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The Transitions to Agriculture in Japan

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Crop production was an important part of the prehistoric economies on the Japanese archipelago from Okinawa through Hokkaidō by A.D. 1000. The transition to agriculture was not a singular process however. The standard model brings agriculture from mainland Asia as part of a diffusionary process that rapidly transformed and replaced indigenous cultures. But, this is only one aspect of the agricultural transition in Japan. There are at least four phases in the development of plant husbandry on the Japanese islands. The first phase (Transition 1) is the adoption of small scale gardening during the middle Holocene Jōmon. The next transition (Transition 2) is the disappearance of the Final Jōmon cultures with the influx of people from the mainland to southwestern Japan. The wet-rice based cultures that arose as a result of the strong influence from mainland East Asia are known collectively as the 'Yayoi.' The Tōhoku region of northeastern Japan did not accept these changes in the same way, nor as readily (Crawford and Takamiya 1990). While the Yayoi transition in the southwest involved the rapid replacement of cultures, the northeastern Japanese transformation (Transition 3) to distinctive societies together known as the 'Tōhoku Yayoi' involved the acculturation of local groups resulting in material cultures that still had marked resemblance to those of their Jōmon predecessors. The final step (Transition 4) is the replacement of the last Jōmon cultures in Japan, the Zoku Jōmon, by the Ezo-Haji or Satsumon ancestors of the Ainu.

This chapter provides an overview of the four Japanese transitions by first isolating the respective processes involved in each. Factors affecting the transitions are discussed in the context of similar transitions in eastern North America and Europe. I have been collecting primary data from Hokkaidō since 1974, so I first examine the contributions that research in Hokkaidō has made to our understanding of middle Holocene cultures, as well as late prehistoric and proto-historic cultures in northeastern Japan.

Hokkaidō Research

Salvage archaeology in Japan expanded extensively in the 1970s. The number of salvage excavations increased seven-fold to more than 7000 per year with growing land development beginning in 1969 (Tsuboi 1986:487). The number of archaeologists employed by prefectural governments correspondingly increased from about 100 to over a thousand in the same period (Kobayashi 1986; Tsuboi 1986). Minamikayabe (Figure 1), a town in southwestern Hokkaidō, began an archaeological program at the beginning of this expansive phase in Japanese archaeology. Nearly a decade and a half of excavations began at the Early Jōmon Hamanasuno site in Minamikayabe in1973. At the same time, William Hurley had been looking for an assemblage of Jōmon pottery to test analytical techniques. Yoshizaki Masakazu invited Hurley to apply his technique as a member of the Hamanasuno Project in 1974.

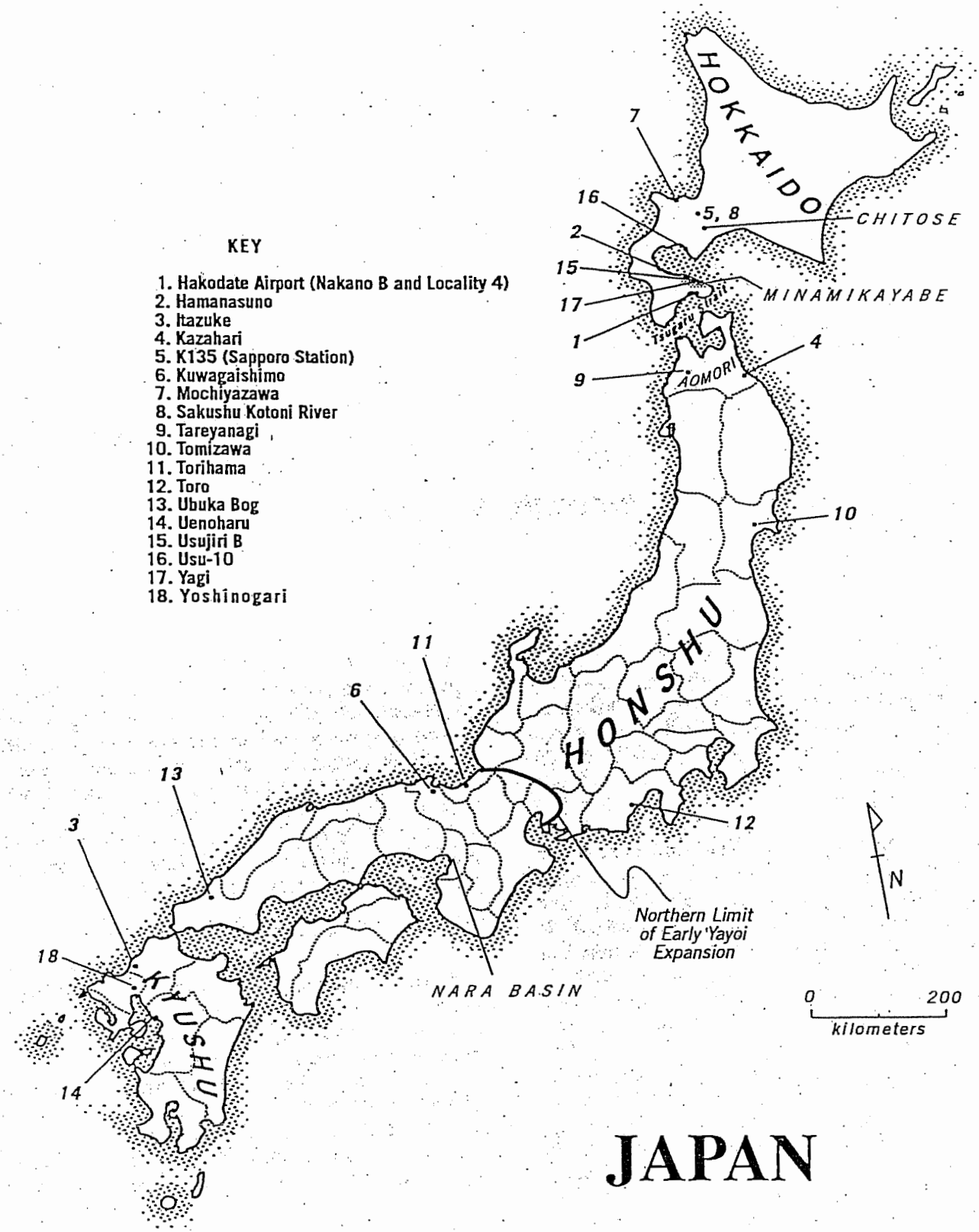

Figure 1. Location of archaeological sites in Japan mentioned in the text.

