900-3900 BCE)





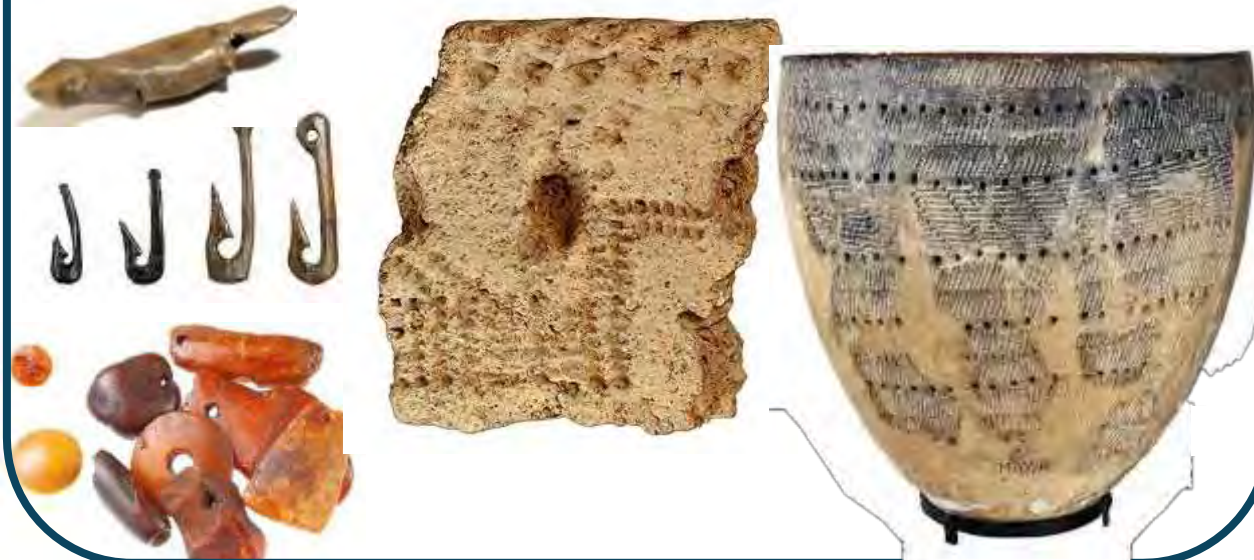
Arrival of domesticates



Drawing: Jaana Ratas

# Context: NE Baltic 3rd mill cal BCE

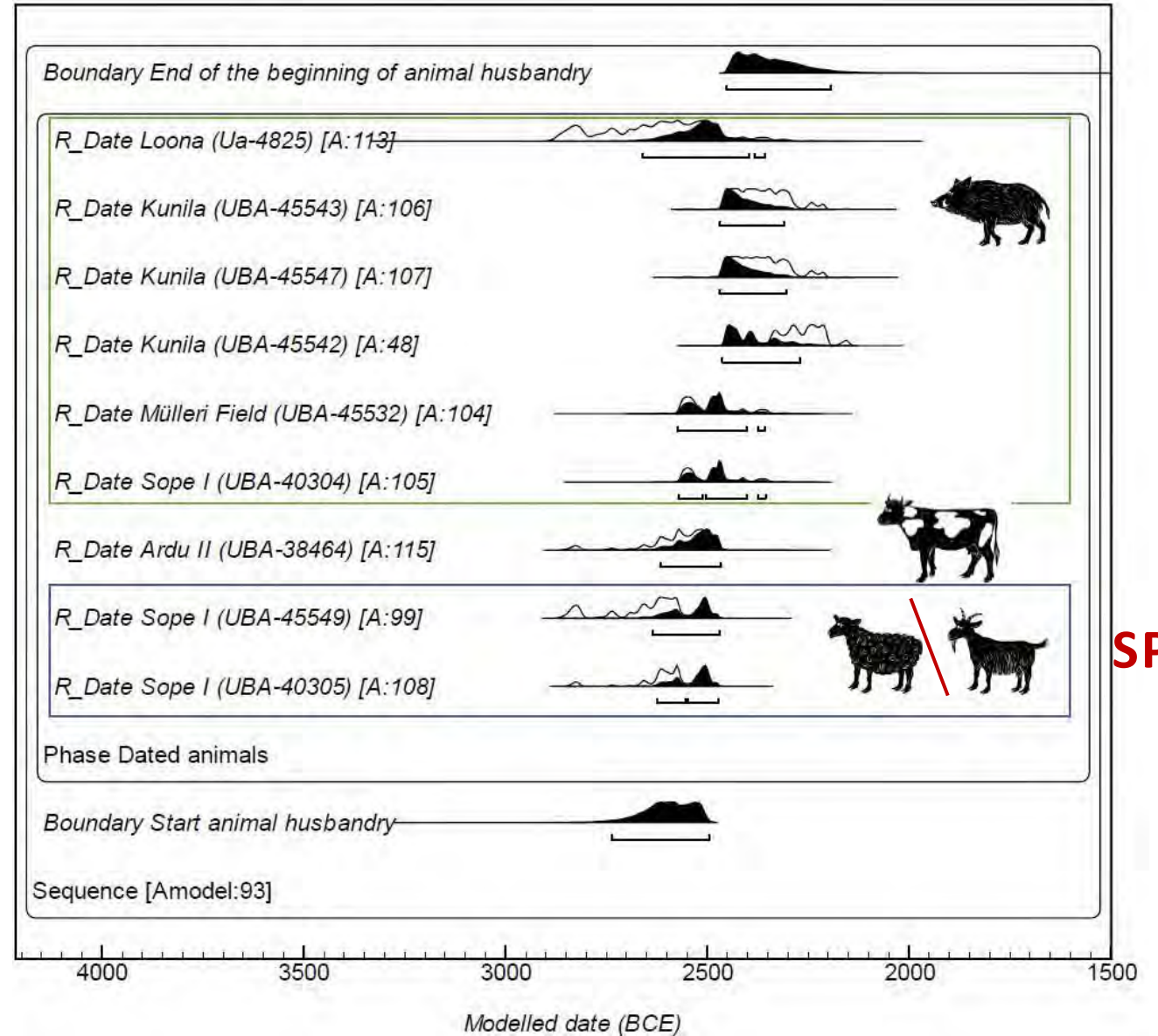
Comb Ware culture (3900–1800 BCE)  
**hunter-gatherers**



