Seasonality and Sedentism

Archaeological Perspectives from Old and New World Sites

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CHAPTER 7

Scheduling and Sedentism in the Prehistory of Northern Japan

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Since 1974 we have been working on a series of case studies in northeastern Japan ranging in time from the Initial Jomon to the protohistoric ancestors of the Ainu, known as the Satsumon or Ezo-Haji (Crawford and Takamiya 1990). These include research programs on the Oshima Peninsula of southwestern Hokkaido (the Yagi, Hamanasuno, Usujiri B, and Hakodate Airport localities), in the Ishikari Plain (the Zoku-Jomon K135 localities and Mochiyazawa site and the Ezo-Haji Sakushu-Kotoni-Gawa, Botanical Gardens, and Kashiwagi-Gawa sites), and in Aomori (the Kazahari and Tominosawa sites) (Hurley 1974; Crawford et al. 1978; Bleed et al. 1979; Crawford 1983, 1987, 1992b; Crawford and Yoshizaki 1987; Crawford and Takamiya 1990; D'Andrea 1992, 1995a) (table 1 and fig. 1).

The sites we have been researching in northeastern Japan represent a range from hunting and gathering through mixed foraging and farming economies. We group the case studies into three categories with a strong potential for differences in scheduling to be visible in the archaeological record. The first is the Early through Late Jomon, which had large village communities but only minimal evidence for some form of gardening. This phase corresponds to Transition 1 in a model proposed by one of us for the development of agriculture in Japan (Crawford 1992b). Next is the Zoku-Jomon, which has evidence for greater mobility and an ecofactual database both of which indicate clear differences between it and the preceding Jomon periods on the one hand, and the Hokkaido Ezo-Haji, the third category, on the other (see table 1). The Ezo-Haji was the first group in Hokkaido to have substantial farming. The Zoku-Jomon and Hokkaido Ezo-Haji correspond with Transitions 2 and 4 respectively in Crawford (1992b). That is, Transition 2 is the development of the Zoku-Jomon, as well as Tohoku Yayoi cultures, while Transition 4 is the consolidation of agriculture in Hokkaido by the Ezo-Haji.[1] Although the Zoku-Jomon is distinct from the Tohoku Yayoi with which it was contemporaneous, the two cultures interacted and the Zoku-Jomon can be considered part of Transition 2. For the sake of simplicity and continuity with this earlier work (Crawford 1992b), the Transition 1, 2, and 4 terminology is used here.

Addressing the issue of scheduling and sedentism in Japanese prehistory, or any broad issue for that matter, is a daunting task if only because the pace of Japanese archeological research is so great that most summary statements about the era are quickly outdated (Tanaka 1984). New sites are continually being reported and Japanese researchers are exploring virtually every known avenue of archeological insight. Furthermore, the available research has revealed great complexity within the Japanese past so that summary generalizations are hard to support. Even within the Jomon era, cultures from different periods and parts of the Japanese archipelago clearly had very different lifestyles and utilized a diverse range of resources. After all, the Jomon lasted over ten millennia from Okinawa to Sakhalin. Thus, although clear patterns within Jomon technology and society have been related to seasonality and other ecological issues (Akazawa 1986), the Jomon era was not a time of cultural uniformity or simple ecological adjustments. On the contrary, the richness of the record convinces us that it is best to consider the Jomon era in terms of specific regional variations and expressions.

In this paper, we take the view that the Jomon is not "monolithic" and that an approach that examines the details of a limited area of Japan is better than one that makes sweeping generalizations about cultural periods or some Japan-wide pattern. We emphasize the contributions our own research have generated in the context of the investigations of others who are working primarily to the southwest of the region we have been examining. We explore the similarities and differences in seasonality, scheduling, and sedentism among the three categories of occupations (Transitions 1, 2, and 4). In particular, we examine the so-called "Jomon Calendar," which is taken to be the orthodox position in Japanese archaeology. We also examine the view that a conflict in scheduling was a factor that hindered the move of agriculture into northeastern Japan. In addressing this issue, we explore the particulars of a number of data sets that have been collected with the purpose of exploring human-environmental interaction. We do so by developing a comparison among three contrasting phases in the prehistory of northeastern Japan. Ethnographic data regarding the Ainu of northeastern Japan are brought to bear on the analysis as well. This comparative approach brings to light at least three different prehistoric systems in a relatively small geographic area.

