

# Cultural and economic negotiation: A new perspective on the Neolithisation of southern Scandinavia

Kurt J. Gron<sup>1\*</sup> & Lasse Sørensen<sup>2</sup>

<sup>1</sup>Durham University, Department of Archaeology, South Road, Durham, DH1 3LE, UK (k.j.gron@durham.ac.uk)

<sup>2</sup>The National Museum of Denmark, Frederiksholms Kanal 12, 1220 Copenhagen K, DK

## Introduction

After expanding from Central Europe, Linearbandkeramik (LBK) farmers stopped in the northern European plain and did not reach the southern Baltic coast and points north. From c. 5500 to 4000 BC, foragers inhabited the north and farmers the south (Klassen 2004), forming a static border for well over a millennium. The earliest period of the southern Scandinavian Neolithic (Early Neolithic I, ENI, 4000-3500 BC), is poorly understood. The ENI is the first period of the Funnel Beaker Culture (hereafter TRB) and chronologically falls between the Ertebølle Culture (hereafter EBK, 5400-4000 BC) and the TRB Early Neolithic II (ENII, 3500-3300 BC).

The causal questions regarding agricultural origins in the region have persisted. Proposed reasons for the adoption of farming can be narrowed down to only several; population growth, changes in resource availability, social change, or some combination (Fischer 2002). As for those involved, hypotheses generally concentrate on *migrationism*, *indigenism* and *integrationism*, the same themes applicable to the Neolithisation process throughout Europe. *Migrationism* proposes a swift introduction lasting only a few generations by farmers carrying agrarian technologies. *Indigenism* argues for farming introduced in a gradual process with hunter-gatherers as primary actors, obtaining farming technologies as communicable ideas. *Integrationism* is the middle ground, combining both in a two-way process. Implicit in the *indigenism* and *integrationism* hypotheses is that it is possible for hunter-gatherers to learn farming. The debate therefore ultimately centers on the role of local foragers.

In this paper, we critically examine the latest period of the EBK (c. 4400 to 4000 BC) and the earliest TRB, the Early Neolithic Ia and Ib (ENIa, 4000-3800 BC and ENIb, 3800-3500 BC) of southern Scandinavia (herein inclusive of the northern parts of what is today Germany and Poland)(Sørensen 2014: 5). We consider the relationship of the last foragers with the first farmers by focusing on evidence of continuity and change, and its chronology. We reconsider the overall framework for understanding the settlement system, and specifically the relationship between the two general types of site present, the settlement and the hunting stations. Together with a careful reconsideration of the

evidence, and in comparison with the archaeological and ethnographic record from elsewhere, we present the case that the transition was an ongoing process occurring in the ENI.

### **Change in the late 5<sup>th</sup> and early 4<sup>th</sup> millennium BC**

From c. 4400 BC, limited numbers of Neolithic artefacts start to appear in southern Scandinavia. While not the start of the Neolithic, the rare evidence may indicate the start of a process of expanding contact between foragers and farmers. At the site of Flintbek in Schleswig-Holstein for example, a pit filled with short necked funnel beakers, flake cores and scrapers (Zich, 1993) has been <sup>14</sup>C dated between 4300 and 3900 BC, one of the earliest discoveries of funnel beaker ceramics in northern Germany.

Clear evidence of farming is broadly seen from c. 4000 BC, documented through the compiled <sup>14</sup>C dates of charred cereals and domesticated animals (see Sørensen 2014; Figure 1). Late EBK pottery, adzes, and T-shaped antler axes disappear and TRB material culture in the form of short-necked funnel beakers, clay discs, clay spoons, pointed-butted flint axes and battle axes appears. Major changes in lithic production can be observed in the switch from a production dominated by blade tools towards one dominated by flake tools (Stafford 1999) and the disappearance of core axes shafted as adzes in favour of polished pointed butted axes shafted as axes (Sørensen 2012). New developments such as two-aisled houses and flint mines also appear (Sørensen 2014).

A change in symbolic behaviour is also in evidence, because many pointed-butted axes and short-necked funnel beakers start to be deliberately deposited. Such depositions of material culture are almost non-existent within the EBK (but see Berggren 2007; Karsten 1994; Koch 1998), documenting a physical and symbolic change (Klassen 2004; Rudebeck 2010; Sørensen 2014). Somewhat later, deliberate cattle sacrifice in water appears (Noe-Nygaard *et al.* 2005). It may be possible to argue that the act of intentionally depositing items in water or at particular places shows continuity between the last EBK and the earliest TRB at places like Hindbygården (Berggren 2007) but the practice itself is not as common or prescribed as it is in the Neolithic.

### **Fig. 1**

Arguably the most profound change is that of human diets (Fischer *et al.* 2007), in which a near complete shift is observed between diets of largely marine food to terrestrial food. However, in Denmark there are only two fully EN humans from the coastal sites, one from Sejerø and one from Dragsholm, and these offer conflicting perspectives, with the former showing a marine diet and the

latter the converse (Fischer *et al.* 2007). Several other humans of uncertain age, either Late Mesolithic or Early Neolithic depending on the marine reservoir correction, also show conflicting information; some eating terrestrial diets and some eating marine (Fischer *et al.* 2007). Despite this, while not universally accepted (see Milner *et al.* 2006), the evidence does support a dietary shift at some point during the ENI and generally the isotope values clearly prove that from c. 3800 BC onwards, the main diet consisted of terrestrial food resources.

Change in the settlement pattern is also strongly documented. A new type of inland site located on easily worked arable soils emerges. A recent survey of pointed-butted axes dated from 4000 to 3700 BC may reflect the early expansion of pioneering agrarian sites in southern Scandinavia (Sørensen 2014). Their distribution clearly illustrates that the earliest farmers preferred easily arable soils for initiating small-scale farming, areas with limited EBK habitation (Figure 2).

## Fig. 2

Direct evidence of ENI cultivation is attested by plough marks. The fact that some of these have been identified stratigraphically below long barrows indicates that the technology of the plough likely was used from the very beginning of the Neolithic (Beck 2013). Archaeobotanical data offer another perspective; pollen analyses from Scania show concentrations of charcoal dust around 4000 BC, possibly indicating the application of slash-and-burn cultivation (Digerfeldt & Welinder 1989). Other pollen diagrams from c. 4000 BC show higher concentrations of ribwort plantain (*Plantago lanceolata*) and birch (*Betula* sp.), which may indicate a short or long term fallow strategy (Sørensen 2014). Elevated  $\delta^{15}\text{N}$  values of charred cereal grains from Stensborg, Sweden dating from the latter part of the Early Neolithic (EN Ib) have confirmed selective application of animal manure, indicating an integrated package (Gron *et al.* 2017).

As for livestock, sequentially sampled cattle tooth enamel carbon and oxygen isotope results indicated that cattle were born throughout the year (Gron *et al.* 2015). Stone Age landscape variation has also been established through the isotopic analysis of a variety of wild and domestic herbivores revealing that cattle were not living or being fed in forests (Gron & Rowley-Conwy 2017), and were instead living in open anthropogenic environments. Strontium isotope analyses have also been performed, and suggest the movement of cattle over appreciable distances by boat (Gron *et al.* 2016).

The overall impression is that the earliest farming was a sophisticated undertaking and together with evidence of manuring and crop production, but lacking indicators of widespread forest clearance

(Regnell & Sjögren 2006). The data therefore speak to an integrated, landscape-wide system of small-scale farming, an entirely new development.

### **Continuity in the late 5<sup>th</sup> and early 4<sup>th</sup> millennium BC**

There is also remarkable evidence of continuity with the Late Mesolithic. The lithic toolkit found at the earliest TRB sites is almost indistinguishable from its EBK counterpart, save for some slight differences in manufacture (Fischer 2002) and the production of blades and flake axes continues in the EN (Nielsen 1985; Andersen 1991). Furthermore, the earliest characteristically Neolithic polished flint pointed-butted axes may have developed from EBK core axes (Jennbert 1984) and some axe types and manufacturing techniques more characteristic of the EBK persist (Ravn 2011; Jennbert 1984). The same goes for the earliest TRB ceramics, which in some rare cases show similarity in manufacture to Mesolithic vessels (Andersen 2011) and are hard to differentiate. The *contents* of ceramics also show continuity, demonstrating a continuation of the cooking of marine foods (Craig *et al.* 2011).