Corded Ware culture (2800–2000 BCE)  
**farmers**



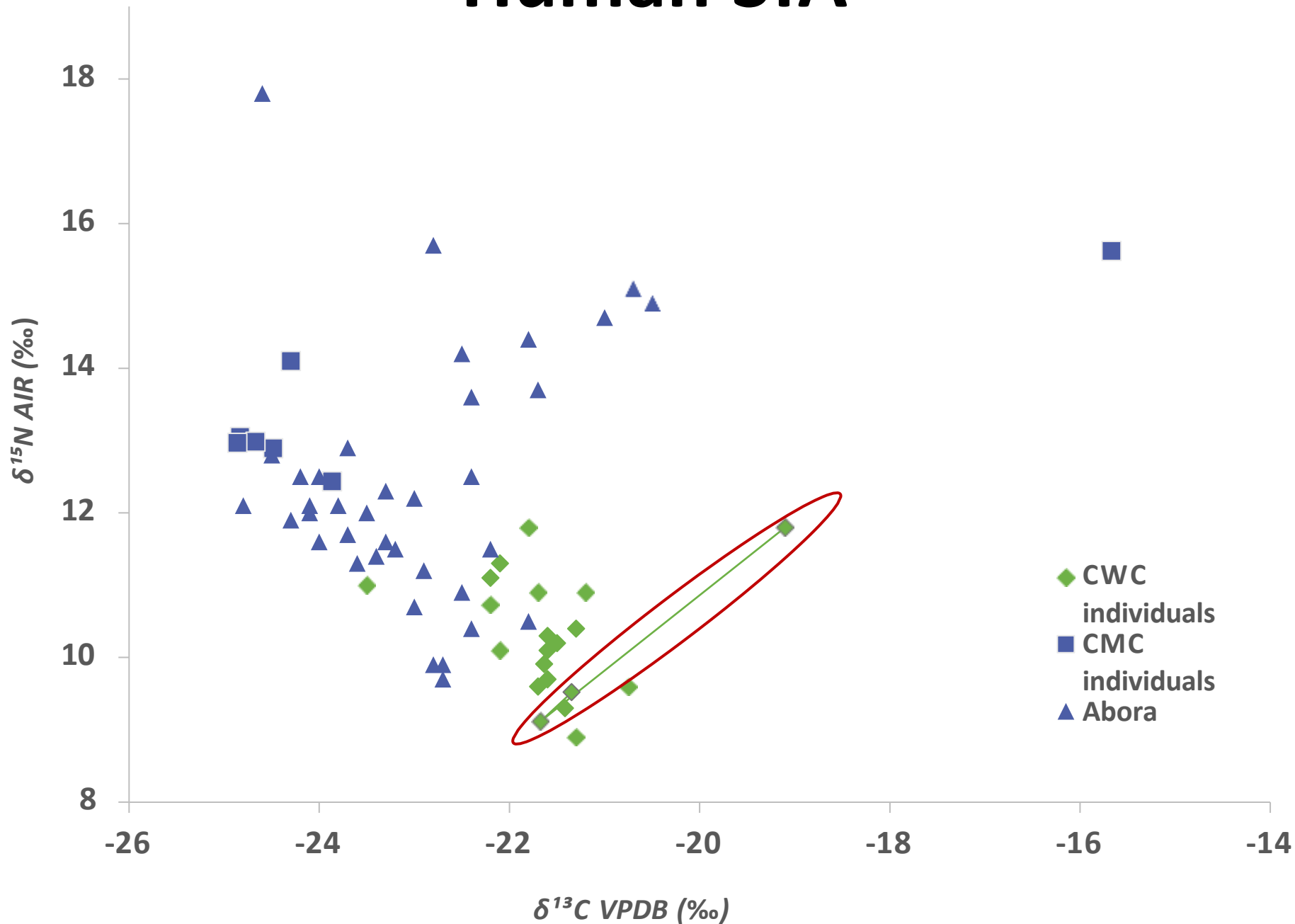
# Animal bones



**Modelled starting time: 2730–2490 cal BCE (95.4%)**

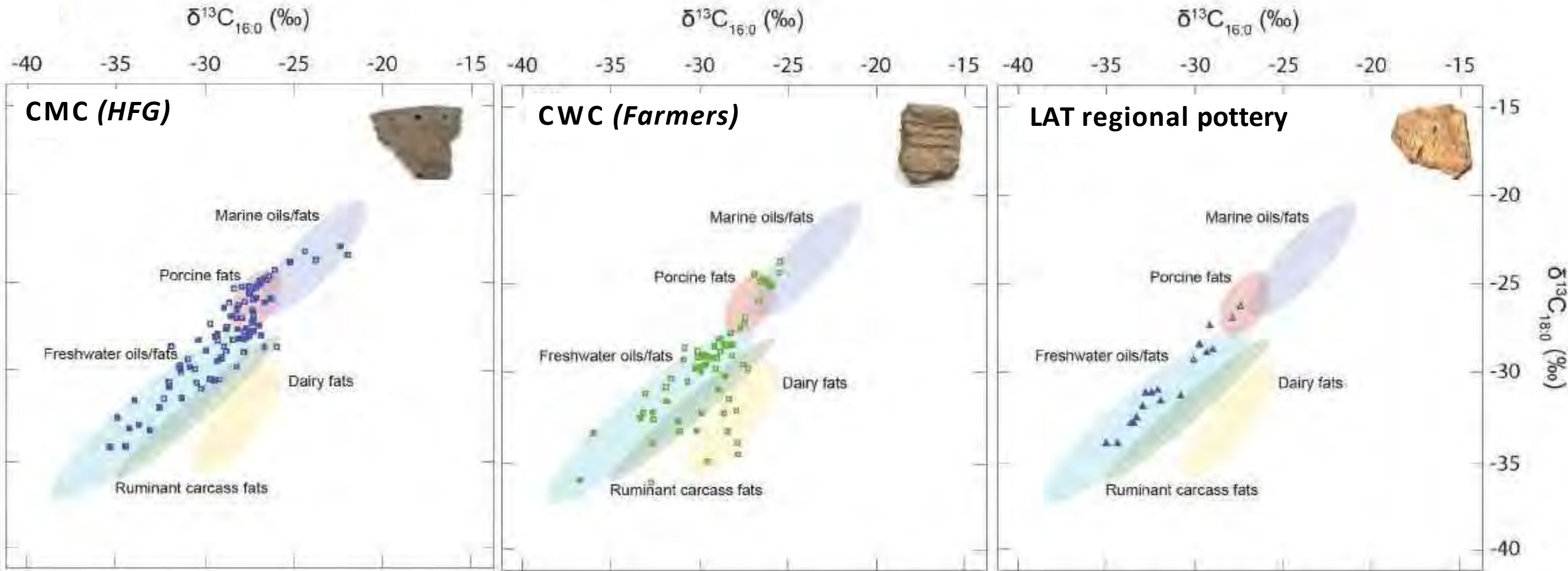
# Human SIA

*Oras et al. 2023, RSOS*



