Growth and decline in complex hunter-gatherer societies: a case study from the Jomon period Sannai Maruyama site, Japan

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The Sannai Maruyama site (3900-2300 BC) is one of the largest known from Japan's Jomon period (14 000-300 BC). This study shows that over 1500 years the number of dwellings, their size, the type of stone tools and the fondness for figurines varied greatly. Nor was it a story of gradual increase in complexity: the settlement grew in intensity up to a peak associated with numerous grinding stones, and then declined to a smaller settlement containing larger buildings, many arrowheads and virtually no figurines. Using a bundle of ingenious analyses, the author explains what happened.

Keywords: Japan, Jomon, hunter-gatherer, subsistence, settlement, house-size, lithics, figurines

Introduction

Understanding the conditions, causes and consequences of cultural change has been an important research focus in anthropological archaeology. To explain the mechanisms of long-term cultural change among hunter-gatherers, and their transition to agriculture, scholars have considered environmental change, technological developments, subsistence practice, mobility, settlement size, population pressure, craft specialisation, long-distance trade, social inequality, labour organisation, historical contingency, human agency, creativity and cultural logic (e.g. Hayden 1995; Kelly 1995; Price & Feinman 1995; Cannon 1998; Jochim 1998; Bettinger 1999; Arnold 2001; Fitzhugh & Habu 2002; Habu *et al*. 2003; Fitzhugh 2004; Prentiss & Kuijt 2004; Sassaman 2004). Over the past couple of decades, there has been a general shift away from ecological models that focus solely on subsistence-settlement systems to alternative models that emphasise the importance of social landscapes and human agency. To test these competing models of the mechanisms of long-term cultural change, and to explain historically unique trajectories of various hunter-gatherer groups, solid archaeological case studies from different parts of the world are needed.

The purpose of this paper is to examine the mechanisms of settlement growth and decline in 'complex' hunter-gatherer societies using a case study from a prehistoric Jomon period site in Japan. The focus of this paper, the Sannai Maruyama site, is dated to the Early

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and Middle Jomon periods, and is currently the largest known Jomon settlement. Using data from Sannai Maruyama, I argue that in order to understand the mechanisms of long-term change it is necessary to examine multiple lines of evidence, including environment, subsistence-settlement, ceremonial practices and crafts/trade at a given site or sites, and identify the order in which changes in each of these aspects occurred.

Background: the Jomon culture

Among prehistoric archaeologists, the Jomon (*c*. 14 000–300 BC) of the Japanese archipel ago is known as an example of *'affluent'* (Koyama & Thomas 1981) or *'complex'* (Price & Brown 1985) hunter-gatherers. Characteristics of the Jomon culture include the presence of large settlements, high site density, low residential mobility and *'logistically organised'* (*sensu* Binford 1980) subsistence strategies evidenced by the presence of storage pits and large shell middens. The Jomon is also known for a sophistication of material culture, the construction of large ceremonial features and long-distance trade (e.g. Aikens & Higuchi 1982).

Not all of these cultural characteristics, however, can be found in all Jomon sub-cultures in different parts of the Japanese archipelago (Ikawa-Smith 1992; Imamura 1996; Habu 2004; Kobayashi 2004; Pearson 2006; Underhill & Habu 2006). Because the Jomon period lasted more than 10 000 years, variation between its six sub-periods (Incipient, Initial, Early, Middle, Late and Final) is quite large. For example, Incipient and Initial Jomon cultures lack many of the 'complex' characteristics. Regionally, the distribution of extremely large Jomon settlements is limited primarily to north-eastern Japan. In addition, Jomon site density in south-western Japan is much lower than that in north-eastern Japan. Evidence also indicates that the degree of Jomon residential mobility might have varied significantly over time and between regions (Habu 2001; 2002). Because of this variability, the Jomon should not be seen as a single entity characterised by a fixed set of cultural traits.

Questions about the growth and decline of the Middle Jomon culture

Among the many changes during the Jomon period, the growth and decline of the Middle Jomon culture in north-eastern Japan has attracted the attention of many archaeologists. Based on site size and density, north-eastern Japan appears to have been most densely populated during the Middle Jomon period. Koyama's (1978; 1984) population estimates based on the total number of sites from the Initial to Final Jomon periods indicate that the population of the Japanese archipelago increased relatively rapidly between the Initial and the Middle Jomon periods. The estimates are based on several assumptions, so the number for each sub-period might not be accurate, but the general pattern holds (Habu 2004: 46–50). According to Koyama's work, the population on the Japanese archipelago peaked during the Middle Jomon period, and then declined through the Late and Final Jomon periods. This pattern is clearly reflected in the population estimates for the Chubu, Kanto and Tohoku regions (Figure 1).

