Journal of Nordic Archaeological Science 16, pp. 49–63 (2009)

Mesolithic consumption practices
Food for thought

Nicky Milner

Department of Archaeology, University of York, The Kings Manor, York, YO1 7EP, Great Britain
(nm507@york.ac.uk)

The subsistence economy has always been one of the key areas of investigation in Mesolithic research and is considered to be important because it can shed light on the way people interacted with their environment. Grahame Clark championed the study of the Mesolithic economy and his work at Star Carr influenced the ways in which subsistence has been studied since. This paper will outline the development of Mesolithic subsistence studies in Britain and Ireland. It will show that on reflection our understanding of Mesolithic subsistence has not changed, in some senses, since Clark's book on *Prehistoric Europe: the economic basis* (1952). However, it is argued that there are many new lines of enquiry which can be addressed concerning social relations and the consumption of food. These may include the study of foodstuffs which have often been ignored or seen as being of "minor" importance, aspects of proscription and symbolic disposal, day-to-day meals and large communal gatherings.

Keywords: Mesolithic, food, consumption, diet, subsistence, Grahame Clark

Introduction

We cannot live without eating and receiving regular intakes of life-sustaining vitamins, minerals and energy, and food also has so many other important social functions. Once natural resources are transformed into food through processing and cooking, food becomes a form of material culture which is bound up inextricably with symbolism, ritual and cultural identity. Meals such as breakfast, lunch and dinner help structure the normal day, but feasts or special meals may mark particular times and events in the year, like Christmas. Some special, traditional foods may be used at these times, and bringing together groups of people in communal consumption helps create and maintain social relationships. Food can also reflect power relations and be used to differentiate between people by gender, class, caste, kin and age.

Although other disciplines such as anthropology and history have a strong tradition in the study of the sociality of food (Lévi-Strauss 1969, 1978; Goody 1982; Douglas 1999), archaeology has been slow to follow (Milner & Miracle 2002; Parker Pearson 2003). Montón Subías (2002) has suggested that until the emergence of gender archaeology within archaeological studies the "domestic" realm of cooking received little attention.

In Mesolithic studies food is barely mentioned. Instead there is a focus on the exploitation of natural resources and the natural environment, the hunt, and the subsistence economy. An implicit assumption is made that the resources are then consumed, and studies of bones, for instance, will tell us *what* parts of an animal were processed *where*, which perhaps might tell us what type of site it is, e.g. a hunting camp or a kill site (although see Conneller 2005). The social process of food consumption from procurement and processing to discarding is rarely explored.

Firstly, I wish in this paper to outline the history of Mesolithic subsistence studies in Britain and Ireland in order to assess the data which are available for study, the methods which have been used and most importantly the dominant questions which have been asked. I will then present a case study to show how the

examination of food consumption can be broadened, what new questions can be asked and how we can go about investigating these.

A history of Mesolithic subsistence studies in Britain and Ireland

The influence of Grahame Clark

Prior to Clark's first books on the Mesolithic (1932, 1936) the Mesolithic Age, never mind subsistence studies, had not been taken seriously and attitudes to this period were on the whole belittling. Childe, for example, preferred to term this period the Epipalaeolithic, because this conveyed the idea that it was a hiatus period when nothing happened, prior to the Neolithic revolution (Childe 1925). Later, Childe (1956:44) appears to do away with the Mesolithic, seeing it as a continuance of the Old Stone Age mode of life: "it has seemed needless in this book to complicate the picture with a Mesolithic" and indeed the chapter on food gatherers ends with the Magdalenians before commencing with the Neolithic revolution. In the preface to Clark's Mesolithic Age in Britain, Burkitt states that "the Mesolithic Age has for some time past been a sort of dust-bin into which any awkward industry which did not seem to belong to any other period could be cast" (Clark 1932:xiii). In terms of subsistence, when it was mentioned, the picture was fairly wretched and an image was conjured up of poverty and savagery. Because of the various excavations of shell middens through Europe (e.g. at Oronsay, Muge, Teviec, Asturias) shellfish were usually mentioned as playing an important part in the diet. Childe (1925:17), for instance, described the Asturians as a poverty-stricken and "miserable population of food-gatherers" who "lived largely on shellfish". More recently it has been suggested (Bailey & Milner 2002) that this language of "wretchedness" associated with shell-gatherers may be traced back to the observations on the peoples of Tierra del Fuego published by Charles Darwin in 1839 (Darwin 1997) following his voyage on the Beagle. His accounts and those of the other early travellers used derogatory language about the state of coastal peoples. These accounts were then used by Lubbock (1865) as an analogy for the Mesolithic people of the Danish kitchen middens.

Clark's first book on the Mesolithic (1932) concentrated much more on lithic technologies than subsistence, but in the chapter on "The food quest" in his book *Prehistoric England* (1940) he begins to paint a picture of hunting and gathering and suggests that temperate animals such as the elk, red deer, roe deer, wild boar and aurochs, hunted with bows and arrows, were the main food sources. He also mentions that fur-bearing animals would have been caught and that possibly the dog was also used in hunting. He discusses the role of plant foods, e.g. hazelnuts, and considers the use of nets in fishing and the use of leisters by inland "fisher-folk". He also notes the importance of resources of the seashore, including shellfish and the occasional seal, and suggests that strand-looping was especially common in Mesolithic Europe. Not once is a derogatory inference made and neither was an evolutionary approach taken when considering the start of the Neolithic. This can be contrasted with the work of Childe (1940:31), in which it is suggested with regard to "man" during the hunting and gathering period of human existence that, "though he exceeded other animals in cunning and dexterity, his attitude to his environment was effectively as passive and negative as that of the beaver and the fox". This observation is used as a means of building up to the Neolithic revolution, in which "men" became active and "adopted a more aggressive attitude to their surroundings" (Childe 1940:31). Jacquetta Hawkes (1945:12) also has little to say about "middle stone age" subsistence except that "game was smaller and more difficult to obtain and the diet had to be made up by the collection of shellfish".

Through the 1940s, Clark began to develop more of an interest in prehistoric social and economic activities in a series of papers on bees, water, whales, fowling, fishing and seal-hunting (1942, 1944, 1946, 1947, 1948a, 1948b). He wanted to move away from the traditional approach of publishing detailed identifications of animal and plant remains and instead concentrate on the potential of an anthropological approach (Clark 1952:4). At the end of the decade, in 1949–1951, Clark got the opportunity to apply this approach with the excavation of Star Carr (Clark 1954). Here, he made sure that the analyses went beyond the classic laundry lists of species. Instead, he included discussions of plant foods, hunting strategies, the analysis of relative numbers of animal bones and the importance of different species within the economy, and the seasonality of hunting and site occupation. In addition, the importance of these themes to him is demonstrated in *Excavations at Star Carr* (1954) through the way in which the book is structured, with the chapter on animal remains situated at the beginning as opposed to being placed in an appendix.

The seasonality of work is particularly significant because this type of study is one of the first of its kind to be made in European prehistory. Clark was greatly influenced by the pioneer studies of Thompson (1939)

on the Wik-Monkan people and Evans-Pritchard (1940) on the Nuer, which traced seasonal rhythms in economic and social life. He saw seasonality as a way in which hunter gatherers "maximised their resources and in effect practiced a kind of husbandry" and considered that seasonal practices would affect a wide range of material culture (Clark 1975:16).

In 1952 Clark brought together many of his ideas in *Prehistoric Europe: the Economic Basis.* He wrote extensively in two chapters on the "catching and gathering strategies", both inland and on the coast, of Prehistoric Europe, but on analysis, little additional information was given about Britain compared to his work in 1940. The key species of land mammals are again discussed, in further detail, and fowling and coastal resource procurement is examined for Oronsay. He does also describe the latter in more detail, discussing the evidence for fishing from boats, seal and whale procurement and remains of crabs. As a general observation, shell-fish are stated as occupying only a subsidiary place, and it is suggested that obtaining foods from the sea shore should not be "..underrated merely because it was common to all societies within reach of the coast" (Clark 1952:62).

Importantly, however, this volume also pushed for new directions in economic and social approaches. The introductory chapters set out his thinking on his interpretative framework. The key theme was the interrelations of culture, biome and habitat in an ecosystem. Through influences from the continent, he also stressed the importance of excavating sites with organic remains in order to expand the evidential base. In addition, he was very keen on bioarchaeological approaches and scientific methods, such as the study of seasonality. He suggested that it is very important to establish the seasonal cycle of occupation and that the chief clues should be seasonal migrants, e.g. birds, foetal or young individuals and the study of antlers (Clark 1952:5), which reflects his work at Star Carr.