Seasonality in Jomon Research

The specific issue of seasonality during the Jomon era presents special problems. First, the richness and regional diversity of Jomon cultures has made solving cultural-historical problems the primary focus of Jomon research (Ikawa-Smith 1980). Japanese researchers have tended to emphasize artifact description and typology. The quality of this research has made it possible to describe very fine chronological subdivisions of the Jomon era, but it has also meant that consideration of other aspects of the era has languished.

In recent years, large salvage excavations have exposed several nearly complete Jomon settlements. This work has led Japanese researchers to consider the social aspects of Jomon culture, but the consideration of ecofactual remains is still uncommon. In part, this situation can be linked to the generally poor preservation of animal remains and the perceived lack of plant remains in Jomon sites. The volcanic soils that make up virtually all of Japan simply do not preserve faunal remains in anything other than caves (Serizawa 1979) and shell middens. Plant remains can, of course, be regularly recovered from Jomon sites, but only recently and only in a few areas has the archaeological commu-

Table 1

Site chronology in northeastern Japan

	Transition 1							Transition 4
Site Name	Initial Jomon	Early Jomon	Middle Jomon	Late Jomon	Final Jomon	Tohoku Yayoi	Zoku-Jomon	Hokkaido Ezo-Haji
Sakushu-Kotoni-Gawa								X
Botanical Gardens								X
Kashiwagi-Gawa								X
Mochiyazawa							X	
K135							X	
Kazahari				X		X		
Tominosawa			X					
Usujiri B			X					
Hamanasuno		X						
Yagi	X	X						
Nakano B	X							

Figure 1. Location of sites in northeastern Japan.

nity in Japan made any commitment to recover them using flotation. The paucity of faunal materials and the presumed lack of plant remains caused Japanese interests to be focused in other directions. As a result, priorities in Japanese archaeology such as the dominance of CRM work reflect the local situation. Few Japanese archeologists take the ecofunctional approach of anthropologically oriented archeologists in North America and Europe, so that consideration of ecofactual remains has not been a theoretical imperative.

Added to these problems, the issue of Jomon seasonality has not presented itself to Japanese archeologists as a problem that needs solution. The clear evidence for the rapid appearance of rice agriculture in Japan during the Yayoi era encouraged the view that the Jomon were hunters and gatherers. That is, agriculture was synonymous with rice production, and if the Yayoi were the initiators of rice production in Japan, then their predecessors were not people who grew crops. If further interpretation was necessary, many Japanese archeologists have suggested that modern Japanese culinary emphasis on seasonal produce and the cycle of fresh fruits and vegetables can be extended back to Jomon cultures.

Dissatisfaction with such implicit interpretations of Jomon seasonality lead Tatsuo Kobayashi to develop a model that summarizes the available information on Middle Jomon seasonal economy (1986). The so-called "Jomon Calendar" graphically suggests much about the operating conditions of Jomon culture and, as such, has been widely cited. It recently appeared in an American textbook on world prehistory (Price and Feinman 1993). The model indicates two peaks in plant food gathering, one in the spring and one in the fall. Land mammal hunting is depicted as having been primarily a winter activity. Summer and fall were the primary fishing seasons while shellfish collecting took place mainly during the spring and summer. Middle Jomon people hunted sea mammals during the winter through late spring. Unfortunately, the elegance and power of Kobayashi's model has had the undesirable effect of making it the orthodox view, despite the lack of empirical data upon which to base such a model. It has tended to limit investigations by presenting Jomon seasonality as a "solved problem" and forced thinking on the issue into normative terms. The power of the Jomon Calendar has discouraged Japanese researchers from looking for contradictory information or diversity within Jomon economic patterns. One need only look at the ethnohistoric Ainu data to find areas of poor fit between reality and the model. We will return to these points later in this paper.