Several other events in Japanese archaeology in the early 1970s made it clear that research on the analysis and interpretation of the chronological and spatial variation of ceramic motifs would need to be placed in a broader cultural context that included subsistence. Yoshinobu Kotani (1972:231-232) had announced the results of the analysis of flotation samples from the Late Jōmon Uenoharu site in western Kyūshū (Figure 1). Two cultigens were present: rice (*Oryza sativa*), and barley (*Hordeum vulgare*). At the same time a few cultigens were fortuitously recovered from a number of other Jōmon sites (Kotani 1981). Assumptions that the Jōmon was strictly a foraging adaptation had been questioned as early as the 1930s, but efforts to investigate the issue were rare. World archaeology was in the throws of a flotation revolution that was changing many assumptions about prehistoric subsistence and the relationship between people and the environment in prehistory (Watson 1976). Kotani's efforts pointed out that the situation was no different in Japan. A general evaluation of Early Jōmon subsistence at Hamanasuno was in order and subsequently undertaken in 1974 (Crawford et al. 1978; Crawford 1983; Hurley 1974). In 1976 I returned to southwestern Hokkaidō to examine Initial, Middle, and Late Jōmon sites in conjunction with further work on the Early Jōmon.

By 1977 it was clear to us that salvage archaeology in Japan, although producing extraordinary quantities of data, suffered in the same way that it does elsewhere. Substantial analysis of all classes of archaeological data in the context of specific research issues was difficult, if not impossible, to accomplish. To solve this problem, Peter Bleed and William Hurley directed excavations at the multi-component Yagi site (Figure 1) for three years under the sponsorship of Yoshizaki and Tadahisa Ogasawara. An interdisciplinary team examined settlement and community organization, subsistence, site catchment, environmental history, and Japanese research methods and epistimology (Hurley et al. 1985). Techniques included flotation, bone analysis, pollen analysis, catchment analysis, detailed attribute analysis of all classes of artifacts, use-wear analysis, and remote sensing.

Interpretations of Jōmon adaptations in Hokkaido inevitably draw upon Ainu analogies (e.g., Watanabe 1986). The Jōmon and Ainu occupied the same environmental zones, appeared to live in communities with a substantial year-round resident population, and were primarily, if not entirely, foragers who depended largely on animal food, according to these comparisons. Foraging appeared to be able to support year-round villages in Hokkaidō until Japanese intercession in the late 1800s. However, the bulk of the Ainu ethnographic data are from the late nineteenth and the twentieth centuries. Although the prehistory of the Ainu was known to some extent, few archaeologists critically examined subsistence ecology, a significant aspect of any Jōmon-Ainu comparisons. We needed to test interpretations of Ainu adaptations, especially during the first millennium A.D. We had reason to be concerned about the quality of understanding of the Hokkaidō Ainu, particularly their subsistence base (Crawford and Takamiya 1990; Crawford and Yoshizaki 1987). The Ainu today perceive themselves as hunter-gatherer-fishers although they are living as contemporary Japanese in most respects. Ethnographers and historians tend to accept the Ainu self image.

Archaeological research on the early Ainu, or Ezo-Haji and Satsumon, and the Zoku Jōmon was under way in earnest by the mid-1980s. The first step involved a detailed analysis of material from the ninth century A.D. Sakushu-Kotoni River site (Figure 1) (Crawford and Yoshizaki 1987). Next, we were able to expand the first millennium A.D. data base to include the northern edge and south central region of the Ishikari Plain that surrounds Sapporo. In addition, data from eastern Aomori Prefecture are contributing to our understanding of early and pre-Ainu subsistence (D'Andrea 1992). At the same time, we have collected Early and Middle Jōmon data from the same areas that help to test our interpretations developed on the basis of the southwestern Hokkaidō studies (Crawford 1983).

Transition 1: The Middle Holocene Record

Japan possesses a rich archaeological record of Holocene cultures. The extensive early Holocene record in Japan is particularly astounding in that, for the same period, we know little about Japan's closest geographic neighbors: China, Korea, and the Soviet Far East. Domestication processes and the evolution of agrarian societies were well under way in China by the *middle* Holocene. The archaeological record in China for this period is well known although the preceding phases are not. Although intensive food production did not develop in Korea or Japan until the first millennium A.D. (Crawford 1992), the preceding periods may provide an inferential reference for the early Holocene period in China when agriculture must have been beginning.

The earliest ceramics in Japan date to the eleventh millennium B.C. but they are not cord-marked (Esaka 1986:226). The general consensus is that the Jōmon Tradition with its cord-marked pottery begins during or towards the end of the Initial Jōmon. During the Early Jōmon, the first cultigens are arguably present

but subsistence was based almost entirely on foraging (Crawford 1983; Kotani 1981).