Post "Prehistoric Europe: The Economic Basis"

Grahame Clark's research has been hugely influential for Mesolithic studies, not only in Britain and Ireland but also across Europe. Clark (1975:4) wrote later that *Prehistoric Europe: The Economic Basis* was written as "an act of propaganda": it illustrated how much evidence already existed and "how rich a harvest might be expected if research turned in this direction". Certainly, the agendas which were set have largely been followed: bioarchaeological approaches, including seasonality studies, continue to be developed. Many other sites have also been excavated, some of which contain fairly abundant organic remains, but these are mainly shell midden sites and unfortunately few inland sites have produced extensive faunal or floral evidence, certainly not comparable to Star Carr. Since the 1970s further work has been carried out around Lake Flixton in the Vale of Pickering, for example, and although some sites have produced faunal assemblages they are not analogous to Star Carr in terms of the abundance or diversity of material (Schadla-Hall 1989; Mellars & Dark 1998; Conneller & Schadla-Hall 2003). A different kind of environment, the estuarine deposits of Goldcliff in the Severn, has also produced faunal and floral remains, and what is even more remarkable is that animal and human footprints have been preserved in the mud (Bell 2007). Other sites lack the requirements needed for the preservation of organic remains, and instead studies of the economy have relied on what has survived through charring and burning, e.g. at Mount Sandal (Woodman 1985a) and Howick (Bailey & Milner 2007).

Thatcham (Wymer 1962) yielded organic finds including faunal remains, but it could be argued that the evidence did little to advance our understanding of Mesolithic subsistence. The report on animal bones was carried out by Judith King (one of the authors of the Star Carr faunal report) and the results were described as showing a general similarity to those of Star Carr. Measurements and identifications were given, but no further interpretation was made (e.g. seasonality) and despite the precedent set by the Star Carr book, the faunal remains report was added as an appendix at the end of the main paper, after the presentation of the flint, bone and antler industries.

Many shell midden sites have been excavated or returned to since the 1960s, Westward Ho! (Churchill 1965; Balaam et al. 1987), Oronsay (Mellars 1978, 1987), Culverwell (Palmer 1976, 1999), Morton (Coles 1971, 1983), An Corran (Saville & Miket 1994), Raschoille Cave (Connock 1985), Ulva Cave (Russell et al. 1995), Carding Mill Bay (Connock et al. 1992), Sand (Hardy & Wickham-Jones 2002), Polmonthill, Inveravon and Nether Kinneal in the Forth Valley (Sloan 1993), Ferriters Cove (Woodman et al. 1999), Glendhu (Woodman 1985b) and Lough Swilly (Milner & Woodman 2005). Some of these sites have produced substantial amounts of data, e.g. the excavations carried out throughout the 1960s at Morton, Fife (Coles 1971, 1983), which provide a comprehensive description of the faunal material and some discussion of related activities, including deep-sea fishing by boat. Following Clark's endorsement of

the importance of seasonality studies, some attention was given to this theme, but nothing conclusive could really be said until the incremental analysis of cockles undertaken at a later date, which demonstrated a bias towards winter collection (Deith 1983).

The excavations by Paul Mellars on the island of Oronsay (1978, 1987) were also important in that the project experimented with new scientific methods in order to interpret subsistence practices. The analysis of the faunal remains revealed the importance of fish, particularly saithe, in the diet, and later work on the otoliths provided seasonality results (Mellars & Wilkinson 1980). Some interesting and novel approaches were also made to the methods of exploitation and processing of food resources, e.g. it was shown that fish bones tended to be concentrated in particular areas of the site, perhaps representing periods when fishing was almost the sole subsistence activity (Mellars 1978:386). Although no analysis of the seasonality of the limpets could be made, some novel methods were adopted for studying the exploitation of shellfish, including analysis of the shapes of the limpet shells, suggesting exploitation from low tide situations (Mellars 1978:389). These methodologies and approaches were also used in a study of molluscs at the Ulva site (Russell et al.1995).

Other shell midden sites, for various reasons, have not produced such comprehensive studies. The shell midden of Westward Ho! has been known about since 1867 but has mostly been inaccessible until an exposure of submerged forest at spring tides enabled further study in 1962 (Churchill 1965) and again in 1983 and 1984 (Balaam et al. 1987). Although much of the site has disappeared through erosion by the sea, some very basic lists of fauna and plant remains are provided in the reports. From the excavations at Culverwell, another site excavated throughout the 1960s, little can be said about subsistence because few faunal remains were found other than shellfish (Palmer 1976, 1999). Again no seasonality studies were performed on the molluscs until much later, when scientific methods had developed, whereupon the results pointed to autumn/winter collection of topshells (Mannino et al. 2003).

Unfortunately, some of the other Scottish cave sites, due to the rescue nature of their excavation, have either not been fully published or lack detailed evidence of subsistence practices, e.g. Raschoille (Connock 1985), Carding Mill Bay (Connock et al. 1992) and An Corran (Saville & Miket 1994). The most recent work in Scotland, on the Scotland's First Settlers project (Hardy & Wickham-Jones 2002), has, however, produced evidence for many more shell midden sites in the Inner Sound region, and the excavation of the site of Sand has provided a wealth of new subsistence information of importance to Mesolithic studies (Hardy & Wickham-Jones in press).

In summary, a number of sites have been excavated over the last 50 years or so, producing varying quantities of faunal and floral remains, and a number of methods have been developed, particularly for investigating seasonality. Seasonality has also been a dominant theme of study at Star Carr, and this site has been revisited and developed many times since the original publication. Clark himself provided a re-interpretation in 1972, when, based on the seasonality work published in the 1954 volume, he suggested that Star Carr was a winter base camp for groups that dispersed into the Moors or the Pennines in the summer (Clark 1972). This interpretation used modern ecological models to reconstruct the seasonal movement of red deer. Pitts (1979) suggested the site was a specialised one for working with antlers and hides, and was of the opinion that this activity would have taken place in the summer. Andresen et al. (1981), however, proposed that the site had been used intermittently through the year and over many years. Further work was carried out on the faunal assemblage by Legge and Rowley-Conwy (1988), and one of the major outcomes was a re-analysis of the seasonality indicators, with a suggestion that the site was occupied in the spring/summer. More recently, further analysis in the form of radiographs of mandibular development in roe deer and red deer has been used to suggest a winter human presence at Star Carr (Carter 1997, 1998).

As well as advances in seasonality studies, other scientific methods have been developed in order to further our understanding of the Mesolithic economy and diet. In the 1970s the importance of plants in the Mesolithic was highlighted by David Clarke (1976), suggesting that the environment may have been rich in plant foods and that these may have been a major contributor to the diet. A number of testable points were identified, including the analysis of wear patterns on microliths and blades. Since then detailed microwear analyses have been carried out on artefacts from a number of sites: e.g. Mount Sandal and Star Carr (Dumont 1985, 1989), and analyses carried out in Scotland (e.g. Finlayson & Mithen 2000) suggest that microliths were used for a variety of tasks. Research into residues may also provide a way towards understanding tool use and subsistence, and starch grains extracted from the working edges of tools at the Sands of Forvie suggest a wide range of activities, including

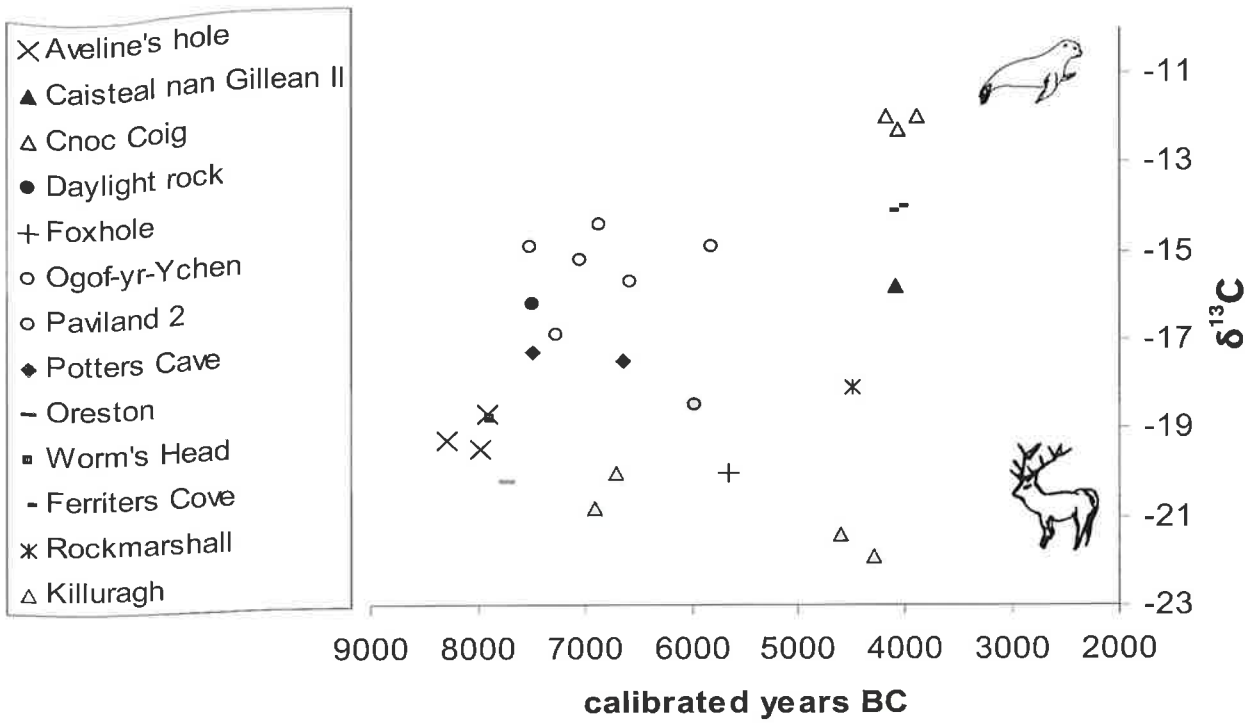

Figure 1. Summary graph of published carbon isotope values for Irish and British Mesolithic sites (before 4000 BC). Values around −2‰ $\delta^{13}C$ are purely marine and are equivalent to those obtained for seal bones from Oronsay. Values around −20‰ $\delta^{13}C$ are purely terrestrial and are equivalent to those obtained for red deer, sheep and cattle. The dates for Aveline's hole were calibrated using CALIB 5.0.1. (Sources of data: Schulting & Richards 2000, 2002a, 2002b; Woodman 2004).