What were the mechanisms of growth and decline of the Middle Jomon culture in these regions? Traditionally, Japanese archaeologists have provided two possible explanations for the phenomenon. Classical Marxist archaeologists proposed that, by the Middle Jomon

Figure 1. Regions of Japan, and the locations of Aomori Prefecture and the Sannai Maruyama site.

period, the hunting-gathering mode of production reached its maximum in terms of the amount of gross production, and thus, after the Middle Jomon, no further development was possible. However, this does not explain the significant decline in population estimates from the Middle to the Late Jomon periods. Other Japanese archaeologists have suggested that the cooling climate at the end of the Middle Jomon period resulted in the rapid decline of settlement and population size (e.g. Kodama 2003). However, this explanation faces two problems. First, while palynologists such as Yasuda (1989) indicate the possibility of cooling trends towards the end of the Middle Jomon, the precise timing of this event is yet to be identified. Second, even if the cooling climate was the direct cause, it is still necessary to explain why the cooling climate resulted in decreased population and settlement size.

In order to approach these questions it is important to examine multiple lines of evidence, including subsistence-settlement, mortuary/ceremonial practices and crafts/trade and identify the order in which changes in each of these aspects occurred. This requires a tight chronological control, since understanding the order of various changes is a critical part of this type of research. Archaeological data from the Jomon period are suitable for this purpose, since Jomon pottery provides a fine-grained chronological scale against which the timing of various changes can be plotted.

In search of conditions, causes and consequences of evolutionary change: a case study from Sannai Maruyama

The recent discovery of a large prehistoric settlement at Sannai Maruyama provides one of the best opportunities so far to investigate the mechanisms of the growth and decline of the Middle Jomon culture. Sannai Maruyama is an Early to Middle Jomon period site in Aomori Prefecture, northern Japan (see Figure 1). The site was originally excavated in 1994 as a salvage project by the prefectural board of education prior to the construction of a baseball stadium. This excavation unexpectedly revealed an extraordinarily large Jomon settlement (Figure 2). Based upon pottery chronology, the site occupation can be divided into 12 phases: they are called Lower-Ento-a, -b, -c, -d (Early Jomon), Upper-Ento-a, -b, -c, -d, -e, Enokibayashi, Saibana and Daigi 10 (Middle Jomon) phases from the oldest to the youngest. Radiocarbon dates indicate that these 12 phases correspond to *c*. 3900-2300 cal BC (Imamura 1999).

Following these discoveries, local residents formed a dedicated preservation movement. As a result, in August 1994, the prefectural governor halted the construction of the stadium and declared that the site should be preserved. Since then, it has been a major tourist attraction in Aomori Prefecture. The total number of pit-dwellings recovered from the site to date is more than 600, which makes this the largest Jomon site. A detailed overview of the site is provided in Okada (2003) and Habu (2004: 108-34). Socio-political contexts of archaeology at Sannai Maruyama are discussed in Habu & Fawcett (1999; 2008).

Since the summer of 1997, I have been working on the site material with students from the University of California, Berkeley. In collaboration with Sannai Maruyama Iseki Taisaku-shitsu (Preservation Office of the Sannai Maruyama Site), we have examined excavation records and conducted collaborative field/laboratory research on faunal/floral remains, soil samples, artefacts and intra-/inter-site settlement patterns (Habu 2005; 2006; Habu *et al.* 2001).

Changes in subsistence practice: an inference from lithic assemblage data

Despite an abundance of excavated materials, the preservation condition of organic materials within this site is rather uneven. So far, the recovery of macro faunal and floral remains is limited primarily to those from Early Jomon layers. Thus, faunal and floral analysis alone will not tell us about changes in subsistence strategies through time (Habu *et al.* 2001).