The Yagi site has an Initial Jōmon component as does the nearby Nakano B site at Hakodate Airport (Figure 1) (Chiyo 1977; Hurley et al. 1985). Early Jōmon phases are represented in southwestern Hokkaidō at Hamanasuno as well as Yagi and Locality 4 of the Hakodate Airport site. Qualitative and quantitative differences in lithic assemblages differentiate the two periods, although similarities abound (Crawford 1983:21). Plant remains document qualitative differences between the Initial and Early Jōmon. From the late Early Jōmon to at least the beginning of the Final Jōmon, the material culture and subsistence regime is qualitatively unchanged. The Initial Jōmon people harvested nuts but the Early Jōmon inhabitants showed little interest in nuts. Weed communities were of little importance to the Initial Jōmon people in Hokkaidō, but by the end of the Early Jōmon, such communities were important collecting territories. The Early Jōmon peoples appear to have taken a keen interest in barnyard grass (*Echinochloa crusgalli*). By 2000 to 1800 B.C., the end of the Middle Jōmon at the Usujiri B site (Figure 1) a few kilometers from Hamanasuno, barnyard grass utilization increased and morphological changes in the grass fruits indicates that domestication was taking place (Crawford 1983:31-34). Other evidence for gardening includes a single carbonized grain of buckwheat (*Fagopyrum esculentum*) from an Early Jōmon house at Hamanasuno and a few grains of foxtail millet from Usujiri B. We are currently assessing the significance of the latter. In the current view, the southern Hokkaidō Jōmon seems to have been slowly developing a form of food production, but foraging remained the dominant resource procurement method for thousands of years.

Animal remains are uncommon at the sites we have been examining. The bones are usually calcined from exposure to heat, so the representativeness of the remains is more difficult to assess than it is for assemblages of unburned bone. Nevertheless, a hunting strategy has been modeled and the degree to which the animal remains from Yagi correspond to the proposed strategy has been examined (Bleed and Bleed 1981; Bleed et al. 1989). The Yagi inhabitants mainly hunted large land and sea mammals. The other remains, including some small mammals, birds and fish indicate a great deal of ecological and technological breadth, although the quantity of the small animals, estimated from the animal remains, appears lower than the model predicts (Bleed et al. 1989). The Yagi surroundings offer a rich and diverse array of resources. All the animals could have been procured within an hour or two of the community. The evidence points to butchering and processing of game within the site limits, so there are likely no special purpose sites related to hunting (Bleed et al. 1989).

The overwhelming majority of stone tools were made of chert and coarser igneous stone whose sources are within a few kilometers of the site; much of the tool production took place on site (Bleed 1989:3). Bleed characterizes the Yagi community as one that is logistically organized but residentially immobile, as opposed to being logistically mobile (Bleed 1989:3). Some barnyard grass seeds, as well as seeds of other herbaceous annual weeds, occur in the Yagi flotation samples. This is consistent with the view that the residentially immobile Yagi population would have affected the local environment to the extent that anthropogenic communities had become significant collecting and, concomitantly, hunting territories. I would add to Bleed's comments that the Jōmon people were not passive participants in their local habitats, but were interacting with them as well; that is, their actions caused ecological changes to which the Jōmon people successfully adapted (Crawford 1983; Nishida 1981, 1983). For example, substantial disruption of local plant communities by people (anthropogenesis) resulted in early successional vegetation that was highly productive and useful. This was taking place before there is solid evidence for domestication in northern Japan.

The general patterns found in southwestern Hokkaidō are consistent with modes of subsistence, settlement, and technology found throughout Japan to the end of the Jōmon, with a few exceptions. A few small stone formations are associated with burials, and some houses or house-like structures are extremely large on many sites by the end of the Middle Jōmon. In the Late and Final Jōmon, houses are generally uniform in size and shape, but the material culture is much more elaborate than in previous periods. In addition, in northeastern Japan large stone formations, usually roughly circular, and stone-marked cemeteries abound. In the Yoichi area of Hokkaidō alone there are several hundred of these sites. Near Chitose, Hokkaidō, are several Late Jōmon earthworks. Few of these special purpose sites are associated with the Final Jōmon but the archaeological record of that period is characterized by elaborate, thin-walled pottery, pottery masks, polished stone batons, and village sites with large quantities of debris and relatively high population densities. We have yet to systematically collect plant remains from Final Jōmon sites, but work on the Late Jōmon is progressing (D'Andrea 1992).

Information from the Late Jōmon component of the Kazahari site in Aomori Prefecture, Tōhoku, (Figure 1) indicates that plant remains are not substantially different from those in the Early and Middle Jōmon of

southwestern Hokkaidō. Small grass seeds are common and three cultigens, broomcorn millet (*Panicum miliaceum*), foxtail millet (*Setaria italica* ssp. *italica*), and rice, are present. A calibrated accelerator date of 787 B.C. (922 to 393 B.C. at the 67 percent confidence level and 1312 to 103 B.C. at the 95 percent confidence level) (TO-2202: 2540±240 B.P. uncalibrated) on a rice caryopsis recovered from within 5 cm of the floor of House 32, subgrid 66, confirms its Late Jōmon association (D'Andrea 1992).

The Late and Final Jōmon of southwestern Japan were not as elaborate as their contemporaries in the northeast. Populations were relatively low (Koyama 1978). Foxtail millet, rice, rice paddies, gourd (*Lagenaria siceraria*), and barley have been found at a few sites dating between 1000 B.C. and 400 B.C. (Crawford 1992; Kotani 1981). Considering the evidence in Tōhoku, broomcorn millet and rice likely were present in southwestern Japan by the second millennium B.C. Material culture with mainland connections does not occur in any abundance, however, until about 400 B.C. By 100 B.C. the Jōmon in southwestern Japan had disappeared. Shortly thereafter, two groups, the Tōhoku Yayoi (to be discussed below) and the Zoku Jōmon developed.