plant working (Hardy & Barton in press). Although residue analysis requires careful testing in order to ensure that the residues are not modern contamination (see Haslam 2004), they do provide a possible avenue for the investigation of tool use and subsistence, particularly at sites which lack other organic remains. In addition, Mears and Hillman (2007) have recently explored the types of plant foods which may have been available in Britain in the Mesolithic and have suggested ways in which they may have been used, but much of this research remains speculative.

Another very recent scientific approach has been carbon and nitrogen stable isotope analysis of human bone. Although there is not a great deal of Mesolithic human bone in the British and Irish archaeological record, much of what does exist has been analysed over the past few years (Richards & Mellars 1998; Richards & Hedges 1999a, 1999b; Schulting & Richards 2000, 2002a, 2002b, 2003; Richards 2003). The results show a variety of diets in the Mesolithic, many of which appear to be mixed diets, but there are some with very strong marine signatures (e.g. Cnoc Coig on Oronsay) and some with a strong terrestrial signature (e.g. Killuragh cave in Ireland), see Figure 1. Similar variations in diet have been demonstrated in Scandinavia, particularly at the Mesolithic/Neolithic transition, where debates are concerned with changing food practices (see, for example, Eriksson 2003; Lidén et al. 2004; Richards et al. 2003).

Evaluation

Although many more sites have been excavated since the 1950s and new scientific techniques have been developed, it is argued here that our understanding of the Mesolithic subsistence economy has barely changed. Looking at the most recent overviews of the Mesolithic, the representations bear a striking resemblance to the one that Clark put forward in 1940 (e.g. Mithen 1994, 1999). The main theme is usually the hunting of the five large mammals: red deer, roe deer, elk, aurochs and wild boar, often with an emphasis on red deer hunting. The use of dogs in hunting and the trapping of fur-bearing animals are also touched upon, as is the exploitation of marine resources such as shellfish, fish, sea mammals and so on, and shellfish are still sometimes seen as a resource to be relied upon when others fail. Plant foods are also mentioned, although

it is acknowledged that the evidence for this is usually poor. The key sites which are regularly used in order to paint this picture are Star Carr and Oronsay.

Not only is this depiction very similar to the overview that Clark gave in 1940, but what has also happened is that the picture has become much reduced in detail (contrary to work in Scandinavia, where sites produce an abundance of data but more avenues are also explored, e.g. Andersen 1995; Fischer 2003, 2007). Clark's broad interest in subsistence, which included activities such as sealing, fowling and exploiting bees, appears to have largely been forgotten. This has perhaps arisen from the influence of processual archaeology in the 1960s and 1970s and the strong focus on scientific and empirical approaches in Mesolithic studies. One of the popular lines of investigation was the calculation of calorific values and consequent ranking of resources. This led to some animals being labelled as major sources of calories. For example, it is often quoted that "approximately 52 267 oysters would be required to supply the calorific equivalent of a single red deer carcase, 156 800 cockles, or 31 360 limpets." (Bailey 1978:39). Not only has this approach led to a strong bias towards the study of these large animals, but it has also been argued that this is an androcentric approach which sees hunting as more important than other subsistence activities, particularly those associated with women such as shell-gathering: a "boys and arrows narrative" as Nyree Finlay (2000) puts it (see also Montón Subías 2002).

The questions which are asked also rarely change: What was being hunted, gathered, fished or trapped, and in what season? Which foods were most important? Did people mostly eat meat? How essential were plant foods? What were the ratios of terrestrial foods to marine foods in the diet?

Scientific techniques are being developed, but sometimes they do not provide the answers to the questions, or else the results are ambiguous. In addition we need to address whether we are sometimes being led by the methods that have been developed rather than the questions we wish to pose. For instance, when confronted with large quantities of shells from a site it has become the rule to count large samples and take hundreds, if not thousands, of measurements (I include my own work here, e.g. Milner in press b). Some of these analyses are relevant, in that they may demonstrate which species are present and lead to questions about how shellfish were gathered and why certain types of shell may be dominant. But some of the huge effort taken in the quantitative approach yields little reward (Milner in press b), e.g. when attempting to answer the question of whether limpets were gathered from the low shore or high shore. This analysis is based on the fact that taller limpets tend to be found higher up on the shore and flatter limpets are found further down, so that this requires a great many hours of measuring limpet heights and lengths and then calculating ratios. One of the methodological problems here is the way in which the results are usually presented: The common use of histograms may obscure mixed assemblages of both low and high tide limpets, and in addition modern samples are usually used, and these may not always be analogous (Milner in press b). However, even if it can be demonstrated that limpets are being exploited on the lower shore, what does this tell us? There are often various reasons posited: it may be that the lower shore zones are often far more productive (Russell et al. 1995), it may also be that the limpets found there are more tender and palatable (Mellars 1978; Woodman et al. 1999), or that the larger limpets from the high shore have been over-exploited. Perhaps instead we should be asking whether this is a useful line of investigation, because despite the huge investment in resources it tells us little about the act of procuring shellfish, unless it is possible to study changes through time using a stratigraphy, which is not always feasible for Mesolithic middens in Britain (see Milner et al. 2007 for an example of such an approach in the case of a Viking midden).

Similarly, seasonality studies also have their limitations (Milner 2002a, 2003, 2005a, 2005b). For instance, they only tell us about when a particular species was exploited, and unless multiple species are tested it is difficult to build up a picture of whether there was a seasonal cycle to food procurement and consumption. This problem is compounded by the fact that many sites are palimpsests and therefore different results may relate to different events or years. Star Carr, for instance, may have been occupied in summer one year and winter several years later, and consequently conflating the data to a typical yearly round may produce unsatisfactory results. The data from Star Carr have been approached from many angles, and yet, as already stated, there are many interpretations and the question is hard to resolve (see also Lane & Schadla-Hall 2004).

This tendency to amalgamate data is not only the case for seasonality studies, as it is true for Mesolithic subsistence studies as a whole. This creates a normative view of subsistence that usually covers broad temporal and spatial scales. Consequently, there is little understanding of differences. In many cases, however, the currently available data can be looked at in other

ways and may provide interesting insights into dietary variability. One example is that the stable isotope data often used to argue for a rapid and sharp transition from a highly marine diet in the Mesolithic to a terrestrial-based diet in the Neolithic (for a discussion, see Milner et al. 2004). If we examine all the data for the Mesolithic in Britain and Ireland, however, there appears to be a significant amount of variability through time and space, Figure 1. It is also interesting that the data from the island of Oronsay demonstrate some variability. Here, five bones from Cnoc Coig (MNI=2 individuals) show that more than 90% of the protein in the diet was derived from marine foods, but the results for a bone from the nearby Caisteal Nan Gillean II midden demonstrate more of a mixed diet (Richards & Mellars 1998).

The key problem is that the questions that we are asking do not appear to be taking us much further in understanding how people subsisted, or what the economy was. It is even unlikely that finding new sites with faunal remains will help answer these questions if we continue to look for broad temporal and spatial patterns in the data. We need to begin to contemplate regional scales and variations in the data. But more fundamentally, we need to think about what other questions we could be asking in order to understand the subsistence and ways of life of Mesolithic people.

New lines of enquiry?

What is very apparent from this examination of Mesolithic subsistence studies is that approaches have concentrated on faunal remains as natural resources in the environment, and consequently people have tended to become invisible. It is inferred that these animals are eaten, and stable isotopes provide evidence of individuals' diets, but the actual consumption *practices* of the people have been studied less. This section will present some different questions concerning food in the Mesolithic period and will demonstrate how the data and the methods that have been developed may be used to answer these questions.

What's on the menu?