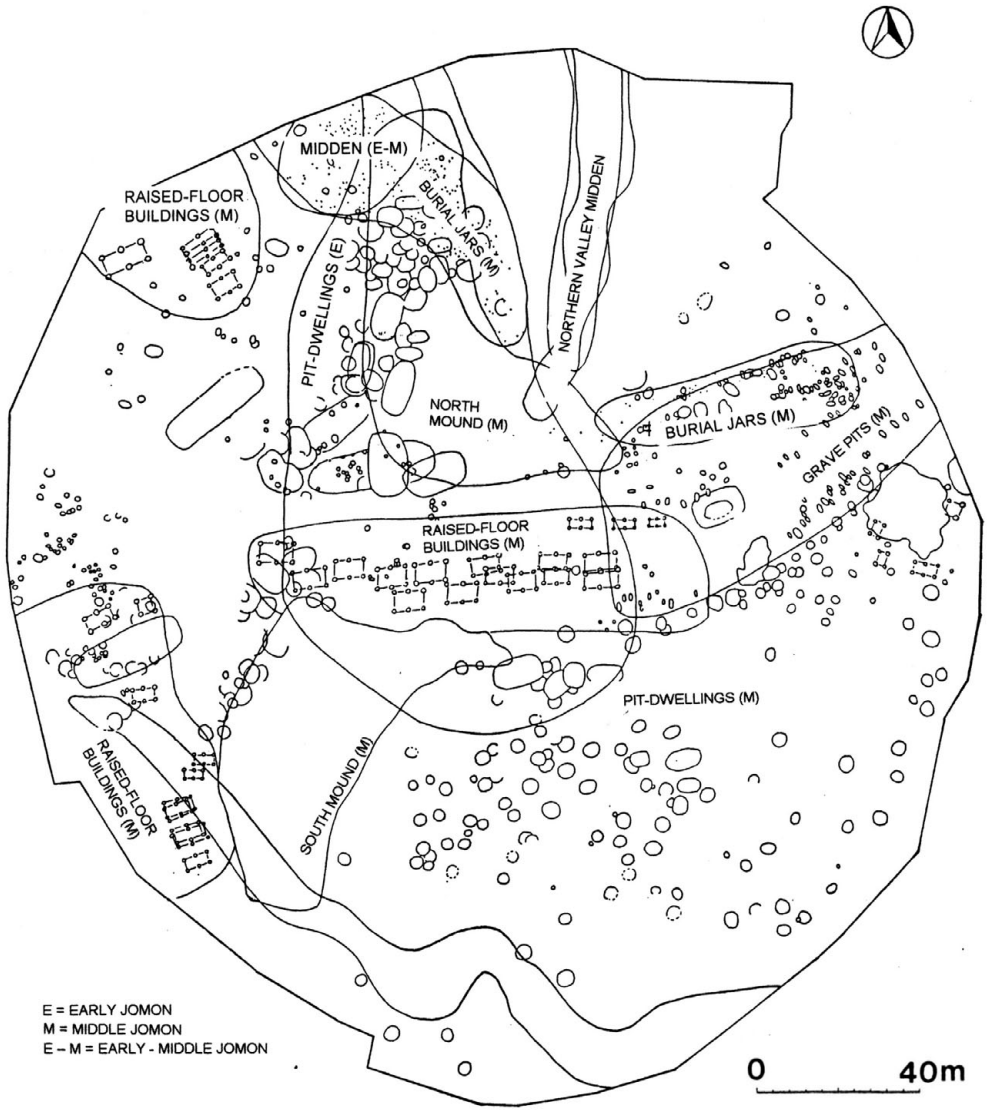

Figure 2. Feature distribution at the stadium area, Sannai Maruyama site (from Habu & Okada 1995).

As an alternative approach, I have explored changes in lithic assemblage characteristics through time (Habu 2004: 125-6). Figure 3 illustrates the percentages of 11 categories of lithic tools associated with each phase. These categories are: arrowheads (ARH), stemmed scrapers (SSC), awls (AWL), semi-circular chipped stone tools (SCC), polished stone axes (PAX), pebble tools (PBL), stone mortars (MTR), grinding stones (GRD), net sinkers (NSK), ornaments (ORN) and others (OTH). Due to the small sample size, data from the Lower-Ento-c phase are not listed in the figure. Nevertheless, data from the other 11 phases show an interesting pattern. During the Lower-Ento-a phase (the first phase of the

