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The Netherlands

# Wild West Frisia : the role of domestic and wild resource exploitation in Bronze Age subsistence

Amerongen, Y.F. van

**Citation**

Amerongen, Y. F. van. (2016, November 10). *Wild West Frisia : the role of domestic and wild resource exploitation in Bronze Age subsistence*. *Archaeological Studies Leiden University*. Leiden University Press. Retrieved from https://hdl.handle.net/1887/44180

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|---|---|
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| Downloaded from: | https://hdl.handle.net/1887/44180 |

**Note:** To cite this publication please use the final published version (if applicable).

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**Author**: Amerongen, Yvonne van
**Title**: Wild West Frisia : the role of domestic and wild resource exploitation in Bronze Age subsistence
**Issue Date**: 2016-11-10

# 11. Valorisation and recommendations for future research

In this final chapter, the results from this thesis will be weighed in terms of the possible valorisation value of the conducted research, and in terms of which steps could be taken in the future for further research on Bronze Age subsistence in wetland environments.

## 11.1 VALORISATION

Valorisation is about the impact that can be achieved through the transfer of scientific knowledge. This impact may include making knowledge and expertise available to other researchers as well as communicating knowledge to the general public. Examples of these two types of valorisation based on this thesis will be shortly discussed here.

### 11.1.1 Valorisation value

The way in which knowledge and expertise is made available to other researchers is through the presentation of the new holistic approach of this thesis, as outlined in Chapter 1 and 10. This approach has not only yielded knowledge on (the reconstruction of) the daily life of a Bronze Age farmer, but is also widely applicable to different geographical locations, time periods, and subsistence strategies with the appropriate adaptations and consideration (see Chapter 10, section 10.4).

Last but not least, this thesis has brought forth a new method for the construction and analysis of mortality profiles based on post-cranial bones. This method, Faustitas, is freely available to others to use and improve for future research on (the use of) domestic and wild animal herds.

### 11.1.2 Public outreach

The main manner in which knowledge based on this thesis was directly communicated to the general public was via the weblog of the project group (www.bronstijdwestfriesland.nl) and during a special open day in West Frisia.

The information produced in this thesis, especially from Chapter 8, can be very useful for archaeological open air museums. New insights into the daily life of the Bronze Age may be used in open air museums to directly transfer knowledge on food, activity, tools, clothing, and the interior of a house to the general public. The museumpark Archeon in Alphen aan den Rijn, the Netherlands, for example, has already incorporated the new view on the contribution of wild resource exploitation in Bronze Age subsistence (cf. Chapter 4 and 7) into their education programme. The Zuiderzee museum in Enkhuizen, West Frisia, which possesses a Bronze Age house reconstruction, has also included this information. Finally, the Bronze Age diet reconstruction presented in this thesis (Chapter 8) has become the topic of an exhibition in the museum Huis van Hilde in Castricum, the Netherlands, which also houses the archaeological depot of West Frisia.

## 11.2 RECOMMENDATIONS FOR FUTURE RESEARCH

This section attempts to outline the general important topics for future research on Bronze Age subsistence in wetland environments which could not be answered in this thesis based on the data presently available. The list presented here is by no means complete or workable under every circumstance, but provides general ways by which site excavators and scientists can work together to research these topics. First, the different topics are summarized per chapter for the chapters on subsistence (Chapter 4-8), each being followed by a number between brackets. This number is used to identify which methods can be employed to answer this topic in future research. Each chapter has its own topics and numbers. Methods are split into two categories: field research and laboratory research. Field research is sub-divided into specific methods, which are related to West Frisia in particular, but also into general methods, which could be of importance anywhere. Laboratory research is also further sub-divided into specific areas

of expertise, which can each provide a different method for analysing the remaining topics. This list of disciplines thus results in the possibility for multi-proxy, interdisciplinary analysis. Finally, a summary of the old methods and viewpoints, which are no longer deemed accurate based on this thesis is provided, followed by the new and alternative methods and viewpoints which may form the basis for further research.

For practical advice on how to sample and preserve samples for further research, see the SIKB guide for sampling (www.sikb.nl).