# Pottery ORA

Oras et al. 2023, RSOS



Preliminary dental calculus shotgun proteomics from CWC: consumption of **ruminant dairy and meat**

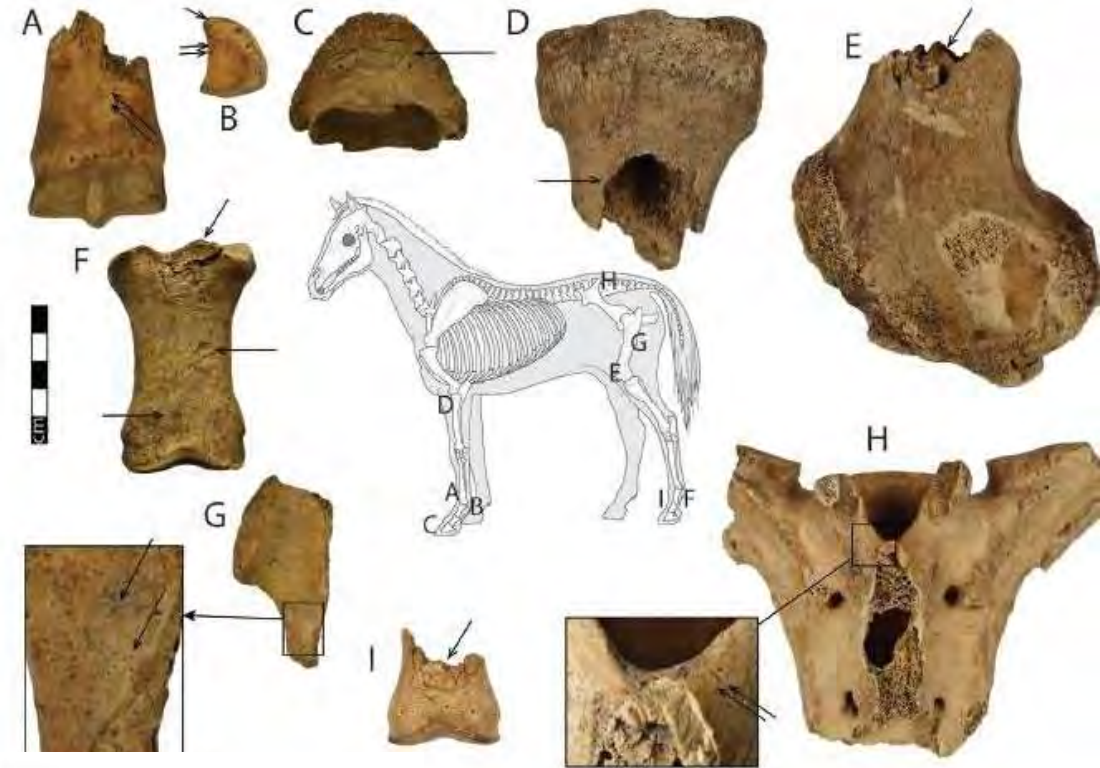
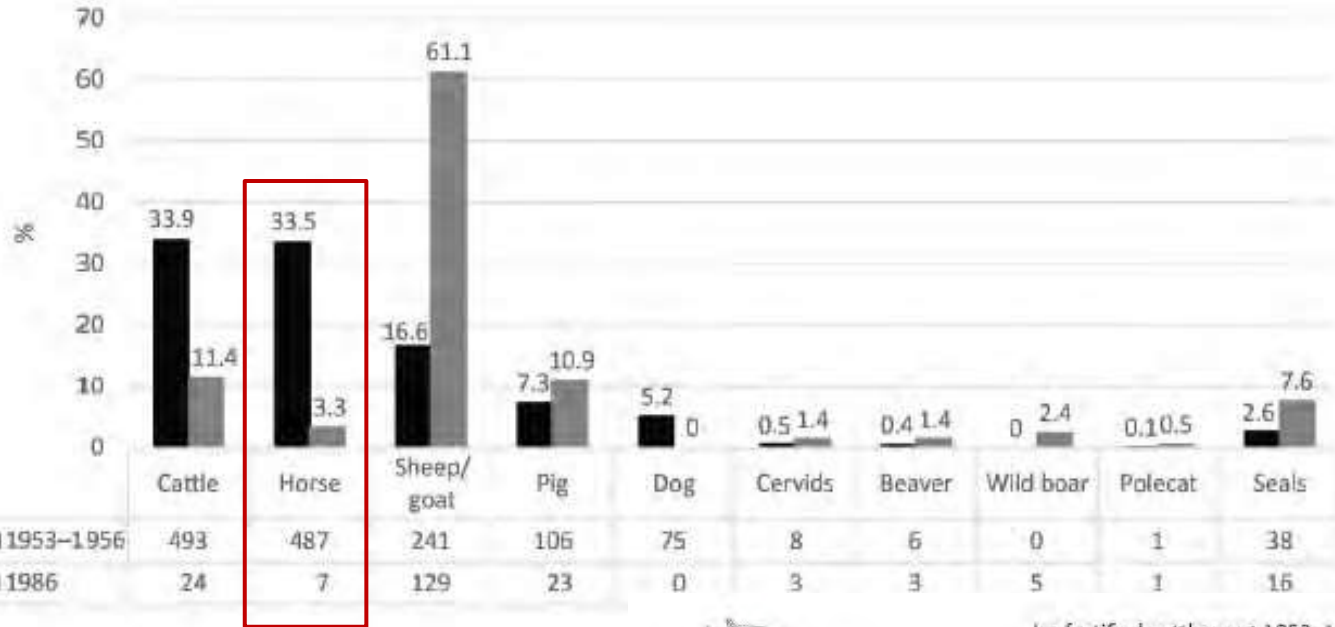