The Jomon era is among the world's most thoroughly studied archeological expressions of so-called "specialized hunters and gatherers" (Aikens 1981; Akazawa and Aikens 1986; Hayden 1990). As such, the Jomon offers excellent opportunities to examine how such economies come about, stabilize, and change. Realizing this opportunity requires solving a number of problems. This is not the place to outline, much less solve, all these problems, but as a background for the specific discussions that follow, we outline the challenges to Jomon seasonality/scheduling research.

As a starting point, we accept a distinction made long ago between seasonality and scheduling (Flannery 1968). The former refers to cycles in which resources present themselves. The latter describes human accommodations to those patterns and specifically how groups adapt to and make use of resources in their environment. Flannery used this distinction to emphasize mobility and site function. In the Jomon case, the distinction reminds us that both the ecological setting of specific sites and the residues of economic activities must be considered in addressing questions of Jomon economy.

Issues in Jomon Seasonality

Japanese researchers have assembled a great deal of useful information about the Jomon environment (Kotani 1969; Yasuda 1975, 1978; Tsukada et al. 1986). The link between specific sites and their environmental settings has also been addressed by some Japanese researchers (Suzuki 1978, 1985; Yamada et al. 1980; Yamada 1986; Koike 1986; Koike and Ohtaishi 1987) although contextual study of Jomon sites is a research strategy that could be developed further. The paucity of ecofactual remains in Jomon sites is a serious block to seasonality research, although our work strongly indicates that Jomon sites preserve more interpretable ecofactual materials than has been suspected. As systematic recovery of these kinds of materials is becoming an increasingly common part of Jomon research (see Matsui 1992), our understanding of seasonal patterns should improve.

Systematic recovery is at best a partial solution. The scarcity of Jomon ecofactual materials, especially faunal remains, is a reality that will not disappear, and researchers will have to find other ways of addressing Jomon seasonality. Investigating the functional relationships between seasonality, settlement patterns, and

technological organization presents one obvious accommodation that has only begun to be explored (Akazawa 1986).

Mounting evidence indicates some gardening took place by 2000–1800 B.C. (uncalibrated), which is the end of the Middle Jomon in southwestern Hokkaido. Gardening seems to have involved growing barnyard millet (*Echinochloa utilis*), foxtail millet (*Setaria italica* ssp. *italica*), and possibly buckwheat (*Fagopyrum esculentum*) (Crawford et al. 1978; Crawford 1983, 1992b, 1997; Crawford and Takamiya 1990). Two of these cultigens, foxtail millet and buckwheat, were domesticated elsewhere in East Asia. Barnyard millet domestication is poorly known, but one center of domestication appears to have been northeastern Japan (Crawford 1983, 1992b, 1997; Yabuno 1987). The trend may not have been limited to Hokkaido, since evidence for plant husbandry has been found at many Jomon sites. This is not the place to evaluate these data; that has been done elsewhere (Crawford 1992a). By the Late Jomon in Aomori Prefecture, Tohoku, rice, foxtail millet, broomcorn millet, and possibly buckwheat were part of the local economy (D'Andrea et al. 1995). The possibility that plant husbandry began in the northeast as early as the Early Jomon should remain open (Crawford 1983). To date, models of Jomon seasonality and scheduling do not entertain the possibility that gardening and/or the use of crops played a role in Jomon subsistence economies.