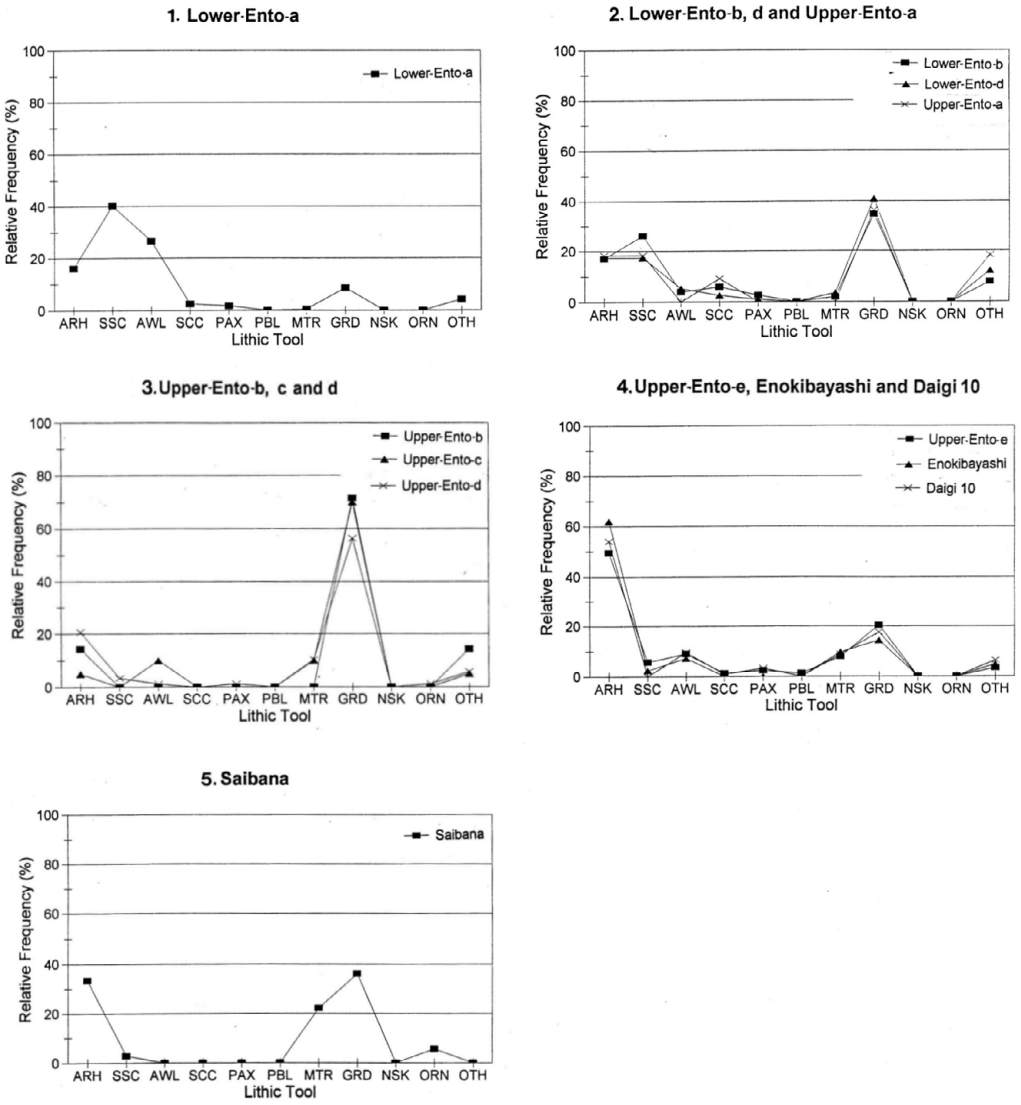

Figure 3. Relative frequency of 11 categories of lithic tools for each phase at Sannai Maruyama (from Habu 2004: 126).

site occupation), the lithic assemblage is characterised by an abundance of stemmed scrapers (Figure 3.1). Through the following three phases (Lower-Ento-b, -d and Upper-Ento-a phases), the relative frequency of grinding stones increased gradually as the relative frequency of stemmed scrapers declined (Figure 3.2). During the next three phases (Upper-Ento-b, -c and -d phases), the grinding stone dominates the assemblage (Figure 3.3). The gradual increase over time in the relative frequency of grinding stone was suddenly interrupted in the Upper-Ento-e phase, when the arrowhead became the most dominant type of lithic tool. Similar characteristics can be observed through the rest of the site occupation (Figure 3.4), with the exception of the Saibana phase (Figure 3.5).

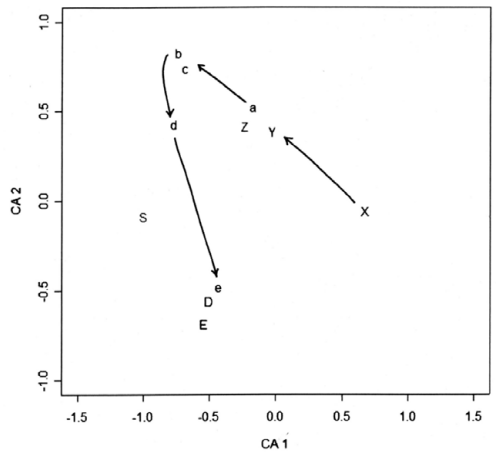

Figure 4. Correspondence analysis of lithic assemblage data (from Habu 2005). X = Lower-Ento-a; Y = Lower-Ento-b; Z = Lower-Ento-d; a = Upper-Ento-a; b = Upper-Ento-b; c = Upper-Ento-c; d = Upper-Ento-d; e = Upper-Ento-e; E = Enokibayashi; S = Saibana; D = Daigi-10.