The Zoku Jōmon is distinctly different from its Final Jōmon predecessors. Sites such as Sapporo Station in Sapporo (Sapporo-shi Kyōiku Iinkai 1987) and Mochiyazawa in Otaru (Otaru-shi Kyōiku Iinkai 1990) are typical of Zoku Jōmon sites (Figure 1). The former is a series of short-term occupations that contain evidence of specialized resource procurement. The second site is a large cemetery with intermixed occupation debris. Few pit houses are known for the Zoku Jōmon.

Transitions 2, 3, and 4

A period of rapid transformation to substantially agrarian societies in Japan began about 400 to 300 B.C. This marks the beginning of the Yayoi Period, a wet-rice based tradition that lasted until A.D. 300. Its legacy likely still remains in the traditions unique to Japan, including the Shinto religion. The Yayoi origin has two important aspects, one being the demise of Jōmon cultures that were remarkably successful in their ability to maintain dominance in Japan for nearly 10,000 years. The other aspect is the rise of a number of distinct Yayoi groups throughout the Japanese archipelago as far north as the Tsugaru Strait that separates Hokkaidō from Honshū. A complex of major and minor crops, as well as one or two domestic animals make their appearance in Japan at this time. In southwestern Japan, agriculture appears to have been centered on wet-rice production. In the northeast, rice production developed to some extent, but in northern Tōhoku dry land plant husbandry focussing on millets, barley, and wheat (*Triticum aestivum*) eventually emerged. This complex was carried into Hokkaidō within a few centuries. The Ainu are the descendants of these northern Tōhoku and Hokkaidō cultures (Crawford and Takamiya 1990).

Transition 2

Until recently, the origin of the Yayoi as either an indigenous transformation or the result of a massive migration from the mainland was open to question. In the first instance, archaeologists accepted that outside influence played a role, but the Yayoi was considered to be a result of acculturation of the local Jōmon and was therefore a mainly indigenous development. Hanihara (1987), Brace et al. (1989), and others now agree that the Yayoi represents a major incursion from the mainland. At first, the most pronounced continental influence was in northern Kyūshū (Kanaseki 1986). Once established in Kyūshū, local Jōmon populations appear to have coexisted with the Yayoi for a time. Little is known about the mechanisms of the replacement of the Jōmon by the Yayoi in southwestern Japan; however, the replacement was complete by 100 B.C. Complicating matters is a northwestern Kyūshū population which is interpreted to be Jōmon people who used Yayoi pottery (Brace et al. 1989:105). That is, acculturation was affecting some or all remaining Jōmon populations. Other sites such as Itazuke (Figure 1), are Jōmon occupations immediately succeeded by Yayoi occupations.

The Yayoi rapidly spread, particularly along the coasts, to the Tokai and southern Chūbu districts in central Honshū and thereafter the Yayoi advance is usually interpreted to have slowed somewhat (Akazawa 1982, 1986; Kanaseki 1986). The difference in the rate of change between the southwestern and northeastern Yayoi spread actually may not be that great. It took roughly two centuries for the Yayoi to reach central Honshū and about the same length of time for the Final Jōmon in Tōhoku to give way to the Yayoi. The rate differential may be exaggerated by those who stress the contrasting speeds of Yayoi appearance in the two areas. In other words, despite some difference in the rate of Yayoi spread, it was relatively quick in both northeastern and southwestern Japan. Without doubt the Yayoi spread is associated with a significant expansion of agriculture in Japan. Pollen diagrams consistently indicate changes such as clearance, burning, and ecological succession associated with agricultural intensification throughout southwestern Japan (Tsukada 1986; Yasuda 1978).

The disappearance of the Final Jōmon corresponds with the first two episodes of Yayoi expansion: the

Early Yayoi spread to central Honshū and the subsequent development of the Tōhoku Yayoi. The event (Transition 4) that eliminated the last of the Jōmon cultures, the Zoku Jōmon, was the movement of the Ezo-Haji (early Satsumon) ancestors of the Ainu into Hokkaidō.

The Middle Yayoi Toro site (Goto 1954) is an excellent example of the southwestern Japanese Yayoi (Figure 1). Toro combines both dwellings and ancient fields. Part of the site is waterlogged, containing well preserved wooden utensils, textiles, as well as ceramics, stone tools, and metal. Earthen embankments with wooden retaining walls form part of an irrigation network. Plant and animal remains include rice, millet, melon, gourd, peach, mammals, fresh water and marine fish, and shell fish and are evidence of a mixed economy. Although dry crops may have been grown on upland sites, a double cropping system that utilized post-harvest, drained rice paddies for a second crop was used in Japan until recently, and is still used in parts of China. Millet, barley, and wheat, for example, may have been grown as winter crops in southwestern Japan, thus permitting a full year of crop production (Crawford 1992).

Craft specialization and social differentiation are characteristics of the Yayoi. By the Middle Yayoi local areas were unifying and agricultural production was intensifying (Kanaseki 1986:319). Imported mirrors and iron weapons became more abundant as well (Kanaseki 1986:331). Long distance movement of goods and/or people within Japan is evidenced by, for example, Okinawan shell comprising nearly all the jewelry uncovered at the Usu-10 site in southwestern Hokkaidō (Figure 1). Inter-group hostilities in southwestern Japan are evidenced but disappear by the end of the Yayoi (Ikawa-Smith 1985:394).

The Tōhoku Yayoi was in many ways Jōmon in character (Crawford and Takamiya 1990; Ito 1986), but it is distinguished from the preceding Final Jōmon by intensive food production. Rice paddies have been found at the first century A.D. Tareyanagi and Tomizawa sites (Figure 1) (Ito 1986). The Yayoi occupation at the Kazahari site contains rice, broomcorn millet, and foxtail millet (D'Andrea 1992). The northern Yayoi was probably never as dependent on rice as its southwestern counterpart. Barley, wheat, and millets were important and eventually became the dominant crops in prehistoric and protohistoric northeastern Japan (Crawford and Takamiya 1990).