Bronze,  
cereals and  
horses

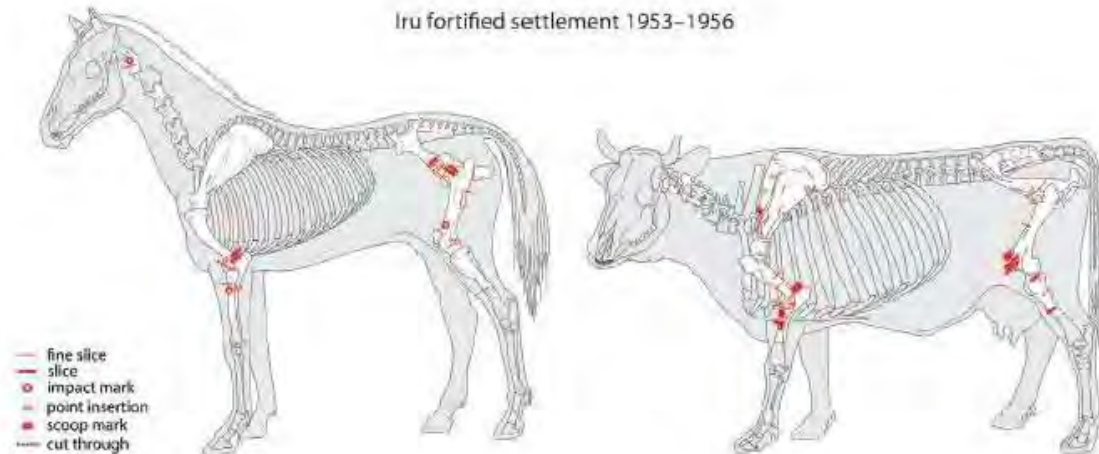


Drawing: Jaana Ratas

# Horsemeat anyone?



Iru fortified settlement 1953-1956



Iron Age  
varieties



Drawing: Jaana Ratas





# Social complexities & micro-regions: 12th-13th cent CE **Kukruse & Pada** comparisons

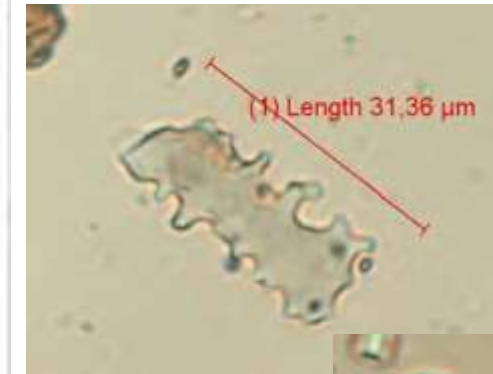


# Ritual & daily food: food-crust SIA

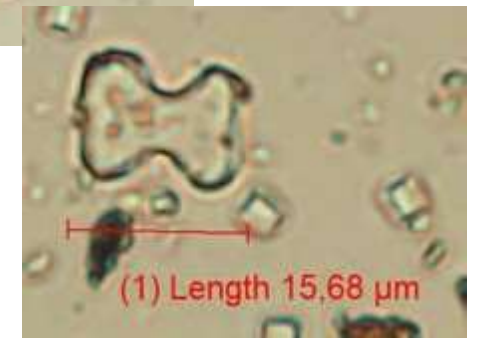


Starch grains

## Phytoliths in food-crusts

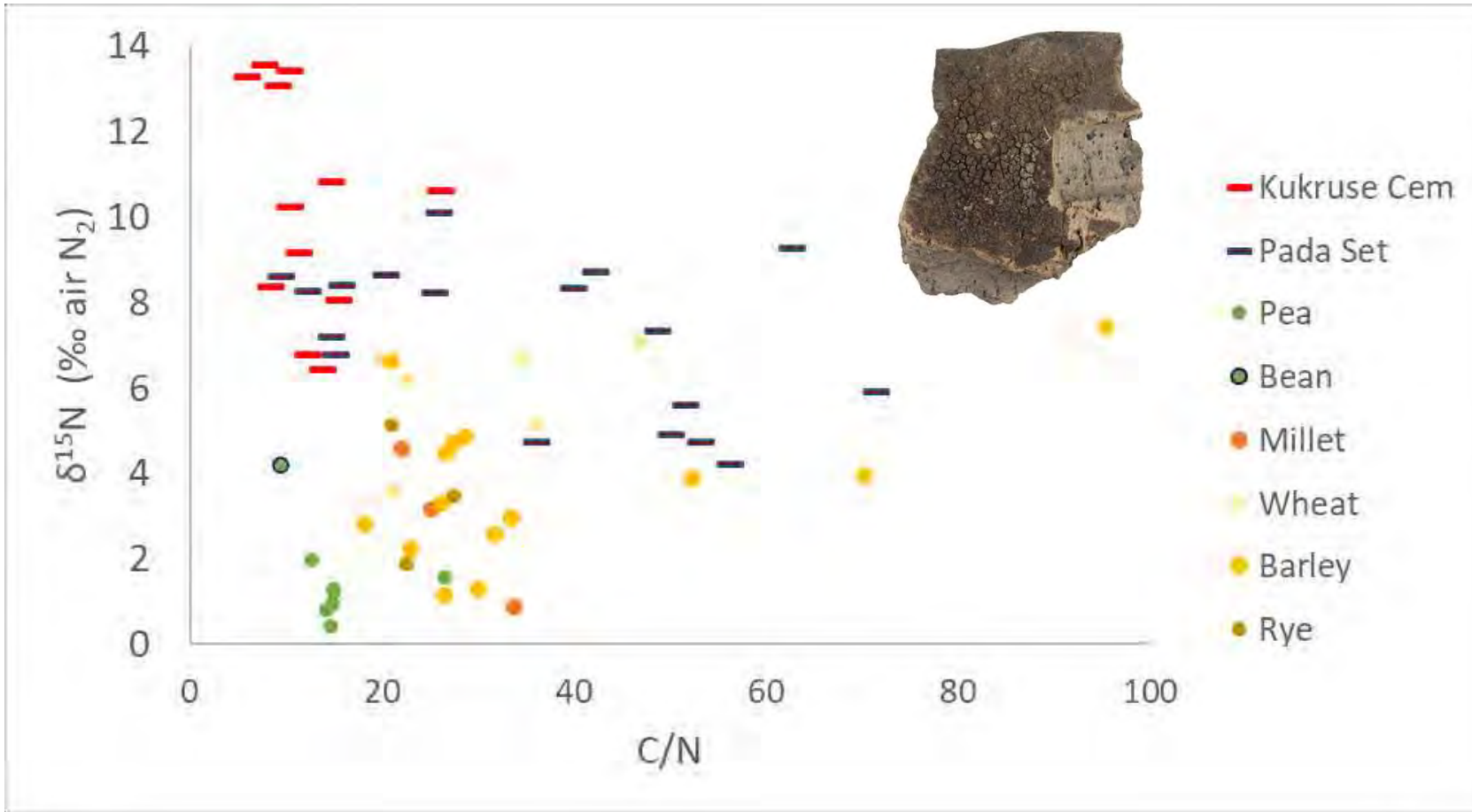
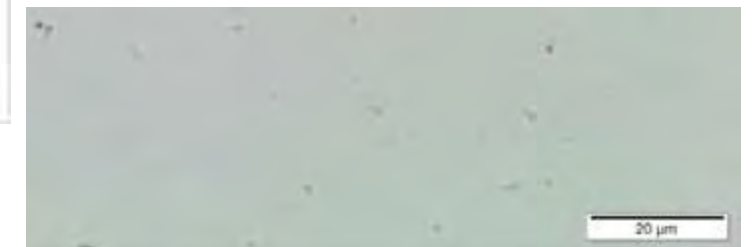