*Chapter 4: Hunting*

Remaining topics:
- Passive and active hunting techniques (1)
- Use of wild animals (2)
- Seasonality of hunting (3)
- Use of crustaceans, molluscs, amphibians, reptiles for consumption (4)

**How to answer them?**

Field research
- Be aware of wooden/organic objects, even though not immediately recognizable as a specific tool > *e.g.* parts of traps/nets? (1)
- Be aware of location of flint arrowheads etc. (1)
- Be aware of the presence of organic raw material, especially in wet contexts (leather, skins) (2, 4)
- Sieve multiple types of settlement context for amphibians, reptiles, molluscs, crustaceans, etc. (4)

General
- Ample sampling of building structures, and contexts on off-site locations
- o Continue to assess the range and spread of wild animals per house and at the settlement (G1)
- Sieve several contexts on 1-2 mm sieves
- o Continue to assess small animal remains to enable inter-site comparison with regard to the environment around settlements and use of animals (G2)

**Specialist research**

Zoology:
- Reconstruct fish size, it gives insight into possible catching techniques (1)
- Be aware of weapon cut marks / skinning marks / gnaw marks (pre-/post-mortem) (1,2)
- Be aware of seasonal indicators for hunting: establish age at slaughter, presence of seasonal traits (antlers), etc. (2, 3)
- Identify crustaceans, molluscs, amphibians, and reptiles to species level where possible in order to assess their potential addition to the diet (4)

Textile and leather research:
- Identify the species of animal from which the leather derives (3)

*Chapter 5: Animal husbandry*

Remaining topics:
- Improved gender recognition of animals (culling, import) (1)
- Location of animals (barn, shed, pen, fields, seasonality) (2)
- Use of animals (traction (oxen?), milk consumption, wool/leather) (3)
- Inbreeding/breeds (4)
- Location of pastures (5)
- Animal health (6)

**How to answer them?**

Field research
- Collect complete animal jaws separately for a DNA analysis and Sr isotopic research (1)
- Collect complete metacarpals separately for metric data and aDNA analysis (1, 3)
- Be aware of possible barns/partitions/kraals/pens (2)
- Collect human jaws separately for identification of milk consumption and the animal species used for milk production (3)
- Be aware of the presence of organic raw material, especially in wet contexts and near (corroded) metal objects (leather, textile!) (3)
- Collect complete skulls separately (4)
- Be aware of “empty” areas in the landscape,

and the possibility of the presence of cattle hoof prints (5)
- Sample the intestinal area, the context feature, and outside the feature when complete skeletons are uncovered to assess the health of the animal (6)

General
- Ample sampling of every house plan
o Continue to assess the range of animal species kept per household (G1)
- Sieve several contexts on 4 mm sieves
o Continue to approach actual domestic animal species ratios (G2)
- Conduct a sieving experiment of multiple closed contexts
o Continue to assess the loss of bones per sediment type (G3)

**Specialist research**

Zoology:
- Assess the loss of species due to sieving and sediment type (G2, G3)
- Measure the metacarpal distal breadth and plot a graph of the results (1)
- Use Faustitas on post-cranial bones to assess age at slaughter and use of the culled herd, as well as the composition of the original living herd (3)
- Assess the age based on teeth, but be aware of taphonomy (ravaging correction!), to compare with post-cranial bones (3)
- Assess the likelihood of the presence of oxen based on traction indicators and size of the animal (3)
- Be aware of differences in breeds/inbreeding (withers heights, inbreeding, horns/polled) (4)
- Be aware of specific pathologies to assess the health of the animal (6)

Entomology:
- Assess the insect species, which can provide information on the location of livestock (2) and on the health of the animal (6)

Parasitology:
- Assess the endo- and ecto-parasites related to the general health of domestic animals (6)

aDNA research:
- Analyse complete metacarpals to assess the gender of the animal, and use as a check for the metric data (1, 3)
- Analyse animal jaws to assess the gender of imported animals (in combination with isotopic research) (1)
- Try to assess difference in breed within a species, based on haplotype, especially on imported individuals (in combination with isotopic research) (4)
- Analyse specific pathological indicators (mycobacteria) to assess the general health of animals (6)