As already discussed, there has been a focus on what are regarded as the major or important species that were hunted rather than fully considering the spectrum of resources which were consumed. This means that "minor" resources like birds or crabs may not get much mention and may simply form part of a list of species in an appendix. But when we consider the variety of foodstuffs found on archaeological sites we can begin to ask questions about the different ways in which these might have been procured, prepared and consumed, how the menu might have varied both temporally and spatially, and also, very importantly, what might have been avoided as a foodstuff. The wide variety of food which may have been consumed both at Star Carr, an inland site, and at the shell midden site of Sand is demonstrated in Figure 2.

Hunting, particularly of red deer, has always been a dominant issue in Mesolithic studies, but it is important to think how the other animals or plants may have been gathered, fished, trapped or hunted. There have been some detailed investigations into fishing and trapping in Denmark, and evidence has been discovered for extensive fish traps which were probably used for catching the large numbers of eels found at many of the shell midden sites (e.g. Enghoff 1991; Fischer 2003, 2007). Crabs are rarely mentioned as a resource, and yet there are many ways to catch crabs, one of which is "gillying", whereby bait is tied to a weighted line and dropped to the bottom. The line is drawn up when movement is felt. Different baits may be used: both live, shelled animals and also rotting material. They may also be caught with long lines, hooks, weighted baskets or simply found under rocks (Milner in press a). These activities take time, and they may be scheduled alongside others such as shell-gathering, or else crabs may have been caught accidentally in baskets used for fishing, or perhaps people went out on purpose to gather them in order to add variety to their diet.

It is also interesting that the actions of shell gatherers are seldom written about, even though the middens indicate that large quantities of shellfish were consumed. Again, shellfish may be given little attention because they are low-ranking in terms of calorific value and are often seen as a famine food (cf. Wickham-Jones 2003). Or perhaps there is a lack of discussion on shellfish procurement because this is seen as the domain of the women and children, which often remains invisible. Moss (1993) suggests that this may partly be the case in the anthropological study of shell-gathering. Alternatively, it might be because it is felt there is little to say on the subject. After all, Darwin states that "To knock a limpet from the rock does not require even cunning, that lowest power of the mind" (Darwin 1997:206)!

In some archaeological studies shell species are identified and their ecology is noted, and some indication may be given as to where on the shore one might find the different shellfish, but there is usually

SAND MENU		STAR CARR MENU
tope (*Galeorhinus galeus*)	fox (*Vulpes vulpes*)	roe deer (*Capreolus capreolus*)
dogfish families (Scyliorhinidae/Squalidae)	otter (*Lutra lutra*)	red deer (*Cervus elaphus*)
ray family (Rajidae)	wild boar (*Sus scrofa*)	elk (*Alces alces*)
elasmobranch	red deer (*Cervus elaphus*)	pig (*Sus scrofa*)
herring (*Clupea harengus*)	roe deer (*Capreolus capreolus*)	aurochs (*Bos primigenius*)
eel (*Anguilla anguilla*)	*Bos* sp.	hare (*Lepus europaeus*)
rockling sp. (*Ciliata/Gaidropsarus*)	sheep or goat (Caprine)	beaver (*Castor fiber*)
saithe (*Pollachius virens*)	limpet sp. (*Patella* sp.)	bear (*Ursus* sp.)
pollack (*Pollachius pollachius*)	periwinkle sp. (*Littorina* sp.)	fox (*Vulpes vulpes*)
cod (*Gadus morhua*)	dogwhelk (*Nucella lapillus*)	dog (*Canis familiaris*)
haddock (*Melanogrammus aeglefinus*)	topshell (*Gibbula* sp.)	pine marten (*Martes martes*)
whiting (*Merlangius merlangus*)	mussel (*Mytilus edulis*)	badger (*Meles meles*)
poor cod (*Trisopterus minutes*)	cockle (*Cardium edule*)	hedgehog (*Erinaceus europaeus*)
sea scorpion family (*Taurulus bubalis*)	scallop (*Pecten maximus*)	white stork (*Ciconia ciconia*)
atlantic horse mackerel (*Trachurus trachurus*)	carpet shell (Veneridae)	common crane (*Grus grus*)
sea bream family (Sparidae)	razor shell (*Ensis* sp.)	red-breasted merganser (*Mergus serrator*)
corkwing wrasse (*Symphodus (Crenilabrus) melops*)	various species of crab	red-throated diver (*Colymbus stellatus*)
goldsinny (*Ctenolabrus rupestris*)	seaweed?	great crested grebe (*Podiceps cristatus*)
ballan wrasse (*Labrus bergylta*)		little grebe (*Podiceps ruficollis*)
cuckoo wrasse (*Labrus bimaculatus*)		lapwing (*Vanellus vanellus*)
butterfish (*Pholis gunnellus*)		buzzard (*Buteo buteo*)
sandeel family (Ammodytidae)		duck (size of pintail *Anas acuta*)
Atlantic mackerel (*Scomber scombrus*)		nettle (*Urtica dioica*)
plaice (*Pleuronectes platessa*)		hemp nettle (*Galeopsis tetrahit*)
flatfish order (Pleuronectiformes)		yellow water lily (*Nuphar lutea*)
whale sp.		reed (*Phragmites communis*)
shag or cormorant (*Phalacrocorax carbo/aristotelis*)		red leg (*Polygonum persicaria*)
razorbill (*Alca torda*)		fat hen (*Chenopodium album*)
guillemot (*Uria aalge*)		sorrel/dock (*Rumex* sp.)
little auk (*Alle alle*)		bog bean (*Menyanthes trifoliate*)
great auk (*Pinguinus impennis*)		chickweed (*Stellaria media*)
thrush and chat family (Turdidae)		knotweed (*Polygonum aviculare*)
dog or wolf (*Canis*)		mountain ash (use of berries?) (*Sorbus aucuparia*)

Figure 2. Ranges of possible foodstuffs found at the Star Carr site (from Clark 1954; Legge & Rowley-Conwy 1988; Mellars & Dark 1998), and Sand (from Parks & Barrett in press; Milner in press a & b). An identification of wolf in the Star Carr monograph was later re-identified as dog (Degerbøl 1961).

no description of how the shellfish may have been gathered. An oyster, for instance, which usually lives cemented on an oyster bed sublittorally must be gathered in a quite different way from cockles, which hide below the sand further up the beach. It is possible that the former may only be accessed at low tides and needs to be prised from the substrate, whereas cockles can be found by looking for small holes in the sand and need to be scooped up either by hand or with some form of tool (Milner 2002b). Equally, the people and the performance are rarely explored; or if they are it is simply noted through an ethnographic parallel that the woman and children probably did the gathering. On consulting the ethnographic literature, however, the situation is rarely that black and white. Although women may be the primary collectors, men often gather shellfish too and have knowledge of shellfish ecology (e.g. Meehan 1982; Moss 1993). In addition, there may be social elements to gathering, such as occasionally providing the women with the opportunity to leave the children back at camp, giving them time to chat with each other on the beach (Meehan 1982:81).

It may also be possible to say more about fishing from an analysis of the fish which have been caught. The habitats of saithe and pollack vary with age, and the small size of these fish found at the shell midden site of Sand is thought to indicate that they were probably caught from the shore. Similarly, wrasse, which was found in abundance here, is associated with rocky shores and was probably caught using stationary traps

or nets (Parks & Barrett in press). Birds may also be caught in various ways, and it has been suggested for Sand that birds such as auks, razorbills and guillemots may have been captured either during the breeding season or during moulting after breeding, when they are flightless for several months and could be captured using boats (Parks & Barrett in press).

There has also been a tendency in the literature to assume that people would have exploited the resources which were available, particularly in discussions of sites with no faunal or floral remains. It is important, however, to consider that some resources may be avoided, even if they are edible. Taboos are usually complex and can serve to distinguish between people. Sometimes eating habits differentiate between groups, e.g. it is normal to eat horses or dogs in some societies, whereas in others this is not acceptable. Different groups in Amazonia do not always proscribe the same animals, or if they do they may do so in different ways or for different reasons (Politis & Saunders 2002:118). More complex issues arise when certain sections of a society are not allowed some foods. The Nukak of the Amazon, for instance, have taboos surrounding smaller animals that are highly selective, and the women cannot eat all the things that the men eat, and the children can eat even less. Pregnant women and their husbands are not allowed to eat foods they would otherwise eat, and parents of newly born children are forbidden to eat various kinds of birds, fish and the howler monkey for several weeks (Politis & Saunders 2002:120).

Taboos of this kind may be difficult to investigate methodologically, but if sites are compared and regional and temporal variations considered it may perhaps be possible to begin to see patterns in resource exploitation to some extent. One example of a possible insight into the question of taboos comes from a recent study of mammal remains in Scotland. Here Mesolithic archaeological and non-archaeological fauna-bearing sites are compared and it is shown that a number of animals do not occur on the archaeological sites, even though they must have been available at the time: elk, reindeer, wild horse, polecat, wolf, artic fox, stoat and beaver (Kitchener et al. 2004). A number of taphonomic reasons have been given for this pattern, but cultural reasons such as taboos have not been considered.