Settlement continuity is documented by continuing occupation at former EBK kitchen middens during the ENI. These sites are occupied in both the EBK and the EN (Andersen 2004) with layers dating to the earliest Neolithic directly overlying Mesolithic occupation. At several of these sites, it has proven possible to separate out much of the faunal material to Mesolithic and Neolithic, most notably at Visborg (Enghoff 2011), Bjørnsholm (Bratlund 1993) and Sølager (Skaarup 1973) (Figure 3). At these sites, in both components wild species dominate, and the overall impression is of a largely unchanged subsistence strategy at the site between the EBK and TRB (Figure 3), save for the low-level inclusion of domestic species in the Neolithic layers (see Settlement and Hunting Stations).

### **Fig. 3**

Empirical studies have also shown that most of the layers dating from 4000 to 3700 BC contain very limited evidence of charred grains, clay discs (baking plates) and grinding stones (Sørensen 2014), things associated with farming. Only *later* Early Neolithic kitchen middens layers dated from 3600 to 3300 BC, have yielded these artefacts. Simply, evidence of continuity with the Mesolithic at the middens is unassailable.

### **Settlement and Hunting Stations**

The conflicting evidence of continuity and change has resulted in an uneasy compromise. Since the 1970s it has been recognised that there are two types of sites in the ENI, settlement and hunting stations, the latter sometimes referred to as “catching sites” (Skaarup 1973; Johansen 2006). Among other differences, including general settlement location, topography, and size, the primary differentiator is the composition of the faunal remains, with hunting stations dominated by wild species and settlement sites by domestic species. Despite the difficulties separating some wild from domestic species, (Rowley-Conwy 1995), the dichotomy of mostly wild hunting stations and mostly domestic settlement sites is real (Table 1). However, because of shared TRB material culture, it has been always been assumed that it is the same group of people occupying the two site-types (Johansen 2006) with the ubiquitous presence of domesticates attributed to provisions brought to hunting stations (Skaarup 1973). But is this likely?

### Table 1

The ethnohistory of European-indigenous contact offers some perspective. In the Massachusetts colonies of North America in the 17<sup>th</sup> century, livestock were often caught in Native American traps intended for deer, and local inhabitants killed or stole cattle for subsistence, retribution, and by accident (Anderson 1994). Furthermore, domestic species including cattle, pigs, and horses commonly escaped and became feral in the wilderness of North America in the 17<sup>th</sup> to 18<sup>th</sup> centuries (Gray 1933). This was so common, that in Florida, their hunting became a relied-upon source of food. Elsewhere, the hunting of feral livestock was common enough that it had to be regulated by colonial officials (Gray 1933). It is reasonable, therefore, that the domesticates at ENI hunting stations just as likely represent individuals that have been hunted, trapped, or stolen, something that probably occurred in the EBK (Zeder and Rowley-Conwy 2014). In fact, the bringing of live domestic animals to a hunting station would likely have been counterproductive, as this scares away deer (Anderson 1994; Cronon 1983).

Similarly, the low proportion of wild species at the settlement sites is consistent with immigrant frontier farmers elsewhere in Neolithic Europe and in the ethnohistoric record. LBK faunal assemblages usually comprise less than 10% wild animals (see Bickle & Whittle 2013; Manning *et al.* 2013). Wild fauna in assemblages from early Neolithic cultures rarely exceed 25% (Manning *et al.* 2013). In fact, the only sites with low proportions of domestic species are Neolithic contexts in the Low Countries, likely a case of slow, indigenous adoption domesticates (Manning *et al.* 2013; Cappers & Raemaekers 2008). Eighteenth century South Carolina frontier farms show a similar pattern. These settlements were

located away from colonial townships in the backcountry with economies based primarily on cattle husbandry (Groover & Brooks 2003). At sites of this type, domestic fauna dominate, but not without wild game, ranging from c. 20-30% of the material.

However, the presence of similar material culture at the settlements and hunting stations needs explanation. Archaeologically, separate groups can share material culture. In the North Atlantic region of the eastern United States about the time of contact with Europeans for example, Mohawk and Mahican ceramic traditions do not differ, but were possessed by groups with different political and social affiliations and who spoke *different languages* (Grumet 1992). Similarly, in the ethnographic record the transfer of technology and material culture between two populations in contact is common (Moorehead 1966; Yinm 2006) and occurs between foragers and farmers. For example, the interaction between the last remaining hunter-gatherers of Borneo, the Penan, and their neighboring farmers (Nicolaisen 1975; 1976) was characterised by the farmers trying to persuade the hunter-gatherers to start farming. Some Penan hunter-gatherers tried to grow rice but gave up, sometimes abandoning their fields near maturation and going pig hunting instead; the activity was associated with higher prestige. They did not return to harvest the mature rice, indicating that they were not really interested in food production. Instead they were interested in closer social relations with the farmers through marriage alliances, and access to new material culture (Nicolaisen 1975; 1976).

In terms of the adoption of domestic animals, Native Americans in the southeastern United States took up to several hundred years of contact with Europeans (Pavao-Zuckerman & Reitz 2006) to do so. Elsewhere the process took decades. The 17<sup>th</sup> Century New England Wampanoag took 30 years to adopt pigs, mostly predicated on contact and the environmental deforestation which reduced the availability of game (Anderson 1994). This example illustrates a wider trend in 17<sup>th</sup> century New England, in which Native Americans selectively adopted pigs, usually taking the order of decades of contact to do so (Anderson 1994). There is no reason to suspect that if indigenous groups adopted domestic animals, it would have happened quickly.

Therefore, it is just as reasonable that separate groups of foragers and farmers were resident at the settlement and hunting stations as it is to assume that commuting farmers are responsible. Both scenarios could have occurred at the same time at different places, depending on the social engagement between the hunter-gatherers and farmers. It is perfectly plausible that some regions had two

populations, while others contained one commuting population moving between the inland and coastal area. It could also be that in some places indigenous foragers were displaced by immigrating farmers.

In fact, this is precisely what is observed in the archaeological record. The reason may lie in biogeography, that the coastal areas were more varied and productive (see Paludan-Müller 1978) than more homogenous coastal areas. Indeed, it does look like the transition was abrupt on Bornholm (Figure 4) and in Scania (Figure 5), with a quick replacement of foraging with farming (Nielsen 2009) corresponding to a shift from coastal to inland settlement as opposed to northern Jutland, where both coastal and inland settlement occur in the EN (Figure 6).

Fig. 4

Fig. 5

Fig. 6

## A Chronological Model

If foragers and farmers are on the landscape at the same time, how does evidence of continuity and change relate? It is not only the presence or absence of continuity that matters; it is the timing of the introduction and persistence. The series and sequence of subsistence, landscape, and material cultural developments from the EBK through the ENI can be traced chronologically (Figure 7). These developments illustrate the ENI as a dynamic period during which any connection with the preceding EBK ceases, and during which new cultural practices appear at varying speed.

Fig. 7

The chronology of new developments and persistence of old practices (Figure 7) is clear; there is a gradual introduction of various practices concurrent with a gradual disappearance of old practices. As such, there is no reason to expect an abrupt demographic and economic replacement at 4000 BC full stop. *We propose that the earliest centuries of the Funnel Beaker culture, synonymous with the ENI, was a period of cultural and economic mixing and negotiation between the last foragers and the first farmers.* This scenario accounts for the idiosyncrasies within the existing data, but also explains the emergence of a more coherent TRB starting in the ENII. All aspects of the ENI can be explained under such a framework. However, this requires an entirely new understanding of the culture history of Scandinavia in the earliest years of the

Neolithic. Initial questions include: How long did this situation persist? How much contact occurred and how often? Should we expect genetic exchange?