Pada settlement



Photos: Kristiina Johanso

## Kukruse cemetery

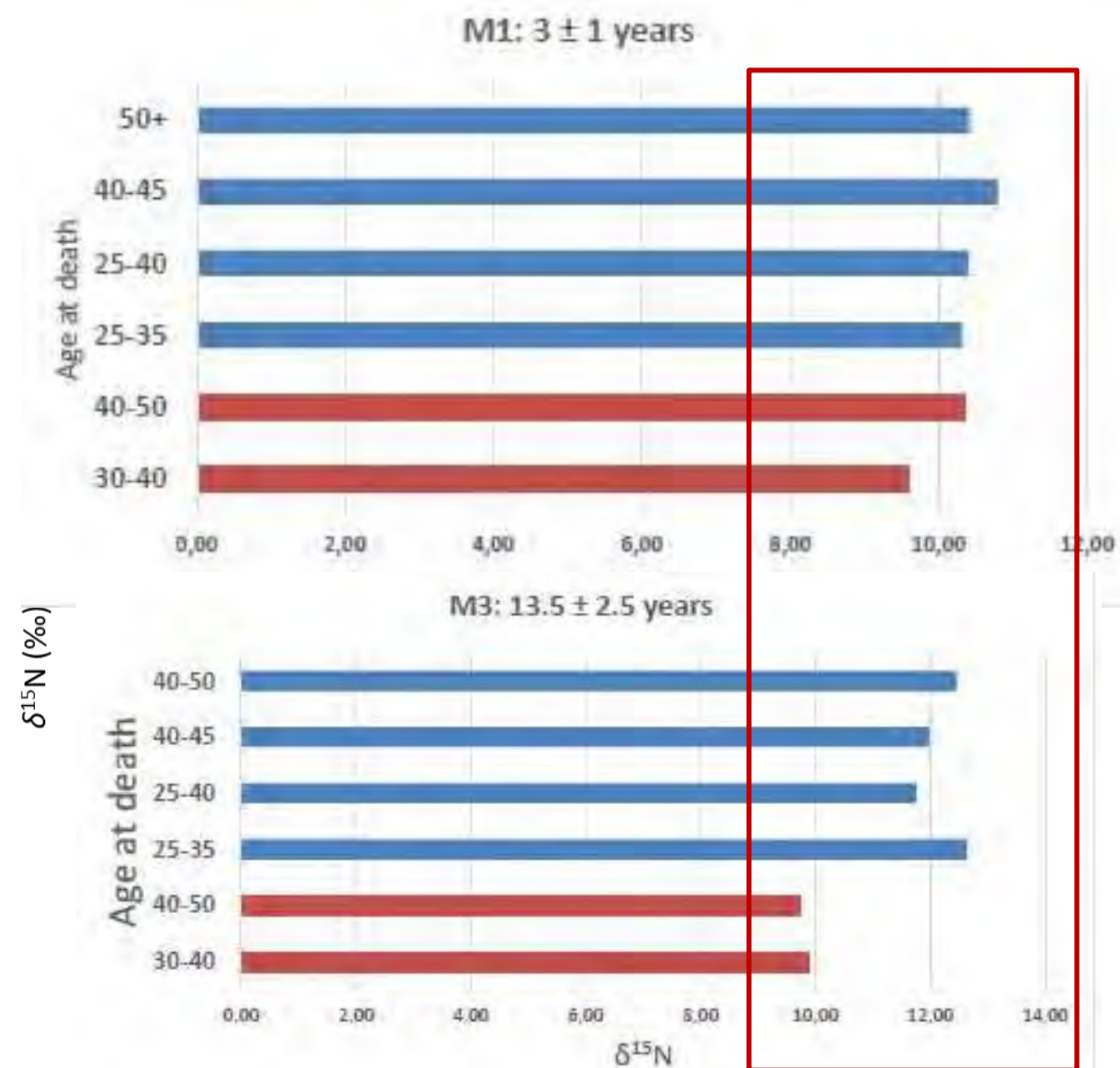
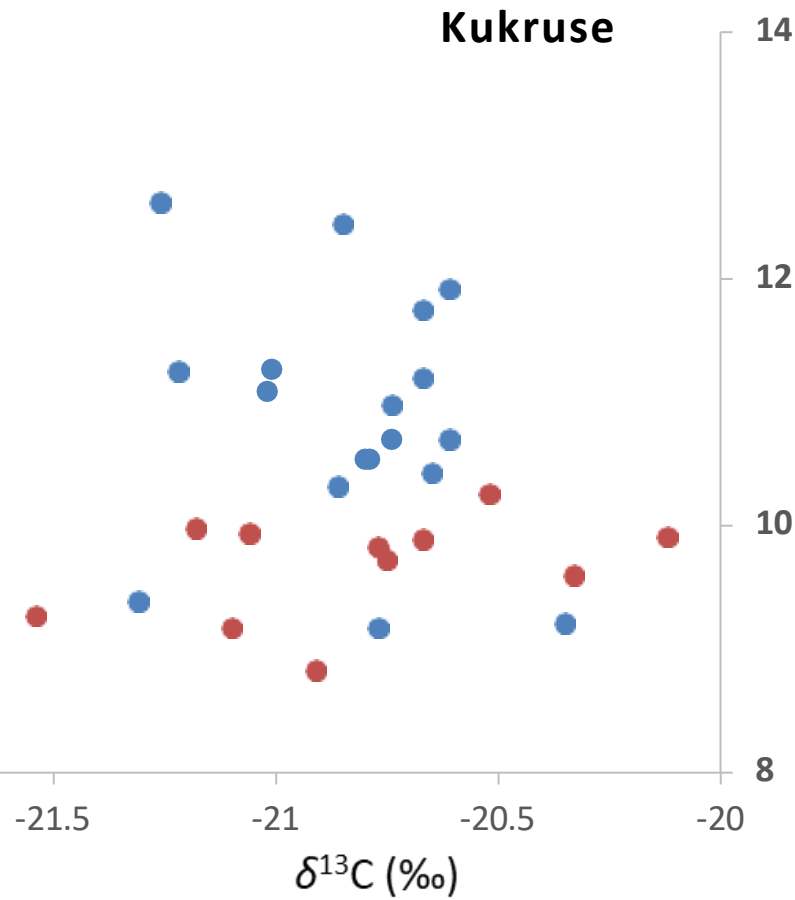