Figure 4 illustrates the results of correspondence analysis (Bølviken *et al.* 1982) using the same set of lithic assemblage data shown in Figure 3. Plots from the 11 phases form a distinct, U-shaped pattern in the chronological order, with the exception of the plot from the Saibana phase. On the upper half of the graph, moving from Lower-Ento-a to Upper-Ento-d correlates with an increase in grinding stones, while moving from the Upper-Ento-d to Upper-Ento-e, Enokibayashi and Daigi 10 corresponds to a decrease in grinding stones and an increase in arrowheads.

What do these patterns mean? If we assume that lithic assemblage data reflect characteristics of subsistence strategies at Sannai Maruyama, we can use these results to identify the timing of the shift in subsistence activities. Assuming that grinding stones were a plant food-processing tool, an increase in the relative frequency of grinding stones from the end of the Early Jomon to the middle of the Middle Jomon reflects an increasing reliance on a specific type or types of plant food. This would have been close to the collector or specialist end of Binford's (1980) collector-forager continuum. A sudden decrease in the relative frequency of grinding stones indicates the decline of this extreme specialist type of economy. A concurrent increase in arrowheads could imply a heavier emphasis on hunting.

A relevant question here is: what was the specific type or types of plant food? Several Japanese scholars have suggested chestnuts, because the amount of chestnut pollen at this site is quite high, with the exception of the last several phases (Tsuji 1999). In addition, using DNA analysis of chestnut remains, Sato *et al.* (2003) suggest the possibility of tending chestnut trees, a form of environmental management or plant cultivation. A closer examination of pollen data from Sannai Maruyama, however, indicates that most of the pollen data were from Early Jomon layers, not from Middle Jomon ones, and thus they need to be further examined with caution. Acorn is another possibility, although so far very few acorn remains have been identified from this particular site.

In addition to nuts, barnyard grass/millet (*Echinochloa*) is another candidate, as *Echinochloa* seeds have been recovered from other Jomon sites. Barnyard grass is a C_4 plant, and if the Jomon people were relying on this type of plant food, it should be reflected in carbon and nitrogen isotope analysis of human skeletal remains. So far none of the carbon and nitrogen isotopic analysis of Jomon skeletal remains indicates their reliance on C_4 plants (Minagawa & Akazawa 1992). Finally, the possible importance of tubers has been discussed by several archaeologists, but so far no concrete archaeological evidence has been reported. Ultimately, residue analysis of grinding stones and pottery might become a key to approach this issue (e.g. Matthews & Nishida 2006).

Changes in settlement size: examination of the number of dwellings

Interestingly, the timing of the change in lithic assemblages does not coincide with a major change in site size as seen in the number of associated pit-dwellings. A preliminary report (Sannai Maruyama Iseki Taisaku-shitsu 1999) indicates that a total of 648 Jomon pit-dwellings were identified as of 1998. Out of these, however, only 277 pit-dwellings are associated with pottery from which the period of occupation for each dwelling can be specified at the phase level. Figure 5 shows changes in the number of these pit-dwellings identified in each phase.

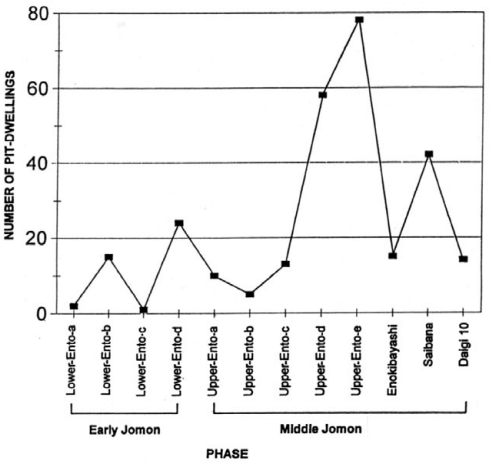

Figure 5. Changes in the number of pit-dwellings at Sannai Maruyama (from Habu et al. *2001: 14).*

Some interesting trends are apparent in this diagram. First, in terms of the number of pit-dwellings, only two phases, Upper-Ento-d and Upper-Ento-e, are associated with more than 50 pit-dwellings. For the other ten phases, there is no archaeological evidence to support the image of a large settlement. Second, the line graph does not form a smooth and gradually increasing curve but instead is characterised by several decreases followed by sharp increases. This suggests that the size of the Sannai Maruyama settlement, measured by the number of associated pit-dwellings, not only changed through time but may also have fluctuated significantly. Despite such fluctuations, the zenith of the Sannai Maruyama settlement can be identified at the Upper-Ento-e phase. On the other hand, lithic assemblage data presented above indicate that the shift from an abundance of grinding stone to that of arrowheads occurred between the Upper-Ento-d and -e phases. These results indicate that a major change in subsistence strategies occurred first, and was followed by a decrease in the number of associated pit-dwellings.