The Sites

Ecological relationships and seasonal economic activities are the specific foci of research conducted at a series of sites in southern Hokkaido and northern Aomori Prefecture. Upon review, this work illustrates the problems of research on Jomon economic patterns and shows the kinds of seasonal patterns that marked the Jomon era in northeastern Japan. In particular, the Yagi site project, coupled with research at the nearby Hamanasuno and Usujiri B sites, and research on later periods in Tohoku provide a view of Jomon subsistence economy from a relatively limited area with closely related people belonging to the Ento, Daigi, and Fukurashima traditions (Hurley 1974; Crawford 1983; Crawford and Takamiya 1990; D'Andrea 1992, 1995a) (fig. 1).

Not far to the north in central Hokkaido are three Zoku- or Epi-Jomon occupations. Excavations at the K135-4 and K135-5 sites at the Sapporo Railway Station on the Ishikari Plain and at the Mochiyazawa site on the Japan Sea coast (fig. 1) have brought to light large collections of plant and animal remains that contrast in many ways with those from the preceding Jomon periods (Sapporo-shi Kyoiku Iinkai 1987; Crawford and Takamiya 1990; Otaru-shi Kyoiku Iinkai 1990; Crawford 1992b; D'Andrea 1995b).

Environment and Ethnohistory

The climate of northeastern Japan is affected by a number of influences. Regional contrasts result from cold ocean currents moving along the north and east coasts of Hokkaido bringing foggy weather and unstable conditions in the summer (Maekawa 1974:7). The western coast of Hokkaido, in contrast, is warmed by the northward-flowing Tsushima current that also branches through the Tsugaru Strait between Honshu and Hokkaido. Vegetation is affected by snowfall, which is much deeper on the Sea of Japan coast (Shidei 1974:21). Southwestern Hokkaido and Aomori are in a temperate zone with relatively cold winters and mild summers. The average July temperature in Sapporo, for example, is about 22 degrees Celsius while in January it is about -5 degrees. Northeastern Hokkaido is subarctic, in general, while the southwest is cool-temperate. The late spring-early summer monsoon, or *tsuyu*, reaches its northern limit between Hokkaido and Aomori. Most of Hokkaido does not experience the monsoon. The Temperate Mixed Forest, or Cool-Temperate Forest of southwestern Hokkaido is comprised mainly of beech (*Fagus crenata*). In the areas of concern to this paper, beech may be associated with maple, and on valley bottoms *Pterocarya-Aesculus* forests are found. In the Hachinohe area of Aomori, which provides some comparative data for this paper, the forests are dominated by oak (*Quercus*).

Ethnohistoric evidence provides an important perspective, particularly on northern seasonality. Northeastern Japan, consisting of Tohoku and Hokkaido, is the homeland of peoples known variously as the Ainu, Utari, Emishi, and Ezo, to name some of the most common attributions. They provide one example of how people interacted with the local environment. The Ainu are usually thought to be descendants, both culturally and biologically, of the northeastern Jomon (Watanabe 1986). As a result, their resource utilization and community location preferences are usually informed by the assumption that they were strictly hunters and gatherers, albeit hunters and gatherers who maintained year-round resident populations at their settlements (Watanabe 1972). This interpretation, however, is

fraught with problems as one of us has explored in detail elsewhere (Crawford and Takamiya 1990; Crawford 1992a). A long history of agriculture has been documented for Ainu ancestors and the interpretation of the Ainu as nonagriculturalists is partly based on what Ainu identity is perceived to be in the context of Japanese society (Peng and Geiser 1977; Crawford 1992b; Howell 1994). More to the point, the Ainu are best conceptualized as descendants of the Tohoku Yayoi who were mixed forager-farmers (Crawford and Takamiya 1990). Nonetheless, revisiting Watanabe's (1972) analysis of seasonality and scheduling of the Tokachi Ainu is instructive, in part because he includes agriculture in his discussion, despite the assumption that the Ainu were exclusively hunter-gatherers. No matter the degree of dependence on agriculture by the Ainu, their economy was mixed and never excluded hunting, fishing, and collecting.