# Gendered food?

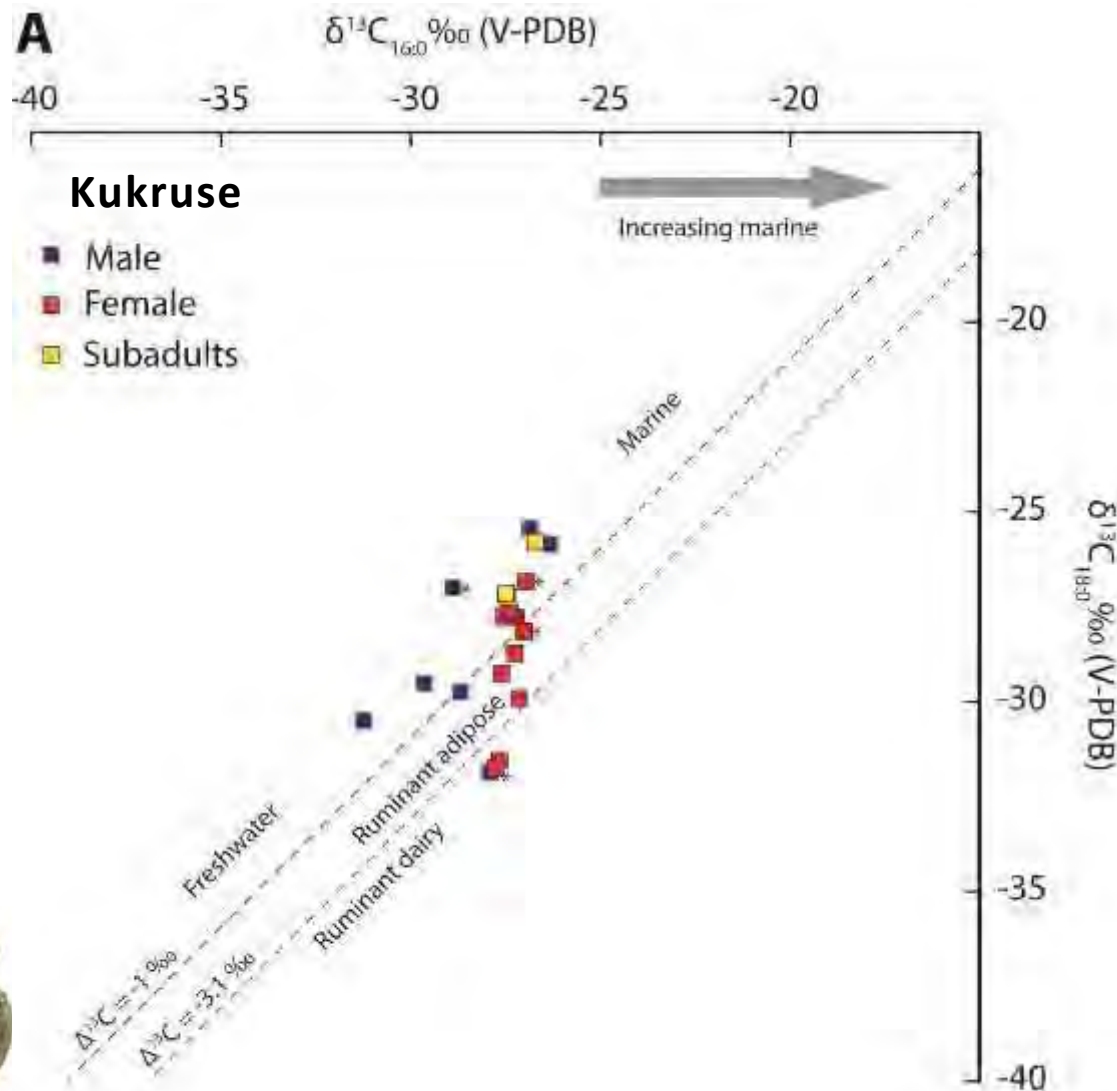


- Males
- Females

Kukruse

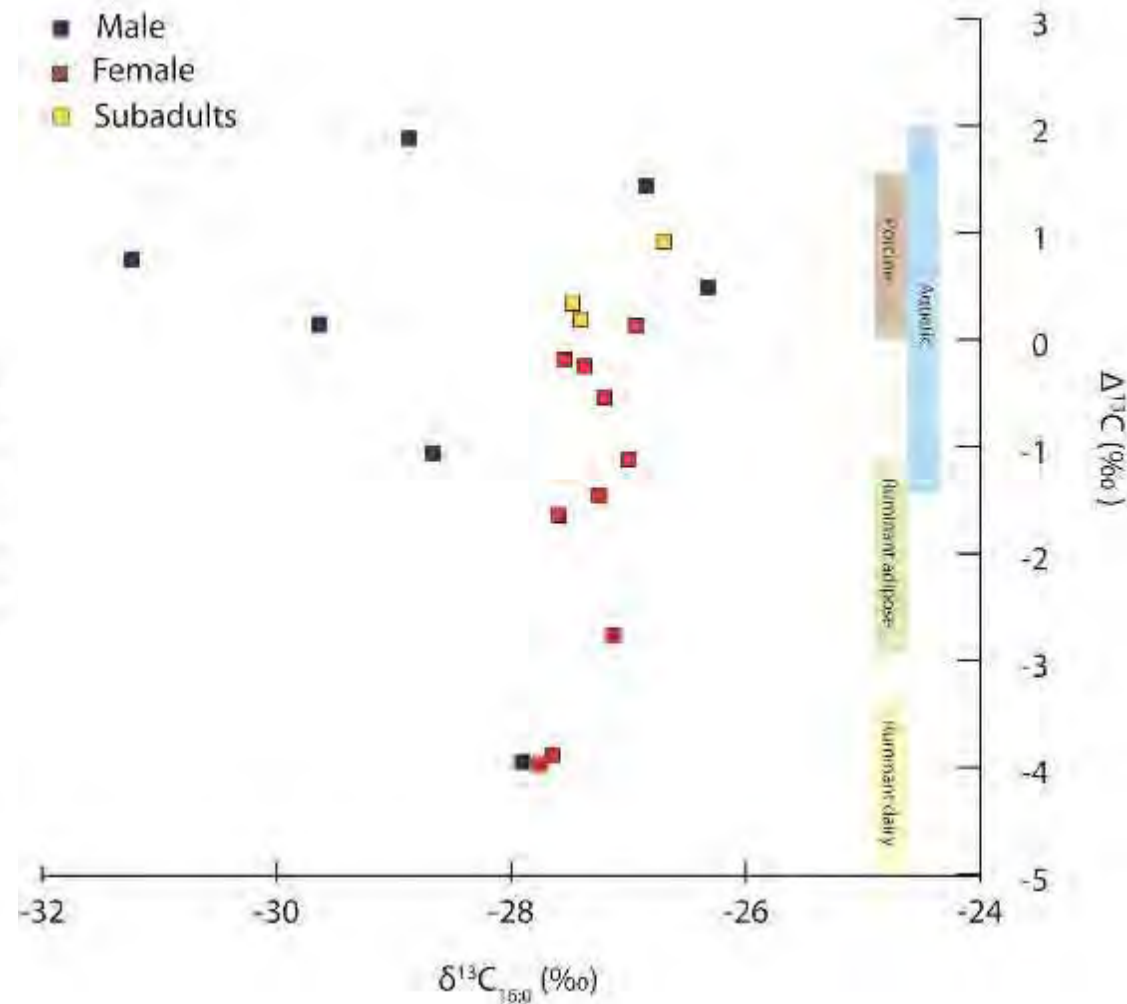


# Gendered afterlife?

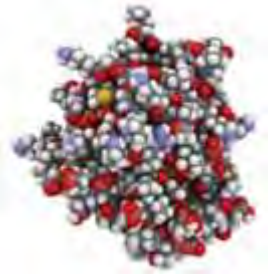


## Kukruze

- Male
- Female
- Subadults



# Going for high resolution: **shotgun proteomics**



Proteins

Lipids

Dent. calculus: Proteins

Lime scale

Food-crust

Food-crust

Ceramic powder



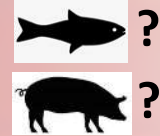
B. I, 25-40



B. VII, 50+



B. XV, 30-40



B. XXII, 50+



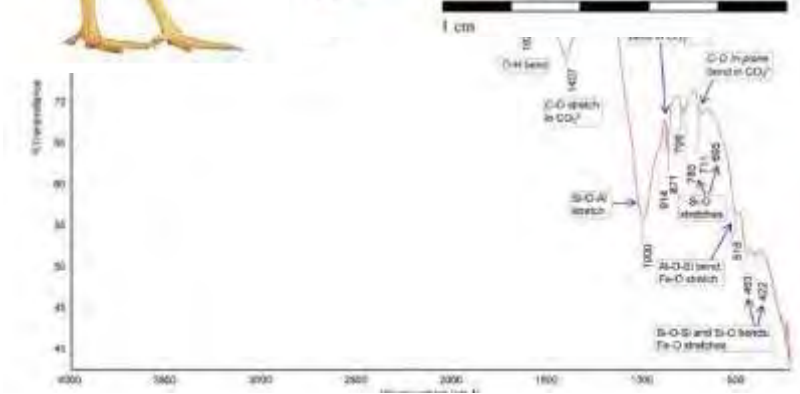
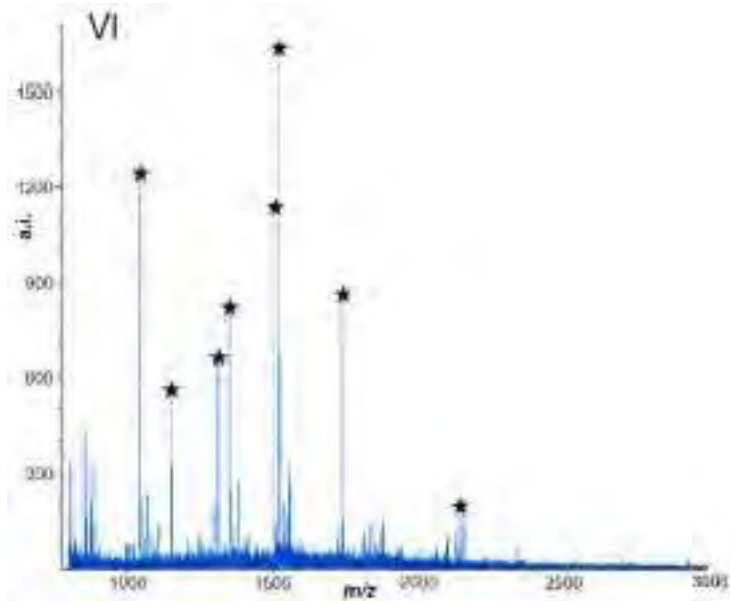
N/A

# Chicken & Egg question 😊

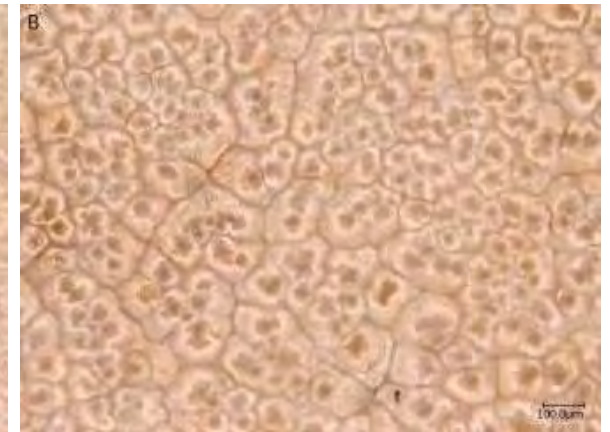