Any widespread cultural or economic duality could not have persisted longer than the period of the ENI. After the introduction of domesticates there is a gradual reduction in hunting and foraging activities, and an introduction of new cultural practices including cattle sacrifice and the commencement of the building of long barrows, an increasing incidence of artefacts associated with cereal agriculture at the middens, and a development of new artefact forms. As most of these developments are in evidence by or c. 3700 BC, we suggest that any duality had largely disappeared by c. 3700 BC.

Four phases can be identified (Figure 7):

- 0) **Contact/scouting phase** (from c. 4400 BC)
- 1) **Introduction Phase** (from c. 4000 BC)
- 2) **Negotiation Phase** (c. 4000-3700 BC)
- 3) **Homogenisation Phase** (after c. 3700 BC)

The **Contact/Scouting Phase** starts c. 4400 BC, during which the first murmurs of the Neolithic begin in southern Scandinavia. This is not the Neolithic, but represents the initiation of a series of contacts that will later facilitate the movement of incoming farmers. From this period, rare finds of Neolithic origin begin, including domestic grain impressions in EBK ceramics, as well as the earliest examples of TRB pottery and polished axes as single finds, probably demonstrating direct contact between Neolithic farmers and EBK hunter-gatherers.

The **Introduction Phase** marks the start of the Neolithic in Scandinavia and the start of the Funnel Beaker culture in the region. It is during this phase that initial immigrants, bringing domestic plants and animals from elsewhere and certain forms of material culture arrived. Considerable flexibility in the model is required with regards to scale and duration, because this phase may have lasted as late as c. 3700 BC, or only for a few decades. Regardless, there is little evidence to suggest persistence past c. 3700 BC, because from this date unique and novel cultural manifestation is in evidence and any connection with the Mesolithic has disappeared, and any incoming population movements may have been restricted to only a short time, with subsequent developments attributable to internal processes.



The **Negotiation Phase** also starts at the very beginning of the Neolithic, but persists longer than the Introduction Phase. This is the period of the dual presence of farmers and foragers on the landscape and cultural negotiation. As with the Introduction Phase, the true duration of this phase cannot be known, mostly owing to its relatively short duration. Any discussion must recognise that there are degrees of both subsistence strategies (see Rowley-Conwy 2004). Nonetheless, we argue that the Negotiation phase almost certainly has come to its close also by c. 3700 BC because it is at this point that new forms of material culture and practice emerge in the form of earthen long barrows, causewayed enclosures, cattle sacrifice, and changes in the prevalence of agricultural equipment at the shell middens. Both foragers and farmers appear to share material culture, but not subsistence strategies. As such, at the settlement sites are the farmers, and at the hunting stations, foragers descendent from EBK groups. Contact is certain, and genetic exchange is likely. Subsequent to immigration, the material culture of the TRB hybridised with EBK forms quickly, with the settlement pattern and subsistence strategy following only later. Ethnographic comparisons predict exactly this sort of progression (Verhart 2003) in which material goods are widely exchanged upon contact, with subsistence changes only seen in context of a major reorganisation of society. This phase witnesses the manufacture of transitional forms of material culture, and the flow of ideas is not unidirectional.

The **Homogenisation Phase** begins roughly when economic duality ceases on the landscape. It is during this phase that a progressive decline in the exploitation of wild resources, an increase in the role of domestic resources, deforestation for agriculture, and the emergence of new, hitherto unknown cultural practices emerge on the landscape. It is only at this point, the transition to agriculture is complete. Given the evidence of continuity and discontinuity (Figure 7), we suggest that this phase probably starts by c. 3700 BC, but certainly by c. 3500 BC.

## **Discussion**

Our model's greatest strength is its ability to accommodate the conflicting evidence of continuity and change, the primary points of contention with regards to understanding agricultural origins in the region. In this, it sidelines what almost certainly are overly simplistic singular explanations. It further allows for a degree of variation *within* southern Scandinavia. We fully admit it has weaknesses, particularly in its explicit acceptance of the supposition that it is possible for societies to change material culture without a change in subsistence practice. Nonetheless, at its core is a recognizance that

Neolithisation is a process and the flexibility the model offers with regards to observed geographic variability in material culture in the years after 4000 BC better accommodates the available data with regards to causality.

Our model does not replace the three phase model of Zvelebil & Rowley-Conwy (1984) but instead applies it multiple times along the same continuum of time. The hunting stations are evidence of groups currently in the Substitution phase (Zvelebil & Rowley-Conwy 1984), while the contemporary settlement sites either represent groups already in the Consolidation phase or incoming farmers. To underscore this, the percentages of wild versus domestic species in the faunal assemblages from hunting station contexts (Table 1) fits nicely into the summed ethnographic societies described by Rowley-Conwy (2004: Fig. 7b) as undertaking the Substitution phase.

It is our opinion that it may not be possible to assign different material culture to incoming farmers, the last foragers, and groups adopting farming in the same fashion as subsistence strategy. Owing to the strong possibility of inter-marriage and the associated transfer of skills, styles, and traditions, any tripartite assignment may be meaningless. However, new forms of material culture and cultural practice are present from the outset, concurrent with the persistence of, or similarities with, earlier forms (Table 7). We take this to mean, that during the Negotiation phase, the demographic balance between incoming farmers and the last foragers was relatively equal.

Several lines of evidence support this assertion. Firstly, widespread forest clearance is rare before the Standardization phase (Gron and Rowley-Conwy 2017), an argument against large-scale immigration. Secondly, cattle are being moved (Gron et al. 2016), possibly to maintain the breeding viability of very small herds at scattered frontier farms, a probable situation underscored by the available faunal record (Table 1). Even the largest faunal assemblages, despite a general lack of MNI (Minimum Number of Individuals) determinations, are unlikely to represent more than a dozen or so individual cattle, below the threshold of demographic stability (Bogucki 1988). Perhaps most telling is the lack of large-investment communal construction during the Negotiation phase; there are no causewayed enclosures, despite such constructions being known earlier in the regions from which the immigrants likely originated (Sørensen 2014). There were not enough farmers to build them.

There is a need to shift the theoretical focus between discussions of when and how does agriculture come to Scandinavia to a focus on how farming is actually transferred between societies. How does

agriculture come to a region and why does it take time? The repeated patterns of agrarian strategies can be interpreted as routinised practices (Giddens 1984). For farmers, day-to-day agriculture becomes routinised, and repeats itself every year according to preferred strategic choices in the breeding of animals, cultivation of crops and the securing of winter fodder. Any foraging by farmers also falls under this purview. Through the year, these routines are repeated activities by individuals who do not need to consciously think or speak about them.

We expect future research to reveal evidence of the intermixture of incoming farmers and hunter-gatherers as has been seen elsewhere (González-Fortes *et al.* 2017). Unfortunately, the character of interaction in different regions still remains to be investigated, and will require a detailed high-resolution review of material culture, C14 dates, and other scientific analysis documenting the complexity of the agrarian practices in order to move forward in this discussion.

## **Conclusions**

The Scandinavian example demonstrates that Neolithisation processes are dictated by a combination of factors, including demographics, biogeography, economics, and cultural circumstances. Whilst each individual European Neolithisation “event” occurred in its own unique setting, our model is likely applicable whenever indigenous foragers, in the face of incoming migrants, are able to maintain their traditional subsistence strategy for a time. As such, we suggest that the data indicate a period of economic and probably cultural negotiation during which agriculture came to Scandinavia. Recent research has allowed a more nuanced understanding of agricultural origins by investigating at a much finer scale the processes, their timing, and systems of complexity in place from the earliest years of the Neolithic. It is our impression that our understandings are not furthered by taking a side, but instead by looking to the compromise represented by a model of economic, if not cultural dualism in the earliest centuries of the Funnel Beaker Culture. Our model is imperfect, but it is consistent with the data, and flexible, and we hope that it furthers the recognition that Neolithisation is a process.