Changes in dwelling size

Changes in the size of pit-dwellings at Sannai Maruyama also show interesting patterns. Figure 6 represents changes in the long-axis length of pit-dwellings from each phase. Looking at this diagram, it becomes clear that the majority of dwellings from the Upper-Ento-d and -e phases are very small. In other words, when the site size reached its zenith in terms of the number of associated pit-dwellings, the overall site consisted of extremely small dwellings. In terms of site function, this might imply a short-term seasonal residential base or a place of seasonal communal gathering (see Habu 2004: 129-30).

The presence of two large long-houses, one abandoned during the Enokibayashi phase (*c*. 32m long) and another during the Daigi 10 phase (*c*. 23m long; see the upper-right end of Figure 6), might reflect changes in social organisation and/or changes in residence

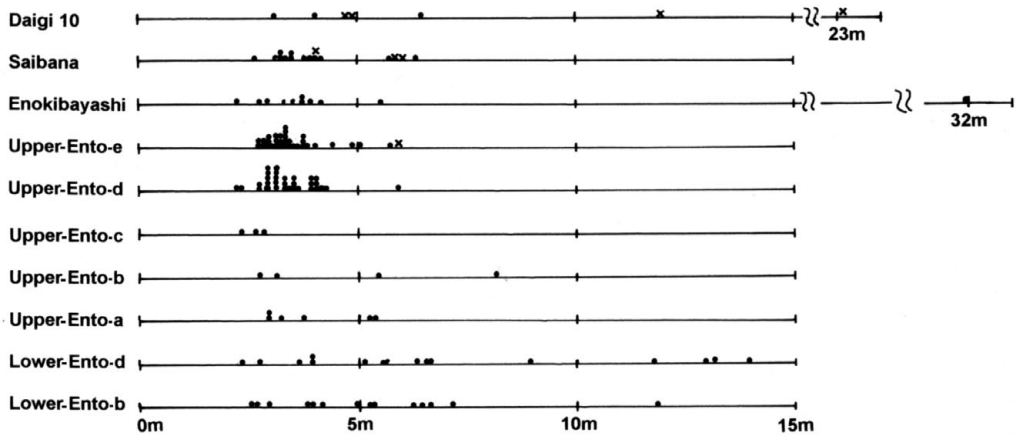

Figure 6. Changes in long-axis length of pit-dwellings at Sannai Maruyama (from Habu 2004: 124).

patterns. Associated with multiple sets of post-moulds, however, both long-houses show evidence of long-term use. Thus, the occupational span of these long-houses warrants further investigation.

Changes in clay figurine rituals

For the moment, quantitative data that reflect long-term social changes at the site are still limited. One of the few exceptions is the number of clay figurines. According to Ogasawara (2002), the total number of clay figurines excavated from Sannai Maruyama is more than 1600. This number is unusual, since the number of Middle Jomon clay figurines from other sites in Aomori Prefecture is usually 20 or less. It should also be noted that the majority of clay figurines from Sannai Maruyama have been recovered in a midden context from Middle Jomon mounds. The depositional context of figurines, as well as their large number, indicates that the site might have functioned as a place for rituals associated with these figurines.

Typological analysis of clay figurines from Sannai Maruyama (Habu 2006) indicates that most of them can be dated to either Upper-Ento-a, - c, -d or -e phases (Figure 7). A drastic decline in the number of clay figurines from Upper-Ento-e to the following Enokibayashi phase is clear. This implies that, similar to the case of the change in the number of pit-dwellings, a major decline in the number of clay figurines did occur between the Upper Ento-e phase and the Enokibayashi phase.

The growth and decline of the Sannai Maruyama settlement: a hypothesis

In summary, the growth and decline of the Sannai Maruyama settlement seem to have been closely related to the development of subsistence strategies represented by grinding stones, which were probably associated with the exploitation of a particular type or types of plant food, possibly chestnuts or other nuts. Figure 8 synthesises the trends discussed above. As