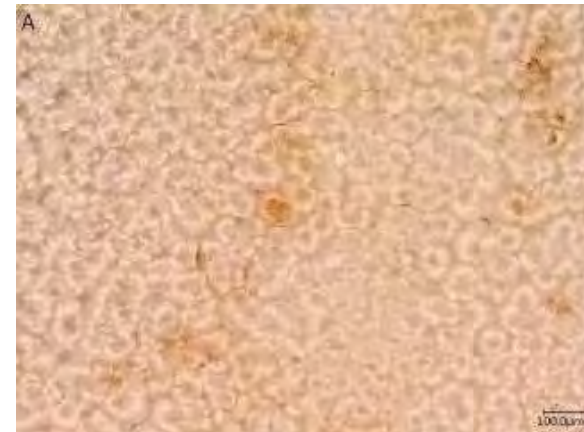
ZooMS = Domesticated chicken



C14 date 200BCE-5CE



Microscopy = fertilised egg with chick inside



# The Importance of...



Drawing: Jaana Ratas

- **Multiple dietary proxies:** bones, teeth, pottery, ecofacts (animal bones, plant remains)
- **Multiple analytes:** lipids, proteins, microfossils, stable isotopes etc
- Combined with (detailed) **archaeological context** → dietary practices based on:
  - Age
  - Gender
  - Wealth/status
  - Provenance
  - ...



# Thank you!



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BioArCh



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