## **Acknowledgements**

We thank three anonymous colleagues for their thoughtful comments. KJG and LS thank the Leverhulme Trust and the Carlsberg Foundation respectively for funding.

## References

- Andersen, S.H. 1991. Norsminde: A 'køkkenmødding' with late Mesolithic and early Neolithic occupation. *Journal of Danish Archaeology* 8: 13–40.
- Andersen, S.H. 2004. Danish Shell Middens Reviewed, in A. Saville (ed.) *Mesolithic Scotland and its Neighbours*: 393-411. Edinburgh: The Society of Antiquaries of Scotland.
- Andersen, S.H. 2007. Shell middens ("køkkenmøddinger") in Danish prehistory as a reflection of the marine environment, in N. Milner, O.E. Craig, & G.N. Bailey (eds.) *Shell middens in Atlantic Europe*: 31-45. Oxford: Oxbow.
- Andersen, S.H. 2011. Kitchen middens and the early pottery of Denmark, in Hartz S, Lüth F and Terberger T (eds.) *Frühe Keramik im Ostseeraum – Datierung und Sozialer Kontext. Internationaler Workshop in Schleswig vom 20. bis 21. Oktober 2006*. Mainz: Bericht der Römisch-Germanischen Kommission, pp. 193-216.
- Anderson, V.D. 1994. King Philip's herds: indians, colonists, and the problem of livestock in early New England. *The William and Mary Quarterly* 51(4):601-624.
- Andersson, M., M. Artursson, & K. Brink. 2016. Early Neolithic landscape and society in southwest Scania- new results and perspectives. *Journal of Neolithic Archaeology* 18:23-114.
- Beck, M.R. 2013. Højensvej Høj 7- en tidligneolitisk langhøj med flere faser. *Aarbøger for Nordisk Oldkyndighed og Historie* 2011-2012: 33-118.
- Berggren, Å. 2007. *Till och från ett kärr: den arkeologiska undersökningen av Hindbygården. Malmöfynd nr 17*. Malmö: Malmö Kulturmiljö.
- Bickle, P. & A. Whittle. (eds.) 2013. *The first farmers of central Europe: diversity in LBK lifeways*. Oxford: Oxbow Books.
- Bogucki, P. 1988. *Forest Farmers and Stockherders*. Cambridge: Cambridge University Press.
- Bratlund, B. 1993. The bone remains of mammals and birds from the Bjørnsholm shell-mound: a preliminary report. *Journal of Danish Archaeology* 10: 97–104.
- Cappers, R.T.J., D.C.M. Raemaekers. 2008. Cereal cultivation at swifterbant? Neolithic wetland farming on the North European Plain. *Current Anthropology* 49(3):385-402.

- Craig, O.E., V.J. Steele, A. Fischer, S. Hartz, S.H. Andersen, P. Donohoe, A. Glykou, H. Saul, D.M. Jones, E. Koch, & C.P. Heron. 2011. Ancient lipids reveal continuity in culinary practices across the transition to agriculture in northern Europe. *Proceedings of the National Academy of the Sciences* 108(44):17910-17915.
- Cronon, W. 1983. *Changes in the land: indians, colonists, and the ecology of New England*. New York: Hill and Wang.
- Digerfeldt, G., S. Welinder. 1989. The prehistoric cultural landscape in South-West Sweden. *Acta Archaeologica* 59: 127-136.
- Enghoff, I.B. 2011. *Regionality and biotope exploitation in Danish Ertebølle and adjoining periods*. Copenhagen: The Royal Danish Academy of Sciences and Letters.
- Fischer, A. 2002. Food for feasting, in A. Fischer & K. Kristiansen (eds.) *The Neolithisation of Denmark – 150 years of debate*: 343-393. Sheffield: Collis Publications.
- Fischer, A., J. Olsen, M. Richards, J. Heinemeier, Á.E. Sveinbjörnsdóttir, & P. Bennike. 2007. Coast-  
inland mobility and diet in the Danish Mesolithic and Neolithic: evidence from stable isotope values of humans and dogs. *Journal of Archaeological Science* 34: 2125–2150.
- Giddens, A. 1984. *The Constitution of Society*. Cambridge: Polity Press.
- González-Fortes, G., E.R. Jones, E. Lightfoot, C. Bonsall, C. Lazar, A. Grandal-d'Anglade, M.D. Garralda, L. Drak, V. Siska, A. Simalcik, A. Borondeant, J.R.V. Romani, M.V. Rodríguez, P. Arias, R. Pinhasi, A. Manica, & M. Hofreiter. 2017. Paleogenomic evidence for multi-generational mixing between Neolithic farmers and Mesolithic hunter-gatherers in the lower Danube basin. *Current Biology* 27:1-10.
- Gotfredsen, A.B. 1998. En rekonstruktion af palæomiljøet omkring tre senmesolitiske bopladser i Store Åmose, Vestsjælland-baseret på pattedyr- og fugleknogler. *Geologisk Tidsskrift* 98(2): 92–104.
- Gray, L.C. 1933. *History of agriculture in the southern United States to 1860*. Washington: Carnegie Institution of Washington.
- Gron, K.J. 2013. The Ertebølle faunal economy and the transition to agriculture in southern Scandinavia. Unpublished PhD dissertation, University of Wisconsin-Madison.

- Gron, K.J., & P. Rowley-Conwy. 2017. Herbivore diets and the anthropogenic environment of early farming in southern Scandinavia. *The Holocene* 27(1):98-109.
- Gron, K.J., J. Montgomery, P. Rowley-Conwy. 2015. Cattle management for dairying in Scandinavia's earliest Neolithic. *PloS One* 10(7):e0131267
- Gron, K.J., J. Montgomery, P.O. Nielsen, G.M. Nowell, J.L. Peterkin, L. Sørensen, & P. Rowley-Conwy. 2016. Strontium isotope evidence of early Funnel Beaker Culture movement of cattle. *Journal of Archaeological Science: Reports* 6:248-251.
- Gron, K.J., D.R. Gröcke, M. Larsson, L. Sørensen, L. Larsson, P. Rowley-Conwy, & M.J. Church. 2017. Nitrogen isotope evidence for manuring of Early Neolithic Funnel Beaker Culture cereals from Stensborg, Sweden. *Journal of Archaeological Science: Reports* 14: 575-579.
- Groover, M.D., R.D. Brooks. 2003. The Catherine Brown cowpen and Thomas Howell site: material characteristics of cattle raisers in the South Carolina backcountry. *Southeastern Archaeology* 22(1): 91-110.
- Grumet, R.S. 1992. *Historic contact: early relations between indian people and colonists in Northeastern North America, 1524-1783*. Philadelphia: National Park Service.
- Hede, S.U. 2005. The finds: mammal, bird, and amphibian bones, in T.D. Price & A.B. Gebauer (eds) *Smakkerup Huse: A Late Mesolithic Coastal Site in Northwest Zealand, Denmark*:91-102. Aarhus: Aarhus University Press.
- Heinrich, H. 1999. Die tierknochenfunde des Früneolithischen wohnplatzes Wangels LA 505. Ein Vorbericht. *Offa* 54/55:43-8.
- Jennbert, K. (1984) Den produktiva gåvan. Tradition och innovation i Sydskandinavien för omkring 5300 år sedan. *Acta Archaeologica Lundensia* 4(16):1-221.
- Johansen, K.L. 2006. Settlement and land use at the Mesolithic-Neolithic transition in southern Scandinavia. *Journal of Danish Archaeology* 14:201-223.
- Karlsen, K.B., A. Nylén, J. Ros, K. Anttila, H. Runeson, A. Lihammer. 2013 Attersta – fossil åker, skärvstenshög och medeltida gård. Förundersökning och särskild arkeologisk undersökning. *Stiftelsen Kulturmiljövård Rapport* 2010:15.
- Karsten, P. 1994. Att kasta yxan i sjön. *Acta Archaeologica Lundensia* 80(23):1-360.