The intensive food production of the Yayoi period eventually enabled the support of a full-time, centralized government. The first indication of the end of the Yayoi is the appearance of large tombs (*kofun*), the largest of which are keyhole shaped. The Yamato state, marking the beginning of the Japanese nation, arose in the Nara Basin during the Kofun Period (A.D. 300–700), named for its characteristic earthen tombs. The Kofun Period ends a century or so after the emergence of recognizable Ainu ancestors in the north.

The Yamato state emerged during the Kofun Period by the early 6th century A.D. One of the outcomes of the Yamato state formation was the institutionalization of occupational groups (*be*) (Barnes 1987:86). The administrative organization of this state was a structure that provided direct access to the commoner, breaking up the locally autonomous cells characteristic of the Yayoi (Barnes 1987). Mechanisms such as the integration of occupational groups assured continued dependence of the various regions on the state (Barnes 1987:46). Farmers were one such specialized occupation group. The Kofun Period is associated with a new era of interaction with the mainland and exotic items appear in Japan at this time. One important introduction was the horse and another was Buddhism (Ikawa-Smith 1985). By the end of the Kofun Period, materials from as far away as western Asia were moving into Japan. Domesticated plants such as safflower (*Carthamus tinctorius*) from the Middle East were introduced at this time (Crawford and Takamiya 1990).

Transition 3

Northern Honshū came under some undefined influence of the Yamato state by the seventh century (Aikens and Higuchi 1982; Crawford and Takamiya 1990). Shortly after the Yamato state emerged in southwestern Japan, northern Yayoi pottery was supplanted by Haji ware typical of the Kofun Period. The ceramics were all locally manufactured, however. Numerous keyhole-shaped tombs like those in southwestern Japan are found as far north as Tōhoku; circular tombs are found in central Hokkaidō. House styles were similar from Hokkaidō to the Kantō district at this time. The Yamato state may have been trying to incorporate the autonomous northern cultures into its fold in much the same manner as Barnes (1987) describes for southwestern Japan. Ikawa-Smith has suggested that ideology in the form of a *kofun* cult was an important aspect of the spread of Yamato influence and that the appearance of *kofun* throughout Japan need not indicate local ties to a central Yamato authority (1985:395). Certainly the Yamato state did not incorporate Tōhoku as it did southwestern Japan. In the first half of the second millennium A.D. authorities representing the Japanese government were in place in Tōhoku, but the region was largely foreign territory to the Japanese. The local inhabitants, called the *emishi* or *Ezo* (Aston 1896:XXVI,262), are generally accepted to be the ancestors of the Ainu. Following the precedent

set by Yoshizaki (1984), I refer to the archaeological cultures of the period from about A.D. 600 to A.D. 900 as the Ezo-Haji, a name reflecting the likely cultural identity of the people as well as the ceramic complex in use at the time. Others refer to this phase as early Satsumon (Aikens and Higuchi 1982). Not until the middle of the second millennium A.D. did the Japanese state come to include Tōhoku and Hokkaido (for a more detailed discussion see Crawford and Takamiya 1990).

Transition 4

Transition 4 took place some time shortly after A.D. 500–600 (Crawford and Takamiya 1990). By A.D. 700–800 only dry crop agriculture was being carried out by the Ezo-Haji throughout the Ishikari Plain in central Hokkaidō, as well as in southern Hokkaidō. This pattern correlates well with records of an exodus of native peoples from Tōhoku (Takakura 1960). So far, there is no evidence of Ezo-Haji artifacts at Zoku Jōmon sites or the reverse. Hanihara (1990a) prefers a unilineal scheme that derives the Ainu from Zoku-Jōmon ancestors because of the physical similarity between the Jōmon and Ainu populations in the north. Hanihara's model assumes that the Ainu and their direct ancestors were hunter-gatherers. The model of Ainu origins deriving them from Tōhoku rather than the Hokkaidō Zoku Jōmon is consistent with the human osteological data as well as the archaeological data on agriculture and technology of the Ezo-Haji.

Ezo sites are all small hamlets or villages. Ceramics are generally pots with flaring rims and bowls (Figure 2). There is very little geographic variation in pottery styles at this time. Variation through time is recognized, particularly in the more complex trailing/incising that becomes more common in later periods around the rims of pots. In contrast, the crops vary from region to region. On the Northern Ishikari Plain, the west coast of Hokkaidō and in southern Hokkaidō, a wide variety of crops are found in the plant remains. In the southern Ishikari Plain, almost all the cultigen seeds we have recovered so far are foxtail and broomcorn millet (Crawford and Takamiya 1990:905; Crawford 1991). At the moment we have no explanation for this pattern.

Conditions and Causal Factors

A number of proximate causes have been suggested to have given rise to food production in Japan in particular and East Asia in general. These include deterministic environmental changes, demographic influences, and/or social forces. Little progress has been made in exploring complex causality in the way that Flannery (1986) has done for Mexico, however. This is partly because the concept of diffusion dominates thinking about agricultural origins in Japan; but the factors giving rise to agriculture in primary areas, as opposed to those influencing developments in secondary regions, should be carefully considered.