During the winter period, where base snow was extensive such as in the Tokachi area, the Ainu depended largely on stored salmon, venison, and plant food. As the base snow disappeared, fishing, hunting, and collecting began. Collecting was intensive from this time through autumn. Fishing did not intensify until the summer arrival of cherry salmon. Spring hunting focused on bear and deer. Deer were hunted as they migrated into lowland fields. Bear, on the other hand, were hunted in their dens. In the summer months, hunting tapered off because meat was less greasy and furs were sparse. By July, cherry salmon was in abundance and was mostly eaten fresh. By September, dog salmon had replaced cherry salmon as the fish of choice. The main focus of summer collecting was the roots of the *uba-yuri* lily, *Lilium cordatum* var. *glehnii* (or *Cardiocrinum glehnii*). The more a local population depended upon farming, the less they collected this lily root. In October when animal fur was thickening and base snow covered vegetation, field hunting intensified. Nuts, berries, and other fruit were collected at the same time. Most of these resources were prepared for storage over the winter. Fall was also the time for collecting raw materials for clothing and other technological purposes. Dog salmon fishing continued through December or January. Hunting continued in the foothills in winter yarding areas until the snow prevented it. As the bear retreated in the late fall to their dens for the winter, they, too, were hunted.

Although this example is limited to one small area of northeastern Hokkaido, it is instructive. The Ainu were logistically flexible. Although they built permanent villages or hamlets, unmarried men would take up residence at sources of rivers for bear hunting or along river tributaries for fishing. Farming was scheduled by taking effort away from wild plant resource collecting. Because collecting versus hunting and fishing were marked by a sexual division of labor, the balance of attention to farming and collecting was decided by women. Snowfall appears to have been the main factor in scheduling the beginning and ending of the hunting season. Other factors included the quality of meat and fur. This is likely but one variant of a diverse set of Ainu scheduling strategies. Because of the relevance of snowfall to scheduling their activities, Ainu living in parts of northeastern Japan with less snow or earlier or later snowfalls than in Tokachi would likely have made somewhat different scheduling decisions than the ones described here. Unfortunately, the kind of examination that Watanabe made of the Tokachi Ainu has not been made elsewhere. We do not mean to imply that northeastern Jomon scheduling followed this Ainu pattern, but at least it exemplifies one pattern in our area.

The Northeastern Japan Jomon

The Yagi Project was an international investigation of a large Early Jomon period (Transition 1) community—the Yagi site—in southwestern Hokkaido. Excavations were conducted during the summers of 1978, 1979, and 1980 (Crawford et al. 1978; Bleed et al. 1979; Crawford 1983). A primary goal of the Project was to describe the subsistence economy of the Yagi community. The Yagi site is located on the Pacific coast of the Oshima Peninsula, which forms the curved tail at the southwestern corner of the island of Hokkaido (fig. 1). This portion of the coast faces the rich coastal waters of Uchiura Bay (fig. 2).

Topographically, this portion of the Oshima coast is rugged and broken. Yagi sits on one of the few areas of level ground in the area. It overlooks the mouth of the Yagi River on a terrace that is about 45 m above sea level. The Yagi site is, thus, surrounded by low mountains, the Pacific Ocean, and small rivers.

Since plant foods in southern Hokkaido have a limited seasonal availability, plant remains may yield information about the seasonal activities of the community, but they clearly cannot reflect the entire annual round. For example, most seeds and fruits that account for the majority of relevant remains at these sites mature in the fall and would have been harvested at that time. Buds and green, leafy foods can be collected as early as late winter to early spring, but rarely, if ever, do we recover their remains. Since we expected that faunal materials would be entirely absent from the