- Klassen, L. 2004. *Jade und Kupfer Untersuchungen zum Neolithisierungsprozess im westlichen Ostseeraum unter besonderer Berücksichtigung der Kulturentwicklung Europas 5500-3500 BC*. Århus :Jutland Archaeological Society.
- Koch, E. 1998. *Neolithic bog pots from Zealand, Møn, Lolland and Falster*. Copenhagen: Det Kongelige Nordiske Oldskriftselskab.
- Krings, S. 2010. *Statistisches Jahrbuch 2010. Für die Bundesrepublik Deutschland mit Internationalen Übersichten*. Wiesbaden: Statistisches Bundesamt.
- Magnell, O. 2015. Animal husbandry and social identities during the Neolithic in southern Sweden, in K. Brink, S. Hydén, K. Jennbert, L. Larsson & D. Olausson (eds.) *Neolithic Diversities – perspectives from a conference in Lund, Sweden*: 80-88. Lund: Acta Archaeologica Lundensia.
- Magnussen, B.I. 2007. En geologisk og zooarkæologisk analyse af kystbopladsen: Lollikhuse på overgangen mellem Mesolitikum og Neolitikum. Unpublished Master's dissertation, Copenhagen University.
- Manning, K., S.S. Downey, S. Colledge, J. Conolly, B. Stopp, K. Dobney, & S. Shennan. 2013. The origins and spread of stock-keeping: the role of cultural and environmental influences on early Neolithic animal exploitation in Europe. *Antiquity* 87:1046-1059.
- Milner, N., O.E. Craig, G.N. Bailey, & S.H. Andersen. 2006. A response to Richards and Schulting. *Antiquity* 80(308):456-458.
- Moorehead, A. 1966. *The fatal impact*. London: Penguin Books.
- Müller, J. 2011. *Megaliths and Funnel Beakers: societies in change 4100-2700 BC*. Amsterdam: Amsterdams Archaeologisch Centrum van der Universiteit.
- Nicolaisen, J. 1975. The Negritos of Casiguran Bay. Problems of affluency, territoriality and human aggressiveness in hunting societies of Southeast Asia. *Folk* 1974/75(16-17):401-434.
- Nicolaisen, J. 1976. The Penan of Sarawak. Further notes on the neo-evolutionary concept of hunters. *Folk* 1976(18):205-236.
- Nielsen, P.O. 1985. De første bønder: Nye fund fra den tidligste Tragtbægerkultur ved Sigersted. *Aarbøger for Nordisk Oldkyndighed og Historie* 1984:96-126.

- Nielsen, P.O. 2009. Den tidligneo-litiske bosættelse på Bornholm, in A. Schülke (ed.) *Plads og Rum i Tragtbagerkulturen. Bidrag fra Arbejdsmodet på Nationalmuseet, 22. september 2005*: 9-24. Copenhagen: Det Kongelige Nordiske Oldskriftselskab.
- Nielsen, P.O. & F.O. Nielsen. 2017. *First farmers. The Early Neolithic settlement at Vallensgård, Bornholm*. Copenhagen: Nordiske Fortidsminder.
- Noe-Nygaard, N. 1995. Ecological, sedimentary, and geochemical evolution of the late-glacial to postglacial Åmose lacustrine basin, Denmark. *Fossils and Strata* 37: 1–436.
- Noe-Nygaard, N., T.D. Price & S.U. Hede. 2005. Diet of aurochs and early cattle in southern Scandinavia: evidence from <sup>15</sup>N and <sup>13</sup>C stable isotopes. *Journal of Archaeological Science* 32: 855–871.
- Odgaard, B. 1999. Landbrugslandskabet gennem 2000 år. *Geologi Nyt fra GEUS* 1:4-6.
- Paludan-Müller, K. 1978. High Atlantic food gathering in northwestern Zealand: ecological conditions and spatial representation. *New Directions in Scandinavian Archaeology* 1:120–157.
- Pavao-Zuckerman, B., & E.J. Reitz. 2006. Introduction and adoption of animals from Europe. *Handbook of North American Indians* 3:485-491.
- Persson, P., & K-G. Sjögren. 1995. Radiocarbon and the chronology of Scandinavian megalithic graves. *Journal of European Archaeology* 3(2):59-88.
- Regnell, M. & K-G. Sjögren. 2006. Vegetational development, in K-G. Sjögren (ed.) *Ecology and economy in Stone Age and Bronze Age Scania*: 40-79. Lund: National Heritage Board.
- Rowley-Conwy, P. 1995. Wild or domestic? On the evidence for the earliest domestic cattle and pigs in south Scandinavia and Iberia. *International Journal of Osteoarchaeology* 5:115-126.
- Rowley-Conwy, P. 2004. How the West was lost: A reconsideration of agricultural origins in Britain, Ireland and southern Scandinavia. *Current Anthropology* 45(Suppl. 4): S83–S113.
- Rudebeck, E. 2010. I trästodernas skugga-monumentala möten i Neolitiseringsens tid, in B. Nilsson & E. Rudebeck (eds.) *Arkeologiska och förhistoriska världar: fält, erfarenheter och Stenåldersplatser i Sydvästra Skåne*:85-251. Malmö: Malmö Museer Arkeologienheten.
- Skaarup, J. 1973. *Hesselo-Solager: jagdstationen der Südsandinavischen Trichterbecherkultur*. Copenhagen: Akademisk Forlag.



- Sørensen, L. 2012. Fremmede økser som sædekorn for neolitisering – Agrarsamfundenes ekspansion mod Sydsandinavien, in F. Kaul & L. Sørensen (eds.) *Agrarsamfundenes ekspansion i nord. Symposium på Tanums Hällerstnismuseum, Underslås, Bobuslän, d. 25.-29. Maj 2011*:8-30. Copenhagen: Nordlige Verdener.
- Sørensen, L. 2014. From hunter to farmer in northern Europe: Migration and adaptation during the Neolithic and Bronze Age. *Acta Archaeologica* 85: 1–794.
- Sørensen, L. 2015. Endnu et indspark i neolitiseringsdebatten. Aktuell status inden for spredningen af agrarsamfundene. *Arkeologisk Forum* 33: 32-36.
- Sørensen, L. 2016. New theoretical discourses in the discussion of the neolithisation process in South Scandinavia during the late 5th and early 4th millennium BC - an identification of learning processes, communities of practice and migrations. *Documenta Praehistorica* XLIII:1-27.
- Stafford, M.D. 1999. *From forager to farmer in flint: a lithic analysis of the prehistoric transition to agriculture in southern Scandinavia*. Aarhus: Aarhus Universitetsforlag.
- Verhart, L. 2003. Mesolithic economic and social changes in the southern Netherlands, in L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler, & A. Åkerlund A (eds.) *Mesolithic on the Move: Papers presented at the Sixth International Conference on the Mesolithic in Europe, Stockholm 2000*: 442-450. Oxford: Oxbow Books.
- Yin, T. 2006. From hunters to farmers. Changing means of subsistence and food production among the Oroqen. *British Food Journal* 108: 951-957.
- Zeder, M, & P. Rowley-Conwy. 2014. Mesolithic domestic pigs at Rosenhof – or wild boar? A critical re-appraisal of ancient DNA and geometric morphometrics. *World Archaeology* 46(5):813-824.
- Zich, B. 1993. Die Ausgrabungen chronisch gefährdeter Hügelgräber der Stein- und Bronzezeit in Flintbek, Kreis Rendsburg-Eckernförde. Ein Vorbericht. *Offa* 1992/93(49/50):15-31.
- Zvelebil, M, & P. Rowley-Conwy. 1984. Transition to farming in northern Europe: a hunter-gatherer perspective. *Norwegian Archaeological Review* 17:104-28.