Eurasia, North America, and Japan are among the best documented of the regions in which agricultural origins or intensification is primarily a result of diffusionary processes (e.g., Smith 1990; Watson 1989; Zvelebil 1986). I include *intensification* because in North America and Japan, in particular middle Holocene domestication and plant husbandry appear long before more intensive forms of food production develop. Intensive food production spreads in eastern North America during the latter half of the first millennium A.D., after the introduction of corn (*Zea mays*). (In Illinois and Ohio intensification of non-corn food production may well precede the introduction of corn.) In Japan, intensified food production is first associated with rice paddy agriculture in the first millennium B.C. Among the proposed factors influencing the rate of the transition from foraging to farming and the ultimate replacement of foraging by farming in Eurasia are: climate; colonization and a related population imbalance between foragers and farmers; social structure and the emergence of ranking; and the existence of a frontier along which disruption of foraging patterns occurred (Gebauer and Price 1990; Zvelebil 1986:183). In eastern North America, familiarity with plant husbandry may be added to the list, although this does not appear to be a factor on the northern peripheries such as in southern Ontario, Canada. These factors may have been involved in the transition to food production in Japan as well.

The Japanese situation, although sharing a number of characteristics with prehistoric eastern North American and European cultures, is unique in several ways. Material culture, including pottery, was elaborate and sedentism was much more widespread in contrast to the eastern North American Archaic and the European Mesolithic. Animal husbandry was important in Neolithic Europe, but not in Japan or eastern North America. Indigenous plant husbandry was apparently a component of many early eastern North American and Japanese economies, but not of European Mesolithic economies.

The natural environment is often viewed as a determining factor in regard to Jōmon culture. This can be a productive line of enquiry, as in the examination of the convergence of the Kantō Jōmon and the central California Windmiller and later cultures (Aikens and Dumond 1986). In other cases, however, problems arise. Early views of an indigenous Jōmon origin of agriculture in Japan were based on contradictory

Figure 2. Ezo-Haji pot from the Sakushu-Kotoni River site, Hokkaidō. Height: approximately 28 cm.

notions of the richness and the scarcity of resources in the Japanese environment. The comparatively high population density of the Chūbu district Middle Jōmon (central-western Japan), despite the rich resources of the area, could not be attributed entirely to a foraging culture (Fujimori 1963). The elaborate stone and ceramic technology seemed out of place in a foraging context, according to Tsuboi (1964) and Fujimori (1963), and may well have been the result of an agricultural economy.

In contrast, Nakao (1966) and Ueyama (1969) proposed that the sparsely populated western Japanese Jōmon was involved with a form of incipient food production. The low density populations resulted from the scarce resources of the broad-leaf evergreen forest zone. To them, the swidden systems of mainland Asia in the same forest zone implied that the western Jōmon either carried out "semi-cultivation" or swidden in order to solve the resource scarcity problem (Nakao 1966; Sasaki 1971; Ueyama 1969). Scarcity, therefore, provided a *need* for agriculture. In part, these views might best be characterized as wishful thinking.

In recent years the concept of affluent foragers has pointed to the elaboration of culture in resource rich environments without the presence of food production (e.g. Koyama and Thomas 1981; Price and Petersen 1987). Aikens (1981) and Hayden (1990 and this volume) go so far as to propose that food production arose because a social elite among foragers demanded increased production to serve their needs. These demands would lead to food production when the system reached its carrying capacity. In the common wisdom, we think of food production as necessary for elite classes to become established. Later in this chapter I examine this theme of social elaboration in more detail, but in terms of resource abundance or scarcity as a factor in agricultural origins, the seasonal cycle of resources and their annual unpredictability is at issue, not their absolute or average abundance. The scarcity or richness issue is not adequately resolved unless we can measure resources in the context of population densities and technology.

Environmental change during the Holocene likely had an impact on Jōmon subsistence. In the southwest, Yasuda (1978:254) interprets pollen evidence to mean that an *Artemisia* steppe developed after the Pleistocene boreal forests disappeared about 10,000 B.P. The sparsely represented Incipient Jōmon may have developed in this environment. Broad-leaf forests replaced the steppe by 8500 B.P., first with deciduous then with evergreen broad-leaf species (Yasuda 1978). The development of the Initial Jōmon by 8500–8000 B.P., presumably from an Incipient Jōmon ancestor, coincides roughly with the establishment of broad-leaf forests throughout Japan. Chard's (1974) co-traditions were in place; the southwestern Early Jōmon was well developed by then, with characteristics differentiating it from the northeastern Early Jōmon.

In the northeast, where no Incipient Jōmon is known, the boreal forest was replaced by oak (*Quercus*) and beech (*Fagus*) forest between 9000 and 8000 B.P. (Tsukada 1986:27-28). Tsukada (1986:28) proposes that a clearer understanding of Jōmon subsistence will derive from understanding beech distribution dynamics through time because beech nuts were an important Jōmon food. Tsukada is mistaken. We have no evidence that beech nuts were a food, let alone an important resource, during the Jōmon period. The evidence for acorns is not much better. Much as in eastern North America, people were not concerned with beech nuts, a resource that is relatively inefficient to harvest. Understanding the long-lasting subsistence regime in Hokkaidō that began in the Early Jōmon is much more complex than examining distributions of beech trees. The establishment of deciduous broad leaf forests in southern Hokkaidō is followed by decreased nut use and increased anthropogenic plant use by 6000 to 5000 B.P. (Crawford 1983).

Ho (1977) proposed that the steppe-forest ecotone played a role in the origins of agriculture in China, although he did not elaborate. I have cautioned elsewhere (Crawford 1992) that borrowing this model to explain developments in Japan would be futile. Ho's evidence for a steppe or a steppe-forest origin of agriculture in China is inadequate. The evidence for an early Holocene steppe in Japan is not correlated with a substantial move to food production. The evidence for subsistence change, which may have had food production as a component, is later than 10,000–8500 B.P. on the whole, and long after the broad-leaf forests were established throughout their modern range in Japan.