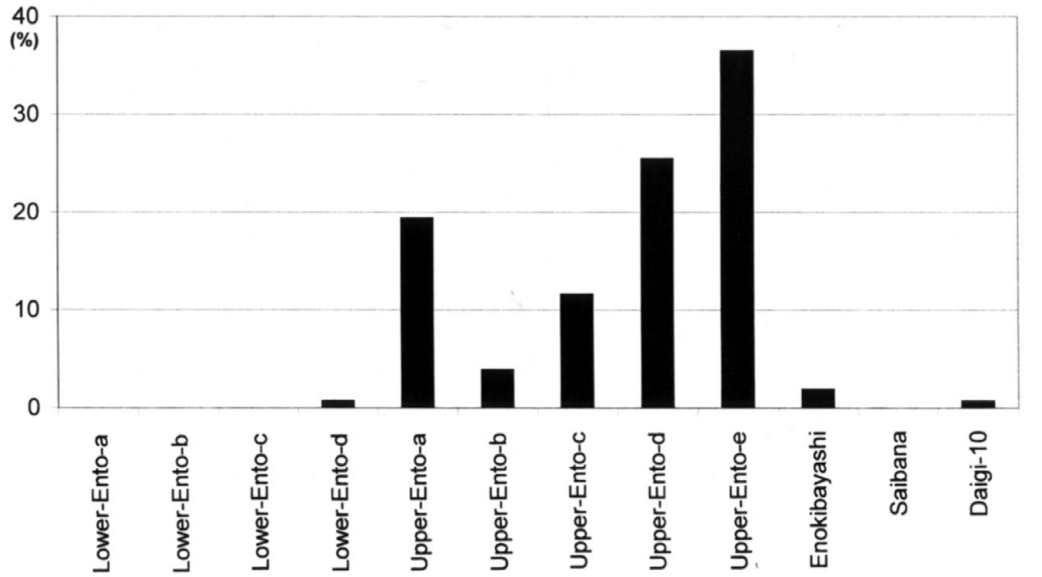

Figure 7. Percentages of clay figurines belonging to each phase (after Habu 2006: 49).

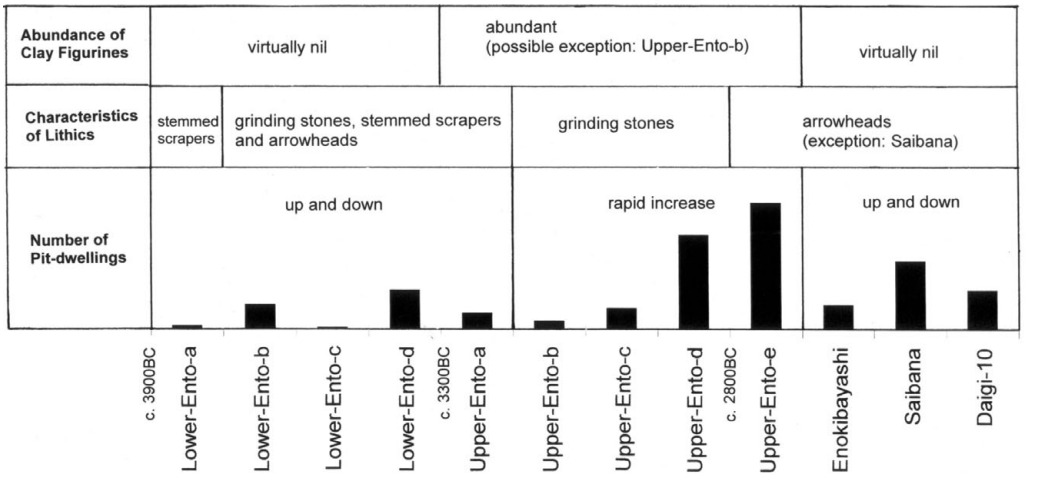

Figure 8. Summary of observed archaeological patterns.

shown in this diagram, archaeological data indicate that the change in the lithic assemblage occurred first, starting with the Upper-Ento-e phase. This was followed by a decrease in settlement size and a decrease in the number of clay figurines. Thus, currently available data indicate that a major change occurred first in subsistence practice, which was then followed by changes in settlement size and ritual practice. In the context of the ongoing debate on the causal relationship between economic and social factors, this case implies that economic factors were the trigger for long-term cultural change.

What caused the major shift in subsistence strategies as reflected in stone tool changes? Looking at the Sannai Maruyama data, the lithic assemblage data indicate an increasing degree of subsistence specialisation with a focus on plant food, which began at the Lower-Ento-b phase and culminated in the Upper-Ento-b to -d phases. It is likely that this new system was suitable to support a larger site population. But was the system stable?

My hypothesis is that, by moving towards the specialist end of the specialist-generalist continuum, the site residents may have crossed the point of no return. One possibility is that the population became too large to be sustained by a less specialised subsistence practice. Alternatively, social or technological constraints that developed as a result of subsistence specialisation might have been the reason for this overspecialisation. In any case, without the option of going back to a more generalist strategy, the highly specialised system would have been quite susceptible to such incidences as overexploitation or minor climate fluctuations. Thus, even if the cooling climate triggered the decline of the Middle Jomon system as suggested by Yasuda (1989) and others, I suggest that the deeper cause of the decline was the overspecialisation in subsistence.

To test the applicability of this hypothesis to the rest of the Aomori area, it is necessary to examine changes in the lithic assemblage data from other Early and Middle Jomon sites within Aomori Prefecture. While this work is still in progress, preliminary analysis indicates that changes in lithic assemblage characteristics observed at Sannai Maruyama can be found at many other settlement sites in Aomori (Habu 2006). Assuming that lithic assemblage characteristics reflect subsistence strategies, it is likely that the proposed development and decline of the specialised subsistence strategy was not unique to Sannai Maruyama but a general phenomenon in this region.