## Figures

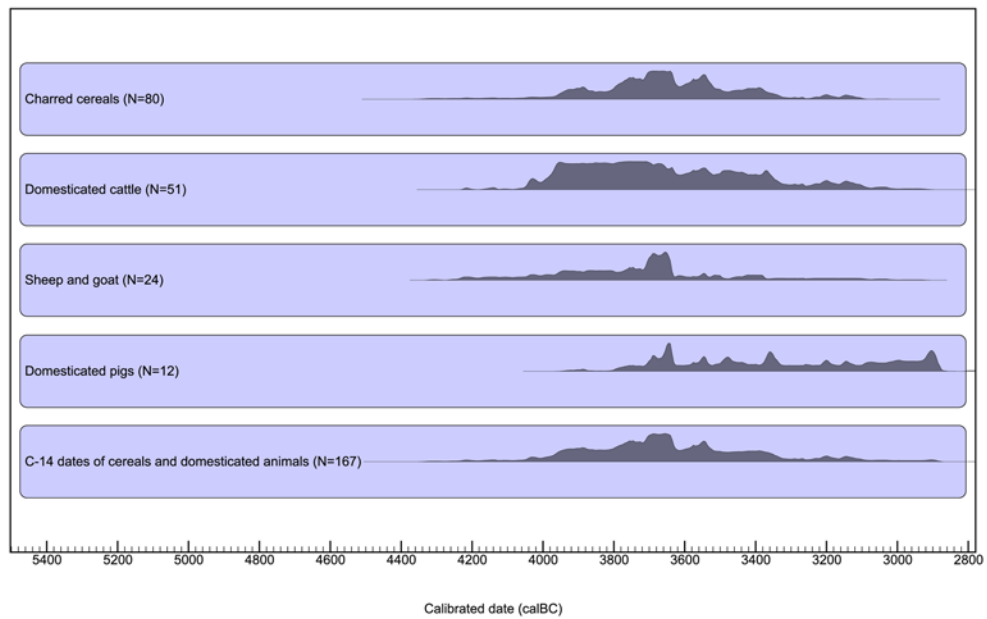


Figure 1: Available  $^{14}\text{C}$  dates for the arrival of domesticates to southern Scandinavia (see Karlsen *et al.* 2013; Sørensen 2014; Andersson *et al.* 2016, Nielsen & Nielsen 2017 and references therein. See Supplementary Table 1 for the individual dates). Calibration using OxCal v4.3.2.

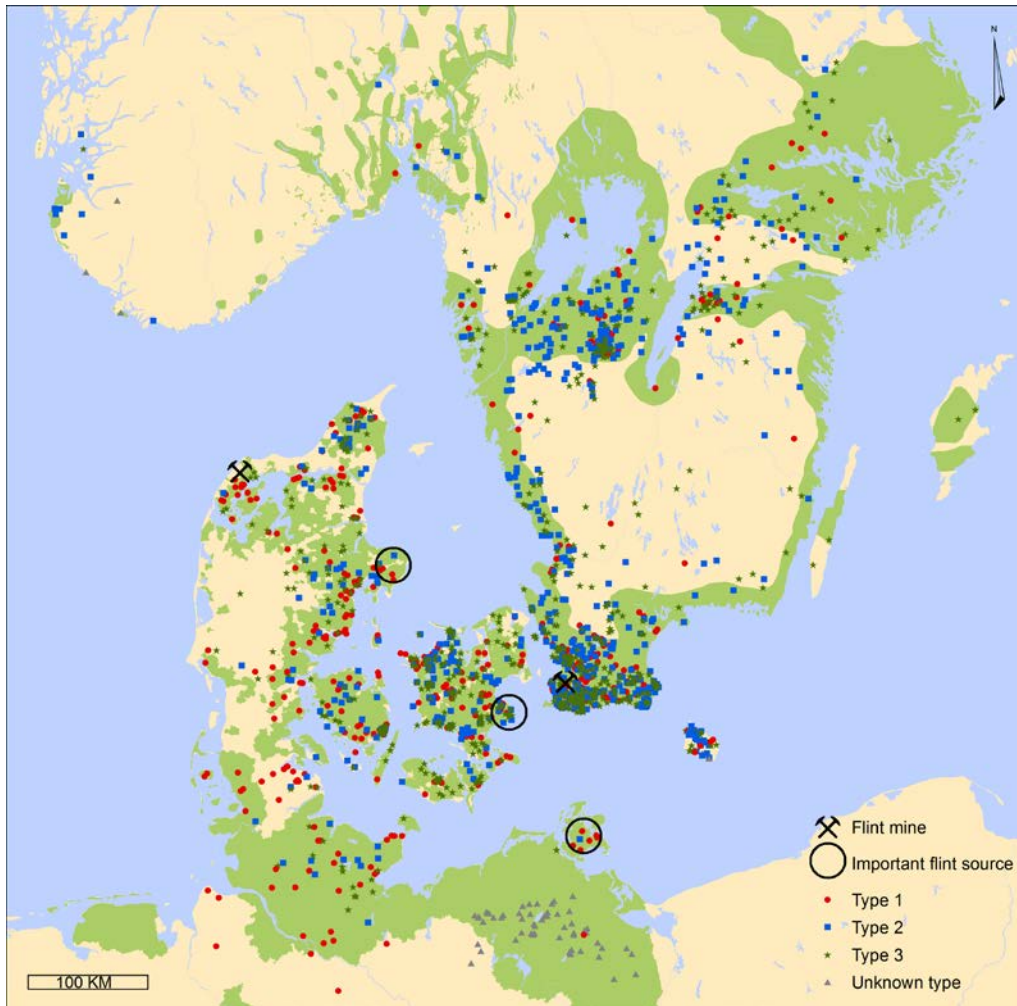


Figure 2: The distribution of pointed butted flint axes from the Early Neolithic overlaying current and historic arable land (green) (after Odgaard 1999; Krings 2010; Sørensen 2014).