Human induced changes in local ecology, or anthropogenesis, take two forms pertinent to agriculture. The first involves the disruption of habitats due to agricultural activities. The second involves the non-agricultural creation of open, disturbed habitats that are colonized by weeds as a proposed initial step in the domestication process. In the first case, by tracing the history of changes known to be the result of cultivation, the development and spread of agriculture can be discerned (e.g., Dimbleby 1978). In the second case, some weeds may be potential cultigens and are thought to be ancestral to domesticated plants (Anderson 1971; Harlan and de Wet 1965). Domesticated plants may not all have weeds as their ancestors however. Hillman and Davies (1990) observed no wild barley or wheat colonizing humanly disturbed areas in western Asia and believe that agricultural activities preceded domestication there. In any

case, evidence of environmental disruption may provide important clues to the domestication process and the origins of agriculture.

Certain evidence in the vegetation history of Japan is related to agricultural activities. Tsukada (1986) links the development of pine (*Pinus*) woodlands and forest fires evidenced in pollen cores to agriculture in Japan. The pine forest induced by humans as a secondary succession stage due to clearance for agriculture is probably a relatively late phenomenon, developing "a few thousand years ago" (Tsukada 1986:46). Frequent forest fires caused by people, but not related to agriculture are evidenced as early as 8500-7000 B.P. in southwestern Japan (Tsukada 1986:41). However, at Ubuka Bog, shifting agriculture appears about 7700 B.P. and pollen from buckwheat, an exotic cultigen, is common in levels dated to 6600 B.P. (Tsukada et al. 1986; Tsukada 1986).

The data from southwestern Hokkaidō are similar to Tsukada's. Rather than examine regionally sensitive pollen evidence, I have attempted to isolate the plant remains at the sites that were remnants of plant parts harvested by people (Crawford 1983). From the Early Jōmon to the end of the Middle Jōmon, the latest period in the Minamikayabe study, no major plants were added to, or removed from, the Jōmon diet (Crawford 1983). The evidence does indicate an increasing dependence on annual and perennial weedy taxa such as knotweeds (*Polygonum*), grasses (Gramineae), sumac (*Rhus*), and other forest edge and open ground plants. Site specific pollen records imply large-scale local disruptions, but these disturbances do not show up on regional pollen diagrams (Davis 1979). At Yagi, for example, non-arboreal plants had greater input to the pollen record than arboreal pollen did (Davis 1979). In my view, disturbed habitats, whether gardens or not, were important to the Jōmon. Through time they became increasingly dependent on resources from such habitats.

Nishida (1983) provides a slightly different twist to the discussion of anthropogenesis. In his opinion, the Jōmon developed a symbiotic relationship with chestnut (*Castanea*) and walnut (*Juglans*) trees as well as a host of other sun-loving plants (Nishida 1983:315). Nut trees were by far the most important of these plants, however. The nature of the deposition of the plant remains at the waterlogged sites Nishida has studied (Torihama and Kuwagaishimo) makes it almost impossible to ascertain which remains are food and which are not. Nevertheless, Nishida and I agree on the importance of anthropogenic communities to the Jōmon people, although we do not agree on the specific plants that were used.

The *success* of indigenous cultures is a common theme helping to explain a relatively slow rate of the transition to, or intensification of, food production. Underlying themes include the degree to which foraging cultures were disrupted or disruptable by new ideas, people, and technology. Gregg (1988) models a symbiotic relationship between foragers and farmers that involves an exchange of food resources. Foragers successfully maintained their existence by cooperating with farmers, according to this model. Unfortunately, Gregg is unable to find good archaeological data to test her model. Keely (this volume) interprets the archaeological record for Linearbandkeramik to mean that the two groups of farmers and foragers in fact repelled each other and never assimilated. Keely sees no evidence of exchange or any other kind of cooperation. Gebauer and Price (1990) also do not support the interaction model. The cooperative model usually involves the exchange of crops and domestic animals for service or wild resources. They report, however, that crops and domesticated animals were the last items to be borrowed by Mesolithic foragers in Denmark (Gebauer and Price 1990:260).

European archaeologists admit to some frustration with the archaeological data from the period of the Mesolithic demise. Radiocarbon dates are confusing and little organic material has been recovered from sites of this period (Gregg 1988; Keely this volume). Japan, on the other hand, offers a well established chronology, good human osteological data, and a plethora of sites rich in organic debris.

Whatever the natural environmental circumstances and the success of the Jōmon, little doubt remains that the rapid spread of the Yayoi and the end of the Jōmon in southwestern Japan was a result of the reproductive and technological success of these newcomers to Japan. The Yayoi in the southwest are physically much like mainland northeast Asian peoples (Brace et al. 1990; Hanihara 1987, 1990a and b). Hanihara (1990a; 1990b) argues that the southwestern Japanese and mainland Asians are not entirely alike; the variation from mainland-like Japanese to Ainu-like Japanese follows a cline from southwest to northeast in Japan. The Kyūshū Yayoi is particularly northeast Asian in appearance. One major Yayoi site, Yoshinogari (Figure 1), excavated recently was planned by the migrants (Hanihara 1990a). If little acculturation took place between the Yayoi and Jōmon in southwestern Japan, Akazawa's (1982; 1986) argument that the southwestern Jōmon was predisposed to accept rice production because of their familiarity with gardening may be moot. No matter what the Jōmon adaptation in southwestern Japan, replacement and acculturation appear to be the main process of agricultural development.

Relative population densities and the nature of local economies and sociocultural systems are significant

issues in explaining the initial halt of the early Yayoi spread at the Tokai boundary, followed by the development of the Tōhoku Yayoi and eventually an agricultural system based not on rice, but on wheat, barley, and millets among other crops (Crawford and Takamiya 1990). The northern Yayoi and subsequent cultures retained much of their Jōmon physical characteristics. The osteological pattern of the Ainu, who descended from these cultures in northern Tōhoku (Crawford and Takamiya 1990), differs little from the Jōmon pattern (Brace et al. 1990). The mechanisms for the development of the northern Yayoi have not been explored, but are the subject of current research (D'Andrea 1992).