Preparation and consumption

Rarely does the discussion of Mesolithic resource exploitation move on to preparation and cooking, but this is an essential part of the process which transforms resources into food in order for them to be consumed. Butchery of animals is usually studied in connection with body part representation, but this is more often for the purpose of assessing site function, e.g. at Star Carr, where the representation of animal bones has been used to argue for an industrial skin and antler working site, a hunting camp, or a butchery site (e.g. Jacobi 1978; Pitts 1979; Legge & Rowley-Conwy 1988).

There are various methods which may be used to understand processing activities, and butchery marks will obviously demonstrate the kinds of cuts of meat that are being prepared. The analysis of stone tools through wear and residue analysis, as already described, may also provide information on both the types of foods that are being processed but also what tools are being used for this.

Some foods may be prepared for cooking, but others may be prepared in order to store them by drying or smoking. Fish, for instance, may be split and gutted and then cut into thin strips across the grain for drying, which increases the drying surfaces and exposes the cut veins so that they drain quickly (Shephard 2000:21). Meats may also be dried more quickly, especially in damper or cooler places, by pressing them down with stones or weights to remove initial moisture. Food could be cooked over fires, whereupon the smoke would have partly cooked and dried it. Experimental work on hazelnuts has shown that roasting them is helpful for storing them, facilitates processing and is an aid to digestion (Mithen et al. 2001). Interestingly, it was shown in this work that once the shell becomes charred the nut is of no value, and therefore the many charred shells found on archaeological sites may in fact represent waste.

There are also many ways of cooking food, including roasting, boiling, steaming, scorching, stewing etc and there may be some ways of investigating which of these processes were being used. At the Sand site, for instance, some of the larger crab claws exhibited burning on the tips, suggesting that these had perhaps been roasted in the fire (Milner in press a). At the Late Neolithic site of Durrington Walls a regular pattern of burning has been demonstrated on some pig elements, indicating contact with fire (Albarella & Serjeantson 2002:42). The analysis suggests that the pigs were butchered at the humerus-radius joint of the fore limb and the tarsal joint of the hind limb and then the limbs or carcasses were roasted on a fire either above the flames or in the embers. The extremities were partly exposed and consequently burnt, whilst the rest of the

bone was protected by the meat. Boiling and steaming are often the best way to extract shellfish from their shells. Miracle (2002:76) suggests that the land snails (*Helix*) found at the site of Pupićina, Croatia, were broken after deposition, and therefore concluded that steaming or boiling may have been used to extract the meat from the shells. Similarly, one of the best ways of extracting bivalves such as oysters and cockles from their shells is through steaming or applying heat (Meehan 1982). These methods usually do not leave obvious signs on the shells, however, and any burnt shells are more likely to have been burnt post-extraction (through being thrown on a fire, or having a hearth built on top of them). At places where pottery existed in the Mesolithic, e.g. in Denmark, it is possible using scientific techniques to extract residues in order to determine what the pots were used for (Craig et al. 2007), and even where pottery was not being used, other containers made of organic materials may have been used for boiling water and cooking foods.

Hearths are often found on archaeological sites, but rarely is the relationship between hearths and cooking explored. At Cnoic Coig, Oronsay, clearly defined hearths were recorded in at least 50 locations (Mellars 1987:234). Many of these were defined by roughly circular patches of heavily burnt shells of a more solid and compacted structure. Most were about 60–80 cm in diameter although some substantially larger ones were found of up to 1.5 m in diameter and were defined by stone settings in the central area of the hearth. Many of them also showed evidence of several distinct episodes of use. These hearths may have been used in different ways, the larger ones perhaps for larger-scale cooking events. In the Danish middens a variety of hearths are also found, including a steep-sided cooking pit, 2.5 to 3 m in diameter with three successive layers of clay, charcoal and burnt clay (Andersen & Johansen 1986:47). It would seem less likely that such large hearths were used for opening shellfish, but instead they may perhaps have been used for cooking large quantities of meat (Milner 2002b).

The communal aspect of consumption is also rarely addressed and the implicit assumption often appears to be that food remains on archaeological sites represent waste from small groups of hunter gatherers. Consumption functions at different levels, however, and as well as the day-to-day meals, food and eating can be integrated into other important activities connected with rites of passage, births, deaths and rituals. Many of the animals which were being consumed were large, and a single red deer, for instance, could have provided a meal for 50–75 people (Miracle 2002:83). As already suggested, some foods may be preserved in various ways, but McCormick (2002) stresses that communal eating was a good way of dealing with large quantities of fresh meat in the days before refrigeration. The remains of large animals have been found at sites such as Thatcham or Star Carr, and even if some portions had been taken away (Legge & Rowley-Conwy 1988:84), or the animals were consumed one at a time, it is possible that communal consumption could have taken place at these sites, which is perhaps something to be considered more seriously. Feasting has also been evaluated in Scandinavia, particularly in relation to the Mesolithic-Neolithic transition, with the suggestion that the main reason for the introduction of livestock and cereals was the social prestige which could be gained by those who distributed and consumed farming products (Fischer 2004).

Disposing of food waste

Once the food had been eaten, the remains of the meals had to be disposed of, and this could take many forms, e.g. in pits, water or shell middens. The residues tend to be examined in terms of taphonomy, i.e. what survives and why, but the fact that they have been created as part of the consumption process tends to be automatically acknowledged rather than explicitly researched. The symbolic and social aspects of disposal are rarely considered.

Symbolic disposal can best be explained through an ethnographic example. As already suggested in the Nukak case, animals are not always viewed as animals as they are in the modern Western sense, and in many cultures they have important meanings, perhaps sacred, spiritual or ancestral, attached to them, and a variety of relationships with humans. These meanings have an influence on what kinds of animals and plants are hunted, gathered or fished, how they are then processed and how they are finally discarded. We have already seen that some animals that Nukak men can consume are proscribed for the women and children, and the discarding patterns consequently relate to this. The white-lipped peccary, for instance, cannot be processed or consumed by women and children, and therefore most of the bones are discarded at the butchering spot or on the outskirts of the base camp, although certain bones such as the tibia, fibula, ulna and the foot and hand bones can be discarded within and around the base camp (Politis & Saunders 2002:121–122). On an archaeological site it may be that these latter bones are the only ones which are found, which consequently might lead to erroneous

interpretations.

Different animals are usually treated differently, and Jordan (2003a, 2003b) describes how the deposition of animal bones by the Siberian Khanty is very important in nurturing relationships with supernatural beings. The elk is the main source of meat, and following consumption the bones are returned to "clean" areas of the forest where dogs and trampling feet will not disturb them. Relationships with the bear are more ideologically complex. Only men can hunt bears, and they then consume certain sacred parts of the animal such as the brain and deposit the bones in still water, such as deep pools or lakes, where they will not be disturbed. Thus again, although these animals are consumed, they may be archaeologically invisible. Therefore, when considering food choices, as in the Scottish case study mentioned above, the species of animals which appear to be missing from the archaeological datasets may not simply represent a taboo, but there may be more complex relationships with animals involving ritual deposition, which is much harder to identify archaeologically.

There may perhaps be some indicators of ritual deposition in the Mesolithic, and further investigation may provide more insight into such practices. Chatterton (2003) has suggested that the finds of barbed points, antler frontlets and animal bones at Star Carr may represent deliberate and purposeful deposition in the lake. There is also evidence in Denmark to suggest that some animals were deposited in bogs (Chatterton 2006) and red deer antlers appear to be deposited in some unusual contexts such as shallow water and separate pits within human cemeteries (Bradley 1998:27–28).

Finally, there are many situations in which human bones are deposited with animal bones, e.g. within the middens on Oronsay (Meiklejohn et al. 2005), which does not necessarily indicate consumption of human flesh, although this may be the case. Not only does communal eating maintain social relationships between people within a group and between groups, but it can also be linked to interactions between the living and the dead (Counihan 1999:13). It has been suggested, for instance, that the shell mounds at shell middens in the San Francisco Bay area may have played a central role in mortuary ceremonialism, and that concepts of food and ancestors were interlinked (Luby & Gruber 1999).

Food also plays a part in funerary rituals. At Skateholm I and II in Sweden, fish bones were found in some of the graves. Some of these were beside the person and are interpreted as having been placed there as an offering, perhaps a fish stew in a container (Jonsson 1986; Larsson 2002), while others were found in the stomach area suggesting a meal before death. In one case there is a deposit in the mouth and it has been suggested this may have been some sort of forced feeding (Strassburg 2000:172).

Conclusions

Grahame Clark initiated the study of the Mesolithic subsistence economy and provided new questions and agendas which have been followed ever since. His enthusiasm for bioarchaeology fuelled an interest in scientific techniques, and these are constantly being developed and applied in ways which would previously have been unimaginable, particularly at the biomolecular level, e.g. residue analysis or stable isotope analysis. What this study has shown, however, is that the overall representation of Mesolithic subsistence has barely changed, and that we continue to ask the same questions, which cannot always be answered.