Isotopic research:
- Assess the origin of domestic animals based on Sr isotopic data (1,4)

Tooth calculus analysis:
- Analyse human tooth calculus on specific proteins to assess milk consumption and the animal species used for milk production (3)

Textile and leather research:
- Identify the species of animal from which leather derives (3)
- Identify the wool characteristics of textiles and compare with wool from contemporary sheep breeds (3)
- Assess whether the woollen textile is potentially dyed (3)

NMR/XRF microscopy:
- Assess whether the woollen textile was dyed, and if so, with which plant species (3)

*Chapter 6: Crop husbandry*

Remaining topics:
- Identification of activity areas in houses (1)
- Recognition of type of fertilizer applied on arable fields (2)
- Seasonality of manuring and ploughing practices (3)
- Burning practices of fields (4)
- Locations of arable fields (5)
- Cultivation of flax for fibres (6)
- Off-site locations (7)

**How to answer them?**

Field research
- Systematic sampling of one house plan (use of areas?) (1)

- Sieve plough layers (use/type of fertilizer) (2)
- Be aware of and sample possible manure layers (2)
- Micro-morphological soil slides (burning, ploughing circumstances, use of fertilizer?) (2, 3, 4)
- Be aware of (absence of) plough marks (5)
- Be aware of and sample organic raw material, especially from wet contexts (6)
- Extend excavations tot areas beyond the settlement, whenever possible (7)

General
- Ample sampling of every context of a house plan
- o Continue to assess household size for new excavations (G1)
- Be aware of storage structures/containers
- o Continue to be alert towards potential storage locations (G2)

**Specialist research**

Botany:
- Use frequency of presence/absence, not quantity (1)
- Apply method of Stevens (G1)
- Be aware of the possibility of stubble burning practices (4)
- Attempt to identify flax fibres (6)

Micromorphology:
- Try to identify seasonal activities such as ploughing (3)
- Be aware the possibility of stubble burning practices (4)
- Try to identify the presence or absence of tillage marks (5)

Geochemistry:
- Test the effect of different types of fertilizer on $^{15N}$ values(2)
- Test the ratio of digestive metabolites (sterols and stanols) to assess the origin of the fertilizer used: herbivores, omnivores, carnivores (2)

Entomology:
- Assess the insect species, which can provide information on the state and type of animal manure (2), and the state and storage of the grain (G2)
- The insect species can also provide information on specific cultivated plant species, which are not always present in the archaeobotanical record (*e.g.* pulses, legumes)

*Chapter 7: Gathering*

Remaining topics:
- Areas of activity in and around the house (1)
- Actual evidence for used/consumed vegetative plant matter (2)
- Impact of taphonomy on different plant parts/ uses (3)
- The potential of waterlogged material (4)

**How to answer them?**

Field research
- Sample multiple complete house plans (1)
- Be aware of pottery with possible food crusts (do not clean) (2)
- Collect human jaws separately for identification of root/tuber consumption (starch) (2)
- Be aware of the presence of organic raw material, especially in wet contexts (basketry, fibres, rope, textile!) (2, 4)
- Sample waterlogged contexts (2, 4)

General
- Ample sampling of building structures, also on off-site locations
- o Continue to assess the range and spread of wild plants per house and on the settlement (G1)

**Specialist research**

(Ethno)botany:
- Assess the possible uses of wild plants (ethnography) and try relate them to the house plan (1)
- Assess the edibility of wild plants (ethnography) and make note of (un)charred vegetative material from those plants in house contexts (2)
- Assess the relative frequency of charred and uncharred remains per species, as well as the preservation conditions in the sampled context (2, 3)
- Assess the potential conservation of different plant parts according to their use (*e.g.* is fire included in the use? Does/Can the plant bear seed

for its eventual use?) (3)
- Assess the range of ecotypes present in waterlogged contexts: many different ecotypes may point to collecting practices and the material may be analysed as such (4)