Material evidence of elaborate public works and ritual are characteristic of the Late and Final Jōmon of Tōhoku and Hokkaidō, as I have already mentioned. This sort of archaeological evidence is usually interpreted to be evidence of social ranking and some degree of public economy. Some have argued that it is the very existence of such structures that is instrumental in the adoption of food production (for a summary, see Gebauer and Price [1990:264]).

Aikens (1981), in a comparison of the prehistory of Japan and eastern North America, concludes that in both areas the change was from broad-spectrum forest economies to agriculture. He traces the evidence for increasing societal complexity and finds that sociopolitical structure that evolved in part due to rich woodland resources ultimately created demand for greater resources and that this demand was satisfied by agriculture. Aikens proposed that societal organization was the crucial factor in the rise of agriculture in both areas (1981:271). Whatever the merit of the original argument, the current data are evidence for the opposite; cultigens precede the development of social complexity. In eastern North America a grain crop, sumpweed (*Iva annua*), was extensively harvested during the Middle Archaic and was domesticated by the Late Archaic in the Illinois Valley (Asch, and Asch 1978; Asch 1985). Several other cultigens are present by the Late Archaic and Early Woodland including chenopod (*Chenopodium berlandiari* ssp. *jonesianum*), cucurbit (*Cucurbita pepo*), sunflower (*Helianthus annuus*), bottle gourd (*Lagenaria siceraria*), and possibly maygrass (*Phalaris caroliniana*) (Fritz 1990; Smith 1990; Watson 1989). Thus, domesticated grain plants, as well as other crops, appear in the archaeological record of eastern North America before there is substantial evidence for changes in social organization related to the establishment of conspicuous consumption.

Unfortunately, the situation in northern Japan is not quite as well researched as it is in eastern North America. I have argued that the Early and Middle Jōmon plant food subsistence has a number of parallels with that of the Early to Late Woodland of North America (Crawford 1983). Domestication of barnyard grass was under way by 2000 B.C. (Crawford 1983) and three cultigens have been identified from a Late Jōmon site in northern Tōhoku (D'Andrea 1992). We have no way of knowing, however, whether they were grown there or imported to Tōhoku. Once the Tōhoku Yayoi was established, the Final Jōmon disappeared from Hokkaidō and was followed by the Zoku Jōmon which lacks any of the extensive material culture and site elaboration of its predecessors. All available evidence indicates a *collapse* of the public economy in Hokkaidō with the introduction of intensive food production, as witnessed by the Zoku Jōmon successors to the Final Jōmon. Cultigens are being recovered from Zoku Jōmon sites, but we do not know whether they were grown in Hokkaidō (Crawford and Takamiya 1990; D'Andrea 1992).

The Tōhoku Yayoi socioeconomic organization is not well known, but because chiefdoms were present in southwestern Japan, they were likely in Tōhoku as well. If this is the case, the Final Jōmon in Tōhoku, with its evidence for social ranking and public economy, was succeeded by local Yayoi societies who incorporated social ranking and public economy to a greater degree than their predecessors. However, rice and two millets were present in Tōhoku at least by the end of the Late Jōmon and barnyard millet and buckwheat and perhaps foxtail millet were present as early as the Early to Middle Jōmon in neighboring southwestern Hokkaidō. It is difficult to reconcile the socioeconomic elaboration model with the available data in northeastern Japan. That is, it seems likely that grain foods were present before the elaboration seen during the Final Jōmon and grains were certainly available to the late Late Jōmon cultures.

Concluding Remarks

Japanese prehistory offers a number of opportunities to examine the transitions to agriculture in a relatively unique cultural and ecological setting. Two regions with similar processes of agricultural development are Europe and eastern North America. Yet differences among the three areas are significant. To clarify the processes in Japan, I have discribed four phases, Transitions 1 through 4, of agricultural development there. The first transition, which is the least well documented of the four, is the largely indigenous use of gardens during the middle Holocene Jōmon. Many of the cultigens such as buckwheat and bottle gourd reported from middle Holocene Jōmon sites are exotic to Japan, yet at least one, barnyard grass/millet, is not. Much as in eastern North America, little if any other material evidence of external contact has been

found besides the cultigens. The evidence of local and regional ecological changes that have been attributed to human influences is also suggestive. These changes begin before the first cultigens appear in the archaeological record.

The second transition that resulted in the Yayoi culture is clearly a result of influence external to Japan, including human migration and the reproductive success of the Yayoi peoples. The third transition brought agriculture to northeastern Japan, but wholesale replacement of indigenous cultures does not appear to have occurred there. The change appears to have created local Yayoi groups who maintained much of the identity of their predecessors. The mechanisms for this change are not obvious. How the change took place at the rate that it did and at the time that it did are areas for further research. Models of social interaction and disruption may well apply.

The final northward expansion of an agricultural way of life took place in the latter half of the first millennium A.D. after a distinctive northern agricultural complex developed. Evidence indicates a replacement of Zoku Jōmon populations in Hokkaido by human populations biologically similar to the Jōmon but culturally quite different. The newcomers, the Ezo-Haji or early Satsumon, were ancestors of the Ainu. The precise mechanisms of the change from Zoku Jōmon to early Satsumon are not known. Although the reproductive success and technological advantages of the Satsumon are likely important reasons for their relative success, it is still quite possible that acculturation of some Zoku Jōmon peoples took place. Nevertheless, by A.D. 1000 two distinct systems of agriculture developed in Japan. One was based on wet rice production and the other on millets, barley, wheat, and a host of other dry field crops.

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