One of the fundamental problems is that the data are usually lumped together in order to paint the picture of subsistence practices, rather than investigating temporal and spatial variability. Another critical problem is that Mesolithic subsistence is very much couched in terms of the natural resources, and there is very little acknowledgement of social and cultural aspects of food procurement and consumption. As has been shown, these are critical for understanding the residues which are found on archaeological sites: resources are not always hunted, gathered and fished just because they are available or provide an important source of calories and nutrition, but there may be many symbolic and cultural reasons for their consumption and for the ways in which they are discarded.

Although we will not be able to identify what the particular meanings were, we can ask various questions which help us to understand the processes of consumption. These include what resources were targeted and what were not, from both an environmental and a cultural viewpoint, how resources were transformed into food through processing and cooking, and finally in what ways the food waste was discarded.

In summary, Mesolithic subsistence has tended in the past to be studied in terms of the natural environment, but this paper suggests that there are also social, symbolic and cultural aspects of consumption which need to be considered. We do not have to separate these ways of thinking, but instead the study of food should integrate these approaches and serve to bridge the nature/culture divide.

Acknowledgements

Some of the research for this paper was carried out as part of work financed by an AHRB grant (B/RG/AN1717/APN14658). I would like to thank Geoff Bailey, Richard Chatterton, Chantal Conneller, Nyree Finlay, Bill Finlayson, Peter Jordan, Lesley McFayden, Penny Spikins, Kevin Walsh and Graeme Warren for comments on earlier versions of this paper. I would also like to thank the organisers of the Food and Archaeology seminar as part of a series on Interdisciplinary Studies on Prehistoric Material Culture, Stockholm University, for inviting me to present these ideas and for giving useful feedback. I also thank the two reviewers who provided useful comments. Any errors are, of course, my own.

References

Albarella, U. & Serjeantson, D. 2002. A passion for port: meat consumption at the British Late Neolithic site of Durrington Walls. In P. T. Miracle & N. Milner (eds.): *Consuming Passions and patterns of consumption*, pp. 33–50. McDonald Institute, Cambridge.

Andersen, S. H. 1995. Coastal adaptation and marine exploitation in late Mesolithic Denmark – with special emphasis on the Limfjord region. In A. Fischer (ed.): *Man and Sea in the Mesolithic. Coastal settlement above and below present sea level*, pp. 41–66. Oxford.

Andersen, S. H. & Johansen, E. 1986. Ertebølle revisited. *Journal of Danish Archaeology* 5, pp. 31–61.

Andresen, J. M., Byrd, B. F., Elson, M. D., McGuire, R. H., Mendoze, R. G., Staski, E., & White, J. P. 1981. The deer hunters: Star Carr reconsidered. *World Archaeology* 13, pp. 31–46.

Bailey, G. N. 1978. Shell middens as indicators of postglacial economies. In P. Mellars (ed.): *The early postglacial settlement of Northern Europe*, pp. 37–64. London.

Bailey, G. N. & Milner, N. 2002. Coastal hunters and gatherers and social evolution: marginal or central? *Before Farming: the Archaeology of Old World Hunter-Gatherers* 3–4(1), pp. 1–15.

Bailey, G. N. & Milner, N. 2007. The faunal remains at Howick. In C. Waddington (ed.): *Howick: a Coastal Mesolithic site in Northumberland*, pp. 137–146. Oxford.

Balaam, N. D., Bell, M. G., David, A. E. U., Levitan, B., Macphail, R. I., Robinson, M. and Scaife, R. G. 1987. Prehistoric and Romano-British sites at Westward Ho!, Devon Archaeological and palaeo-environmental surveys 1983 and 1984. In N. D. Balaam, B. Levitan & V. Straker (eds.): *Studies in Palaeoeconomy and Environment in South West England*, pp. 163–264. BAR British Series 181. Oxford.

Bell, M. J. (ed.) 2007. *Prehistoric Coastal Communities: The Mesolithic in Western Britain.* York.

Bradley, R. 1998. *The significance of monuments on the shaping of human experience in Neolithic and Bronze Age Europe*, London.

Carter, R. J. 1997. Age estimation of the roe deer (*Capreolus capreolus*) mandibles from the Mesolithic site of Star Carr, Yorkshire, based on radiographs of mandibular tooth development. *Journal of Zoology* 241, pp. 495–502.

Carter, R. J. 1998. Reassessment of seasonality at the Early Mesolithic site of Star Carr, Yorkshire based on radiographs of mandibular tooth development in red deer (*Cervus elaphus*). *Journal of Archaeological Science* 25, pp. 851–856.

Chatterton, R. 2003. Star Carr reanalysed. In L. Bevan & J. Moore (eds.): *Peopling the Mesolithic in a Northern Environment*, pp. 69–80. BAR, International Series 1157. Oxford.

Chatterton, R. 2006. Death. In C. Conneller & G. Warren (eds.): *The Mesolithic of Britain and Ireland*, pp. 139–164. Tempus Publishing.

Childe, V. G. 1925. *The Dawn of European Civilisation.* London.

Childe, V. G., 1940. *Prehistoric Communities of the British Isles.* London.

Childe, V. G. 1956. *Man makes himself* (3rd edition). London.

Churchill, D. M. 1965. The kitchen midden site at Westward Ho!, Devon, England: ecology, age, and relation to changes in land and sea level. *Proceedings of the Prehistoric Society* 31, pp. 74–84.

Clark, J. G. D. 1932. *The Mesolithic Age in Britain.* Cambridge.

Clark, J. G. D. 1936. *The Mesolithic settlement of Northern Europe: a study of the food-gathering peoples of Northern Europe during the early post-glacial period.* Cambridge.

Clark, J. G. D. 1940. *Prehistoric England.* London.

Clark, J. G. D. 1942. Bees in antiquity. *Antiquity* 16, pp. 208–215.

Clark, J. G. D. 1944. Water in antiquity. *Antiquity* 18, pp. 1–15.

Clark, J. G. D. 1946. Seal-hunting in the Stone Age of north-western Europe: a study in economic prehistory, *Proceedings of the Prehistoric Society* 12, pp. 12–48.

Clark, J. G. D. 1947. Whales as an economic factor in prehistoric Europe. *Antiquity* 21, pp. 84–104.

Clark, J. G. D. 1948a. Fowling in prehistoric Europe. *Antiquity* 22, pp. 116–130.

Clark, J. G. D. 1948b. The development of fishing in prehistoric Europe. *The Antiquaries Journal* 28, pp. 45–85.

Clark, J. G. D. 1952. *Prehistoric Europe: The Economic Basis.* London.

Clark, J. G. D. 1954. *Excavations at Star Carr.* Cambridge.

Clark, J. G. D. 1972. *Star Carr: a case study in bioarchaeology.* Reading, Massachusetts.

Clark, J. G. D. 1975. *The earlier Stone Age settlement of Scandinavia.* Cambridge.

Clarke, D. L. 1976. Mesolithic Europe: the economic basis. In G. de G. Sieveking, I. H. Longworth & K. E.Wilson (eds.): *Problems in economic and social archaeology*, pp. 449–481. London,.

Coles, J. M. 1971. The early settlement of Scotland: Excavations at Morton, Fife. *Proceedings of the Prehistoric Society* 37 (part II), pp. 284–366.

Coles, J. M. 1983. Morton revisited. In A. O'Connor and D. V. Clarke (eds.): *From the Stone Age to the 'Forty-Five'*, pp. 9–18. Edinburgh.

Conneller, C. 2005. Moving beyond sites: Mesolithic technology in the landscape. In N. Milner & P. C. Woodman (eds.): *Mesolithic Studies at the Beginning of the 21st Century*, pp. 42–55. Oxford.

Conneller, C. & Schadla-Hall, T. 2003. Beyond Star Carr: the Vale of Pickering in the 10th Millennium BP, *Proceedings of the Prehistoric Society* 69, pp. 85–106.

Connock, K. D. 1985. *Rescue excavation of the ossuary remains at Raschoille Cave, Oban: an interim report.* Oban: Lorn Archaeological and Historical Society.

Connock, K. D., Finlayson, B. & Mills, C. M. 1992. Excavation of a shell midden site at Carding Mill Bay near Oban, Scotland. *Glasgow Archaeological Journal* 17, pp. 25–38.

Counihan, C. M. 1999. *The Anthropology of food and body. Gender, meaning and power.* London.

Craig, O. E., Foster, M., Andersen, S. H., Koch, E., Crombe, P., Milner, N., Bailey, G. & Heron, C. 2007. Molecular demonstration of marine and freshwater products in prehistoric pottery from Northern Europe. *Archaeometry* 49, pp. 135–142.

Darwin, C. 1997(1839). *The Voyage of the Beagle.* Ware.

Degerbøl, M. 1961. On a find of a Preboreal domestic dog (*Canis familiaris* L.) from Star Carr, Yorkshire, with remarks on other Mesolithic dogs. *Proceedings of the Prehistoric Society*, vol 27, p. 35.

Deith, M. R. 1983. Molluscan calendars: the use of growth-line

analysis to establish seasonality of shellfish collection at the Mesolithic site of Morton, Fife. *Journal of Archaeological Science* 10, pp. 423–440.