Discussion

In summary, the results of this case study suggest that the growth and decline of the Sannai Maruyama settlement coincided with subsistence specialisation with a focus on plant food, possibly nuts. Lithic assemblage data indicate that this subsistence specialisation began in the Lower-Ento-b phase and ended abruptly at the end of the Upper-Ento-d phase. Preliminary analysis of lithic assemblage data from other sites indicates that this subsistence specialisation was not unique to Sannai Maruyama, but that the change occurred at the regional level. It should also be noted that many large Middle Jomon settlements were abandoned at about the same time as Sannai Maruyama (Kodama 2003; Okada 2003). Thus, it is likely that the growth and decline of the Sannai Maruyama settlement was directly related to the rise and fall of the 'Middle Jomon type' of subsistence-settlement systems in this region. These results encourage us to consider the long-term consequences of hunter-gatherer subsistence specialisation.

The subsistence base of Middle Jomon cultures in north-eastern Japan and an abundance of plant food processing/collecting tools during this period have been topics of debate among many Japanese archaeologists. Previous discussion, however, tended to focus on the question of whether a reliance on plant food was at the level of plant cultivation. The present case study indicates that it should be framed in the context of long-term change in hunter-gatherer subsistence, settlement and society.

The results also allow us to hypothesise that a major subsistence change that occurred between the Upper-Ento-d and Upper-Ento-e phases triggered changes in other aspects of Jomon culture, including settlement size and ritual practice. As discussed above, over the past couple of decades many researchers have moved away from ecological models that focus on subsistence strategies as a condition or cause of cultural change. However, results of this case study indicate that we should not give up on ecological models of culture change just because they are not fashionable. The case study demonstrates that systematic analysis of subsistence, settlement and society with a tight chronological control can contribute to a more holistic understanding of the mechanisms of culture change.

The Sannai Maruyama case is particularly useful in evaluating the potential importance of climate change. The impact of so-called Neoglaciation (the cooling climate which is said to have occurred at around 4500–4000 cal BP) has been a topic of debate (e.g. Dalfes *et al*. 1997; Prentiss & Chatters 2003). Although the precise timing of the temperature fall in Jomon Japan has yet to be determined, the observed archaeological changes at Sannai Maruyama can be used to examine changing human-environment relationships. This, of course, includes not only people's adaptation to the changing natural environment, but also the issue of landscape modification from the perspective of historical ecology.

Finally, just because we are dealing with a large archaeological site, it does not mean it was always a large, sedentary residential base. The fluctuation in the number of pit-dwellings through time and changes in dwelling size indicate that the function of the Sannai Maruyama site might have changed significantly though time. Thus, the observed archaeological patterns could also be a reflection of factors other than the hypothesised subsistence specialisation.

In order to further investigate these issues, new lines of evidence are needed. For this purpose, the Berkeley team is currently conducting several sub-projects that are related to the study of Sannai Maruyama. These include the study of regional settlement patterns, floral and faunal remains analyses to supplement the results presented by Japanese scholars (Habu *et al*. 2001; Habu 2004: 114-8; Katayama & Habu 2007), and quantitative analyses of pollen, phytoliths, diatoms and parasite eggs with a tight chronological control.

Conclusion

By examining various elements of prehistoric hunter-gatherer cultures, including subsistence-settlement, ceremonial practices and exchange, it becomes possible to present a new hypothesis about causes, conditions and consequences of long-term cultural change. The rich Jomon data will allow us to present such a hypothesis.

From the perspective of hunter-gatherer archaeology, my hypothesis has a number of implications. Specialisation is a common form of subsistence intensification, and ethnographically it can be seen among many sedentary hunter-gatherer groups. In most cases, however, hunter-gatherer groups retain the ability to go back and forth on the generalist-specialist continuum depending on various ecological and social factors. The Middle Jomon case might represent that a subsistence change occurred outside the range of the continuum and had a drastic impact on other components of their way of life, including settlement, population size and ritual practice.

It should be noted that if the Middle Jomon represents the high-point of the Jomon culture in terms of population density and settlement size, the Jomon trajectory might not fit into the conventional, progressivist model of cultural evolution. While we tend to think that human cultures evolve unilinearly from simple to complex, such a view is strongly influenced by conventional interpretations of European, Near Eastern and American prehistory and history. Learning about different historical trajectories in different parts of the world will definitely help us understand diversity in human cultures and history, and the Jomon case exemplifies the importance of understanding such diversity.

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