Biochemistry and microscopy:
- Analyse food crusts in ceramics botanically to assess the processing of various vegetative plant parts, most likely for consumption (2)

Tooth calculus analysis:
- Analyse human tooth calculus on starch granules which may point to the consumption of roots/ tubers

NMR/XRF microscopy:
- Assess whether textiles were dyed, and if so, with which wild plant species (2, 4)

*Chapter 8: Bronze Age Farming in West Frisia*

**Remaining topics:**

Diet and health:
- Specific diet composition (1)
- General and specific health indications (2)
- Diseases (malaria, tuberculosis, etc.) (3)

Clothing:
- Clothing types and construction (4)

Houses:
- Inside of the house (5)

Activity:
- Structure plan (6)

**How to answer them?**

Field research
- Be aware of the presence of organic raw material, especially in wet contexts and near (corroded) metal objects (leather, textile!) (4)
- Be aware of tools required for the processing of fibres and the construction of clothing (4)
- Be aware of tools required the different activities related to subsistence in general (5)

General
- Continue to combine all the information on subsistence available in order to gain insight into the household (G1)
- Continue to combine all the seasonality information on subsistence available in order to gain insight into the year-cycles for domestic and wild resource exploitation (G2)
- Be aware of the fact that a structure in the field should not immediately be termed house plan, because its function may be very different (G3)

**Specialist research**

Biochemistry and microscopy:
- Analyse food crusts in ceramics botanically and chemically to assess the composition of meals (1)
- Analyse more wild plant species with regard to their micro-nutrient composition (1)

Tooth calculus analysis:
- Analyse human tooth calculus on several food groups to assess the range of food sources consumed (1)

Isotopic research:
- Analyse human diet with the use of carbon and nitrogen isotopes (1)

Physical anthropology:
- Assess the general health level of individuals based on stature, dental caries, enamel hypoplasia, *cribra orbitalia*, Harris lines, and (healing of) trauma (2)
- Assess specific pathologies related to disease or nutrient deficiency (*e.g.* vitamin C, iron, malaria) (2)

Entomology:
- Assess the presence of *Anopheles* mosquitoes, or their larvae, which are hosts for malaria parasites

Parisitology:
- Assess the endo- and ectoparasites related to peoples' health and present diseases (2, 3)
- Assess the presence of the parasite (*Plasmodium*), which causes malaria

aDNA research:
- Analyse specific pathological indicators (*e.g.* mycobacteria) to assess the general health of people and possibly present diseases (2, 3)

Textile research:
- Identify the wool characteristics of textiles and compare with wool from contemporary sheep breeds (4)
- Assess whether the woollen textile is potentially dyed (4)

**Do's and don'ts:**

| subject | DO | DON'T | see: |
|---|---|---|---|
| landscape reconstruction | use off-site pollen for a landscape reconstruction (diameter of basin > 5m) | use on-site pollen to reconstruct the wider landscape | Chapter 2 |
| subsistence reconstruction | realise that mixed farming is inherently a small-scale affair with limited numbers of livestock and limited size of arable fields | think mixed farming entails endless numbers of livestock and size of arable fields | Chapter 3 |
| hunting | assess the role wild animals play in the subsistence economy and thus their reflection in the archaeological record | relate frequency of remains directly to importance (for subsistence) | Chapter 4 |
| animal husbandry | use the programme Faustitas to reconstruct age and herd dynamics, including use and living herd composition | use the methods of Chaplin (1971) and Payne (1973) to reconstruct age and use | Chapter 5 |
| crop husbandry | keep an open mind towards arable field soil enhancements, such as green manure, turf, household waste, and animal manure | assume that crop husbandry is a static practice | Chapter 6 |
| gathering | assess the potential that vegetative wild plants parts have for the subsistence economy and thus their reflection in the archaeological record | relate frequency of remains directly to importance (for subsistence) | Chapter 7 |
| Bronze Age farming | realise that critical vitamins can only be obtained through the frequent consumption of wild plants | reconstruct diets purely based on calories; also, don't assume that nuts and berries supply enough annual nutrients | Chapter 8 |