Douglas, M. 1999. Deciphering a meal. In M. Douglas (ed.): *Implicit meanings. Selected essays in Anthropology* (2nd edition), pp. 231–251. London.

Dumont, J. V. 1985. A preliminary report on the Mount Sandal microwear study. In P. Woodman (ed.): *Excavations at Mount Sandal 1973–77*, pp. 61–70. Department of the Environment for Northern Ireland. Belfast.

Dumont, J. V. 1989. Star Carr: the results of a micro-wear study. In C. Bonsall (ed.): *The Mesolithic in Europe. Papers presented at the Third International Symposium*, pp. 231–240.

Enghoff, I. B. 1991. Fishing from the Stone Age settlement Norsminde. *Journal of Danish Archaeology* 8 (1989), pp 41–50.

Eriksson, G. 2003. *Norm and difference: Stone Age dietary practice in the Baltic region.* Archaeological Research Laboratory, Stockholm University, Stockholm.

Evans-Pritchard, E. 1940. *The Nuer.* Oxford.

Finlay, N. 2000. Deer Prudence. In C. Conneller (ed): New approaches to the Palaeolithic and Mesolithic, *Archaeological Review from Cambridge*, 17:1, pp. 67–79.

Finlayson, B. & Mithen, S. 2000. The morphology and microwear of microliths from Bolsay Farm and Gleann Mor: a comparative study. In S. Mithen (ed.): *Hunter-gatherer Landscape Archaeology*, pp. 589–598. McDonald Institute Monographs, Cambridge.

Fischer, A. 2003. Trapping up the rivers and trading across the sea- steps towards the neolithisation of Denmark. In L. Larsson, H. Kindgren, K. Knutsson, D. Loeffler & A. Åkerlund (eds.): *Mesolithic on the Move. Papers presented at the Sixth International Conference on the Mesolithic in Europe, Stockholm 2000*, pp. 405–413. Oxford.

Fischer, A. 2004. Food for feasting? An evaluation of explanations of the neolithisation of Denmark and southern Sweden. In A. Fischer & K. Kristiansen (eds.): *The Neolithisation of Denmark. 150 years of Debate,* pp. 343–393. Sheffield.

Fischer, A. 2007. Coastal fishing in Stone Age Denmark – evidence from below and above the present sea level and from human bones. In N. Milner, O. E. Craig & G. N. Bailey (eds.): *Shell middens in Atlantic Europe*, pp. 54–69. Oxford.

Goody, J. 1982. *Cooking, cuisine and class: a study in comparative sociology.* Cambridge.

Hardy, K. & Barton, H. (in press). Functional analysis. In G. Warren (ed.): *The Sands of Forvie.*

Hardy, K. & Wickham-Jones, C. 2002. Scotland's First Settlers: the Mesolithic seascape of the Inner Sound, Skye, and its contribution to the early prehistory of Scotland. *Antiquity* 76, pp. 825–833.

Hardy, K. & Wickham-Jones, C. (in press). Mesolithic and later sites around the Inner Sound, Scotland: the work of the Scotland's First Settlers Project 1998–2004. *Scottish Archaeological Internet Reports*

Haslam, M. 2004. The decomposition of starch grains in soils: implications for archaeological residue analysis, *Journal of Archaeological Science* 31, pp. 1715–1734.

Hawkes, J. 1945. *Early Britain.* London.

Jacobi, R. 1978. Northern England in the eighth millennium BC: an essay. In P. Mellars (ed.): *The early Postglacial settlement of northern Europe: an ecological perspective*, pp. 295–332. London.

Jonsson, L. 1986. Fish remains in Late Mesolithic human graves at Skateholm, Scania, south Sweden. In D. C. Brinkhuizen & A. T. Clason (eds.): *Fish and Archaeology: Studies in Osteometry, Taphonomy, Seasonality and Fishing Methods,* pp. 62–79. BAR International Series 294. Oxford.

Jordan, P. D. 2003a. Peopling the Mesolithic: Insights from ethnographies of landscape and material culture. In J. Moore & L. Bevan (eds.): *Peopling the Mesolithic.* BAR International Series, 1157. Oxford.

Jordan, P. 2003b. Material Culture and Sacred Landscape: *The Anthropology of the Siberian Khanty.* California.

Kitchener, A. C, Bonsall, C. & Bartosiewicz, L. 2004. Missing mammals from Mesolithic middens: a comparison of the fossil and archaeological records from Scotland. In A. Saville (ed.): *Mesolithic Scotland and its neighbours. The early Holocene prehistory of Scotland, its British and Irish context and some North European perspectives*, pp. 73–82. Society of Antiquaries of Scotland. Edinburgh.

Lane P. J. & Schadla-Hall R. T. 2004. "The Many Ages of Star Carr: Do 'cites' make the 'site'?" In A. Barnard (ed.): *Hunter Gatherers in History Archaeology and Anthropology*, pp. 145–162. Oxford,.

Larsson, L. 2002. Food for the living, food for the dead. *Before Farming* 2002, no. 4, pp. 1–11.

Legge, A. J. & Rowley-Conwy, P. A. 1988. *Star Carr revisited: a reanalysis of the large mammals.* Centre for Extramural Studies, Birkbeck College, London.

Lévi-Strauss, C. 1969. *The raw and the cooked.* London.

Lévi-Strauss, C. 1978. *The origin of table manners: introduction to a science of mythology,* vol 3. London.

Lidén, K., Eriksson, G., Nordqvist, B., Götherström, A. & Bendixen, E. 2004. "The wet and the wild followed by the dry and the tame" – or did they occur at the same time? Diet in Mesolithic-Neolithic southern Sweden. *Antiquity* 78(299), pp. 23–33.

Lubbock, J. 1865. *Prehistoric times as illustrated by ancient remains and the manners and customs of modern savages.* London.

Luby, E. M. & Gruber, M. F. 1999. The dead must be fed: symbolic meanings of the shellmounds of the San Franciso Bay area, *Cambridge Archaeological Journal* 9:1, pp. 95–108.

Mannino, M. A., Spiro, B. F. & Thomas, K. D. 2003. Sampling shells for seasonality: oxygen isotope analysis on shell carbonates of the inter-tidal gastropod *Monodonta lineata* (da Costa) from populations across its modern range and from a Mesolithic site in southern Britain. *Journal of Archaeological Science* 30, pp. 667–679.

McCormick, F. 2002. The distribution of meat in a hierarchical society: the Irish evidence. In P. T. Miracle & N. Milner (eds.): *Consuming passions and patterns of consumption*, pp. 25–32. McDonald Institute, Cambridge.

Mears, R. & Hillman, G. 2007. *Wild Food.* London.

Meehan, B. 1982. *Shellbed to shell midden.* Australian Institute of Aboriginal Studies. Canberra.

Meiklejohn, C., Merrett, D. C., Nolan, R. W., Richards, M. P. & Mellars, P. A. 2005. Spatial relationships, dating and taphonomy of the human bone from the Mesolithic site of Cnoc Coig, Oronsay, Argyll, Scotland, *Proceedings of the Prehistoric Society* 71, pp. 85–106.

Mellars, P. A. 1978. Excavation and economic analysis of Mesolithic shell middens on the island of Oronsay (Inner Hebrides). In P. A. Mellars (ed.): *The early postglacial settlement of Northern Europe: an ecological perspective*, pp. 371–396. London.

Mellars, P. A. 1987. *Excavations on Oronsay. Prehistoric human ecology on a small island.* Edinburgh.

Mellars, P. & Dark, P. 1998. *Star Carr in context: new archaeological and palaeoecological investigations at the Early Mesolithic site of Star Carr, North Yorkshire.* McDonald Institute for Archaeological Research. Cambridge.

Mellars, P. A. & Wilkinson, M. R. 1980. Fish otoliths as evidence of seasonality in prehistoric shell middens: the evidence from Oronsay (Inner Hebrides). *Proceedings of the Prehistoric Society* 46, pp. 19–44.

Milner, N. (in press) a. Consumption of crabs in the Mesolithic: side stepping the evidence? In K. Hardy & C. Wickham-Jones

(eds.): Mesolithic and later sites around the Inner Sound, Scotland: the work of the Scotland's First Settlers Project 1998–2004. *Scottish Archaeological Internet Reports*

Milner, N. (in press) b. Mesolithic middens and marine molluscs: procurement and consumption of shellfish at the site of Sand. In K. Hardy & C. Wickham-Jones (eds.): Mesolithic and later sites around the Inner Sound, Scotland: the work of the Scotland's First Settlers Project 1998–2004. *Scottish Archaeological Internet Reports*

Milner, N. 2002a. *Incremental growth of the European Oyster, Ostrea edulis: seasonality information from Danish kitchenmiddens*. BAR International Series 1057. Oxford.

Milner, N. 2002b. Oysters, cockles and kitchenmiddens: changing practices at the Mesolithic/Neolithic transition, In P. Miracle & N. Milner (eds.): *Consuming passions and patterns of consumption*, pp. 89–96. McDonald Institute, Cambridge.