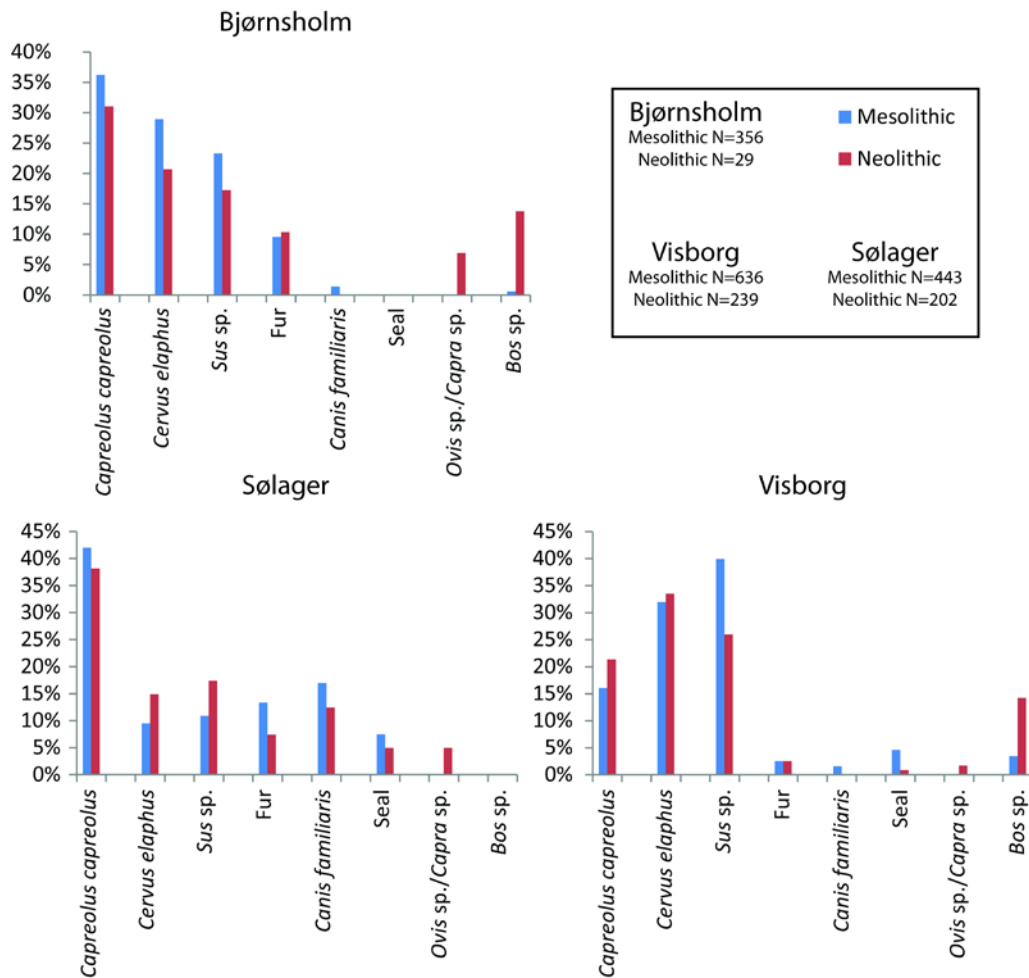


Figure 3: Mesolithic versus Neolithic fauna at Bjørnsholm, Sølager, and Visborg (Bratlund 1993; Skaarup 1973; Enghoff 2011). Sample sizes indicate Number of Identified Specimens (NISP). Table omits birds, amphibians, rodents and fish as well as tentative or mixed identifications save for *Sus sp.* and *Bos sp.* where wild and domestic forms are grouped. Seal species and ovicaprids (*Ovis sp./Capra sp.*) are grouped. Fur animals include *Martes martes*, *Lynx lynx*, *Meles meles*, *Mustela putorius*, *Castor fiber*, *Lutra lutra*, *Felis silvestris*, *Vulpes vulpes*, and *Canis lupus*.

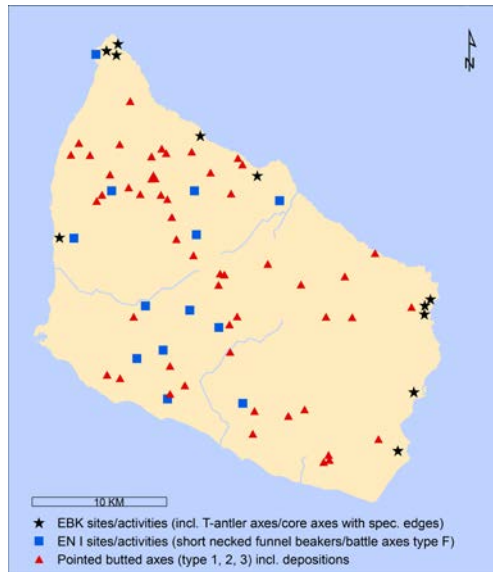


Figure 4: The shift from coastal to inland settlement on Bornholm, Denmark (see Sørensen 2014 and references therein).

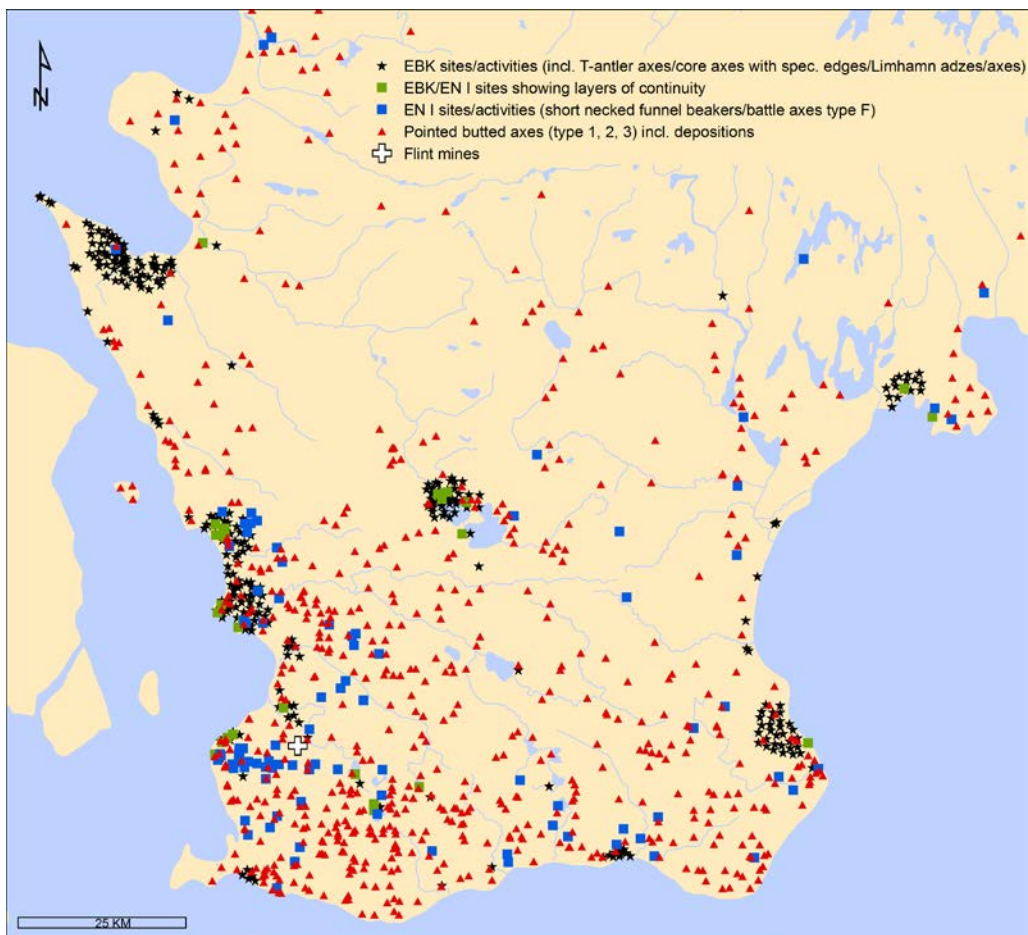


Figure 5: The shift from coastal to inland settlement in Scania, Sweden (see Sørensen 2014 and references therein).

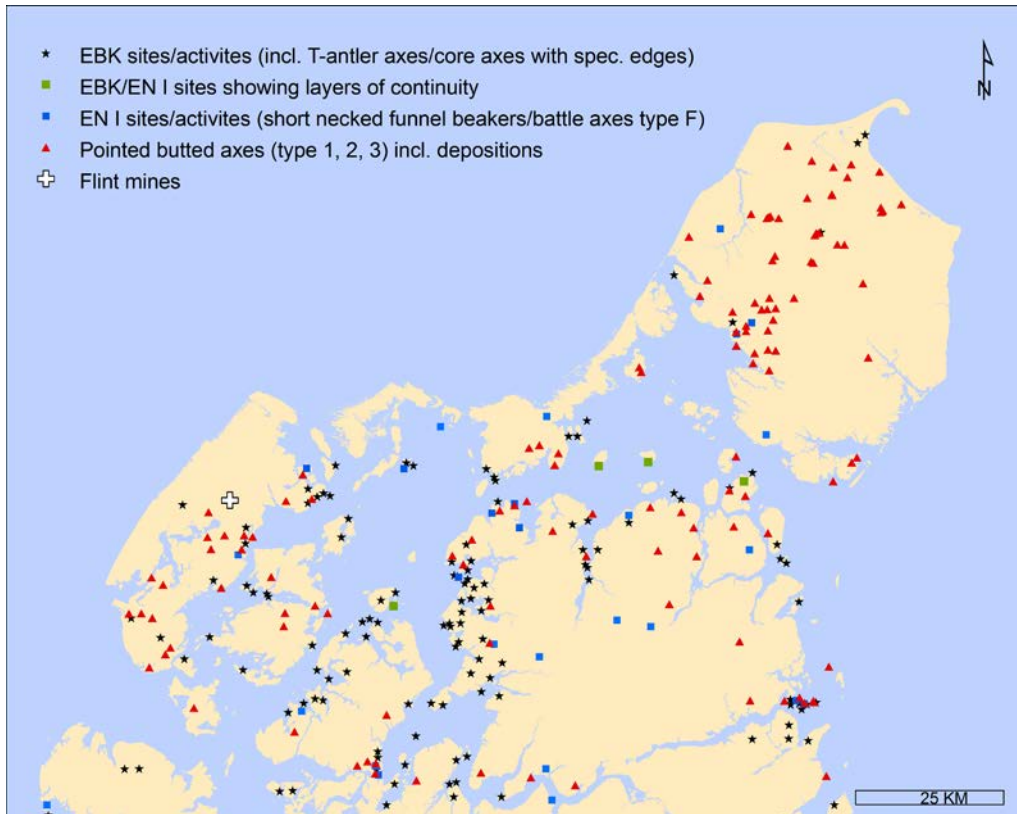


Figure 6: Mesolithic and Neolithic coastal settlement in north Jutland, Denmark (see Sørensen 2014 and references therein).