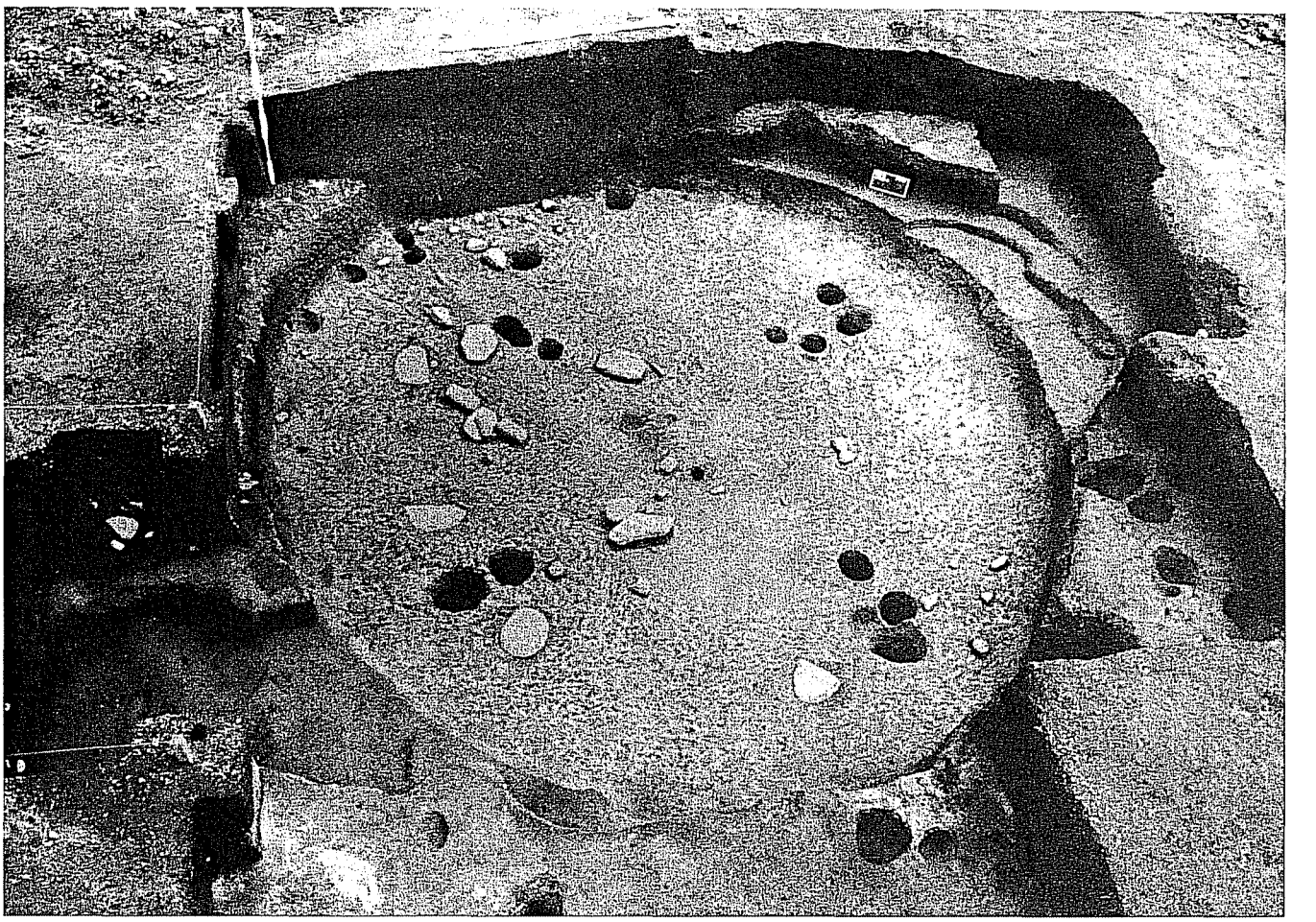

Figure 2. A Yagi site pit house.

site, seasonal patterns of wild resource utilization by the people of Yagi were approached theoretically. Fortunately, some animal remains were recovered and they help test the theoretical interpretation.