Milner, N. 2003. Pitfalls and problems in analysing and interpreting the seasonality of faunal remains. *Archaeological Review from Cambridge* 16:1, pp. 50–65.

Milner, N. 2005a. Can seasonality studies be used to identify sedentism in the past? In D. Bailey, V. Cummings & A. Whittle (eds.): *(Un)settling the Neolithic*, pp. 32–37. Oxford.

Milner, N. 2005b. Seasonal consumption practices in the Mesolithic: Economic, Environmental, Social or Ritual? In N. Milner & P. C. Woodman (eds.): *Mesolithic Studies at the Beginning of the 21st Century*, pp. 56–67. Oxford.

Milner, N., Craig, O. E., Bailey, G. N., Pedersen, K., & Andersen, S. H. 2004. Something fishy in the Neolithic? A re-evaluation of stable isotope analysis of Mesolithic and Neolithic coastal populations. *Antiquity* 78(299), pp. 9–22.

Milner, N. & Miracle, P. T. 2002. Introduction: Patterning data and consuming theory. In P. T. Miracle & N. Milner (eds.): *Consuming Passions and patterns of consumption*, pp. 1–6. McDonald Institute, Cambridge.

Milner, N., Welsh, J. & Barrett, J. 2007. Marine resource intensification in Viking Age Europe: the mollusc evidence from Quoygrew, Orkney. *Journal of Archaeological Science* 34, pp. 1461–1472.

Milner, N. & Woodman, P. C. 2005. Combler les lacunes…L'événement le plus étudié, le mieux daté et le moins compris du Flandrien. In G. Marchand & A. Tresset (eds.): *Unité et diversité des processus de néolithisation sur la façade atlantique de l'Europe (7e-4e millénaires avant J.-C.). Monographie de la Société Préhistorique Française*, pp. 39–46.

Miracle, P. 2002. Mesolithic meals from Mesolithic middens, In P. Miracle & N. Milner (eds.): *Consuming passions and patterns of consumption*, pp. 65–88. McDonald Institute, Cambridge.

Mithen, S. 1994. The Mesolithic Age. In B. Cunliffe (ed.): *The Oxford Illustrated Prehistory of Europe*, pp. 79–135. London.

Mithen, S. 1999. Hunter-gatherers of the Mesolithic, in J. Hunter & I. Ralston (eds.): *The Archaeology of Britain. An introduction from the Upper Palaeolithic to the Industrial Revolution*, pp. 35–57. London.

Mithen, S., Finlay, N., Carruthers, W., Carter, S. & Ashmore, P. 2001. Plant use in the Mesolithic: Evidence from Staosnaig, Isle of Colonsay, Scotland, *Journal of Archaeological Science* 28, pp. 223–234.

Montón Subías, S. 2002. Cooking in archaeozoology: is this issue still raw? In P. Miracle & N. Milner (eds.): *Consuming passions and patterns of consumption*, pp. 7–16. McDonald Institute, Cambridge.

Moss, M. L. 1993. Shellfish, gender, and status on the Northwest Coast: Reconciling Archaeological, Ethnographic, and Ethnohistorical records of the Tlingit. *American Anthropologist* 95(3), pp. 631–652.

Palmer, S. 1976. The Mesolithic habitation site at Culver Well, Portland, Dorset: Interim note. *Proceedings of the Prehistoric Society* 42, pp. 324–327.

Palmer, S. 1999. *Culverwell Mesolithic habitation site, Isle of Portland, Dorset. Excavation report and research studies*. BAR British Series, 287. Oxford.

Parker Pearson, M. 2003. Food, culture and identity: an introduction and overview. In M. Parker Pearson (ed.): *Food, culture and identity in the Neolithic and Early Bronze Age*, pp. 1–30. BAR, International Series 1117, Oxford.

Parks, R. & Barrett, J. (in press). The Zooarchaeology of Sand. In K. Hardy & C. Wickham-Jones (eds.): Mesolithic and later sites around the Inner Sound, Scotland: the work of the Scotland's First Settlers Project 1998-2004. *Scottish Archaeological Internet Reports*

Pitts, M. 1979. Hides and antlers: a new look at the gatherer-hunter site of Star Carr, North Yorkshire, England. *World Archaeology* 11, 32-42

Politis, G. & Saunders, N. 2002. Archaeological correlates of ideological activity: food taboos and spirit-animals in an Amazonian hunter-gatherer society. In P. T. Miracle & N. Milner (eds.): *Consuming Passions and patterns of consumption*, pp. 113–130. McDonald Institute, Cambridge.

Richards, M. P. 2003. Explaining the dietary isotope evidence for the rapid adoption of the Neolithic in Britain. In M. Parker Pearson (ed.): *Food, Culture and Identity in the Neolithic and Early Bronze Age*, pp. 31–36. BAR International Series 117, Oxford.

Richards, M. P. & Hedges, R. E. M. 1999a. Stable isotope evidence for similarities in the types of marine foods used by late Mesolithic humans on the Atlantic coast of Europe. *Journal of Archaeological Science* 26, pp. 717–722.

Richards, M. P. & Hedges, R. E. M. 1999b. A Neolithic revolution? New evidence of diet in the British Neolithic. *Antiquity* 73, pp. 891–897.

Richards, M. P. & Mellars P. 1998. Stable isotopes and the seasonality of the Oronsay middens. *Antiquity* 72, pp. 178–184.

Richards, M. P., Price, T. D. & Koch, E. 2003. The Mesolithic/Neolithic transition in Denmark: new stable isotope data. *Current Anthropology* 44, pp. 288–294.

Russell, N. J., Bonsall, C, & Sutherland, D. G. 1995. The exploitation of marine molluscs in the Mesolithic of western Scotland: evidence from Ulva Cave, Inner Hebrides. In A. Fischer (ed.): *Man and the sea in the Mesolithic*, pp. 273–288. Oxford.

Saville, A. & Miket, R. 1994. An Corran rock-shelter, Skye: a major new Mesolithic site. *Past* 18, pp. 9–10.

Schadla-Hall, T. 1989. The Vale of Pickering in the Early Mesolithic in context. In C. Bonsall (ed.): *The Mesolithic in Europe. Papers presented at the Third International Symposium*, pp. 218–225. Edinburgh.

Schulting, R. J. & Richards M. P. 2000. Mesolithic subsistence and seasonality: the use of stable isotopes. In R. Young (ed.): *Current Research on the Mesolithic of Britain and Ireland*, pp. 55–65. Leicester.

Schulting, R. & Richards, M. P. 2002a. The wet, the wild and the domesticated: the Mesolithic-Neolithic transition on the West Coast of Scotland. *Journal of European Archaeology* 5, pp. 147–18.

Schulting, R. J. & M. P. Richards. 2002b. Finding the coastal Mesolithic in southwest Britain: AMS dates and stable isotope results on human remains from Caldey Island, Pembrokeshire, South Wales. *Antiquity* 76, pp. 1011–1025.

Schulting, R. J. & Richards M. P. 2003. Characterising subsistence in Mesolithic Britain using stable isotope analysis. In L. Bevan & J. Moore (eds.): *Peopling the Mesolithic in a Northern Environment*, pp. 119–128. BAR, International Series 1157. Oxford.

Shephard, S. 2000. *Pickled, potted and canned: the story of food preserving*. London.

Sloan, D. 1993. *Sample, site and system: shell midden economies in Scotland 6000–4000 BP*. Cambridge: University of Cambridge,

unpublished DPhil thesis

Strassburg, J. 2000. *Shamanic shadows. One Hundred Generations of Undead Subversion in Southern Scandinavia, 7000–4000 BC.* Stockholm Studies in Archaeology 20. Department of Archaeology, Stockholm.

Thompson, D. R. 1939. The seasonal factor in human culture illustrated from the life of a contemporary nomadic group. *Proceedings of the Prehistoric Society* 5, pp. 209–221.

Wickham-Jones, C. 2003. The tale of the limpet, *British Archaeology* 71, p. 23.

Woodman, P. C. 1985a. *Excavations at Mount Sandal 1973-77 County Londonderry.* Belfast.

Woodman, P. C. 1985b. Excavations at Glendhu, Co. Down, *Ulster Journal of Archaeology* vol. 48, pp. 31–40.

Woodman, P. C. 2004. The exploitation of Ireland's coastal resources - a marginal resource through time. In M. R. Gonzales Morales & G. Clark (eds.): *The Mesolithic of the Atlantic Façade*, pp. 42–61. Arizona State University Anthropological Research Paper 55.

Woodman, P. C., Anderson, E. & Finlay, N. 1999. *Excavations at Ferriter's Cove, 1983-95: last foragers, first farmers in the Dingle Peninsula.* Bray.

Wymer, J. 1962 Excavations at the Maglemosian sites at Thatcham, Berkshire, England. With a report on the animal bones (by Judith E. King), Proceedings of the Prehistoric Society 28, pp. 329-361.