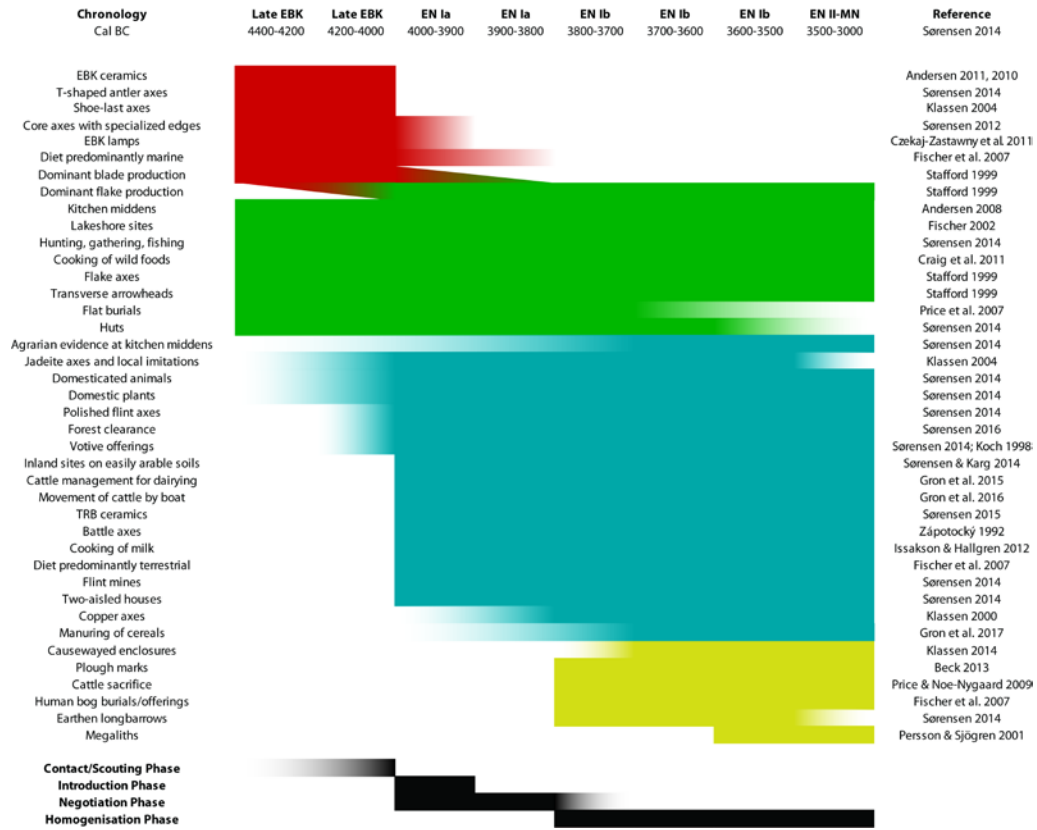


Figure 7: The Chronological development of the ENI (red=disappearance, green= continuity, blue=change, and yellow=subsequent developments). Dominant blade and flake production are connected as the toolkit is similar.

## Tables

Period	Site	Location	Total NISP	Percentage Domestic	Percentage Wild	Maximum Domestic	Maximum Wild	Domestic Adjusted	Wild Adjusted	Citation
Late EBK-ENI	Dyrholmen	Coastal	1581	0.0%	58.7%	41.3%	100.0%	20.7%	79.4%	Enghoff 2011
Late EBK-ENI	Egsminde	Coastal	47	0.0%	70.2%	29.8%	100.0%	14.9%	85.1%	Enghoff 2011
Late EBK-ENI	Havnø	Coastal	1128	10.4%	30.6%	69.4%	89.6%	39.9%	60.1%	Gron 2013
Late EBK-ENI	Krabbesholm II Layer C	Coastal	57	1.8%	38.6%	61.4%	98.2%	31.6%	68.4%	Enghoff 2011
Late EBK-ENI	Lollikhuse	Coastal	1057	0.8%	99.2%	11.4%	99.2%	6.1%	99.2%	Magnussen 2007
Late EBK-ENI	Nøddekonge	Lakeshore	493	0.0%	100.0%	1.4%	100.0%	0.7%	100.0%	Gotfredsen 1998
Late EBK-ENI	Siggenben-Süd	Coastal	152	57.9%	34.2%	65.8%	42.1%	61.9%	38.2%	Heinrich 1999
Late EBK-ENI	Smakkerup Huse	Coastal	1756	0.2%	99.8%	16.1%	99.8%	8.2%	99.8%	Hede 2005
Late EBK-ENI	Vejkonge	Lakeshore	194	0.5%	99.5%	4.1%	99.5%	2.3%	99.5%	Gotfredsen 1998
Late EBK-ENI	Visborg	Coastal	90	0.0%	53.3%	46.7%	100.0%	23.4%	76.7%	Enghoff 2011
Late EBK-ENI	Wangels	Coastal	435	52.6%	30.1%	69.9%	47.4%	61.3%	38.8%	Heinrich 1999
Late EBK-ENI	Åkonge	Lakeshore	2407	0.7%	99.3%	8.5%	93.4%	4.6%	96.4%	Gotfredsen 1998
Late EBK-ENI	Åle	Coastal	173	1.2%	67.6%	32.4%	98.8%	16.8%	83.2%	Enghoff 2011
ENI	Almhov	Inland	442	54.1%	20.8%	79.2%	45.9%	66.7%	33.4%	Weilnder et al. 2009; Rudebeck 2010
ENI	Bjørnsholm	Coastal	31	6.5%	77.4%	22.6%	93.5%	14.6%	85.5%	Bratlund 1993
ENI	Havnelev	Inland	569	59.9%	3.0%	97.0%	39.0%	78.5%	21.0%	Koch 1998
ENI	Krabbesholm II Layers D, E, F	Coastal	40	2.5%	15.0%	85.0%	97.5%	43.8%	56.3%	Enghoff 2011
ENI	Muldbjerg	Lakeshore	1473	2.4%	97.2%	2.8%	97.6%	2.6%	97.4%	Noe-Nygaard 1995
ENI	Sigersted	Inland	13	84.6%	0.0%	100.0%	15.4%	92.3%	7.7%	Nielsen 1985
ENI	Visborg	Coastal	241	1.7%	60.2%	41.5%	98.3%	21.6%	79.3%	Enghoff 2011

Table 1: Wild versus domestic proportion of transitional and ENI faunal assemblages. Table ignores birds, amphibians, fish, and dogs (*Canis familiaris*). Tentative or mixed identifications are omitted save for *Sus* and *Bos*. Seals and ovicaprids (*Ovis/Capra*). Horses (*Equus*) are wild. Roe deer (*Capreolus capreolus*) at Havnelev are reported present, so one fragment is included but is probably an underestimate. Almhov excludes horse and seals, and only ENI pits. *Sus scrofa* are regarded as either wild or domestic. Cattle are domestic only if diagnostic measurements were taken, otherwise grouped as *Bos* sp., excepting finds from Zealand and Scania. Havnelev pigs are grouped as *Sus* sp. Maximum Percentage Wild assumes all *Bos* and *Sus* are wild, and Maximum Percentage Domestic the opposite. Domestic and Wild Adjusted evenly divides the undifferentiated forms of *Sus* and *Bos* into wild and domestic.