Animal resources and the environments of the immediate Yagi catchment offer a range of wild fish, seals, migratory birds, and land mammals, including deer (Bleed et al. 1989). As important as the array of animal resources available to the hunters of Yagi was the fact that game was presented to the community in a series of seasonal peaks that rarely conflicted. Each season of the year offered a readily available and relatively abundant animal source.

Furthermore, an empirically determined two-hour catchment around the site encompassed essentially all the major habitats present anywhere in southern Hokkaido. In other words, any plants or animals found in the region were likely to have been available to the Yagi community. Even a good source of flakeable stone was located near the site. Thus, as long as resources were not depleted, the people of Yagi could engage in a complete round of markedly seasonal activities without leaving the immediate vicinity of their home community. A graphical model describes how the theoretically optimal seasonal hunting patterns of the community were developed (Bleed et al. 1989) (summarized in fig. 3). All habitats in the Yagi vicinity have excellent animal resources. Deer would have been available all year, but more available during the fall rutting season and hunted more during the winter when other prey were absent. Hares and rabbits would have been available all year; bear during the winter while hibernating; foxes and other fur bearing animals in the winter due to their winter pelage; migratory fish

and birds in the spring and fall; invertebrates during the summer; ocean fish in the summer; anadromous salmon and trout during the spring and fall; ducks, geese, and other waterfowl in the spring and late fall; and seals during late fall and winter. The extent to which snowfall restricted winter hunting as it did in the Tokachi Ainu example is difficult to determine, but some limitation should be anticipated. Like all entirely theoretical models, however, the Yagi seasonal reconstruction begs for empirical substantiation. Two independent lines of support have been developed.

First, during the second and third field seasons at the site, an assemblage of 36,000 small, calcinced animal bone fragments was recovered. Since this included only entirely burned pieces and fewer than 850 individual elements, it must be considered incomplete (table 2). Despite the condition of the assemblage, some of it was identifiable due to the presence of articular surfaces or other diagnostic features on some elements (Bleed et al. 1989). Specific seasonal markers are not preserved, but the faunal assemblage is entirely consistent with the predictions of the model. Essentially all of the kinds of game predicted as targets by the theoretical model were taken. Furthermore, the representation of body parts indicates that whole carcasses of deer and sea mammals were brought back to the site for butchering, suggesting that major processing was done at the Yagi site, another prediction of the model. Faunal evidence, thus, does not contradict the model.

The composition of the Yagi stone tool assemblage offers the second line of support for the model of Yagi scheduling. As explained elsewhere (Bleed 1992), the chipped-stone tool assemblage recovered from Yagi is markedly diverse in statistical terms. That is, it includes large numbers of many different kinds of stone tools. Interpreted in light of ideas developed by

TABLE 2

Animal remains from the Yagi site

Common Name	Scientific Name	Number of Elements
Sika deer	*Cervus nippon*	847
Seal/sea lion/walrus	pinniped	93
northern fur seal	*Callorhinus ursinus*	several
Whale/dolphin/porpose	Delphinidae	
dolphin or porpose		3
Fur-bearing carnivores		14
red fox/raccoon dog	*Vulpes vulpes/Nycetereutes procyonoides*	5
wolf	*Canis lupus*	1
Bird		8
hazel grouse	*Tetastes bonasia*	1
cormorant c.f.	Phalacrocoracidae—c.f.	3
pelagic or Temmink's	*Phalacrocorax pelagicus* or *P. capillatus*	
albatross	Diomedeidae	1
auk c.f. common murre	*Uria aalge*	1
small duck/grebe		1
Fish		54
bony fish	Osteichthyes	31
salmon	*Oncorhynchus* sp.	5
tuna	*Thunnus* sp.	2
greenling?	*Hexagrammidae*	1
flounder	Pleuronectidae	1
Invertebrate		
sea urchin	Echinoidea	1

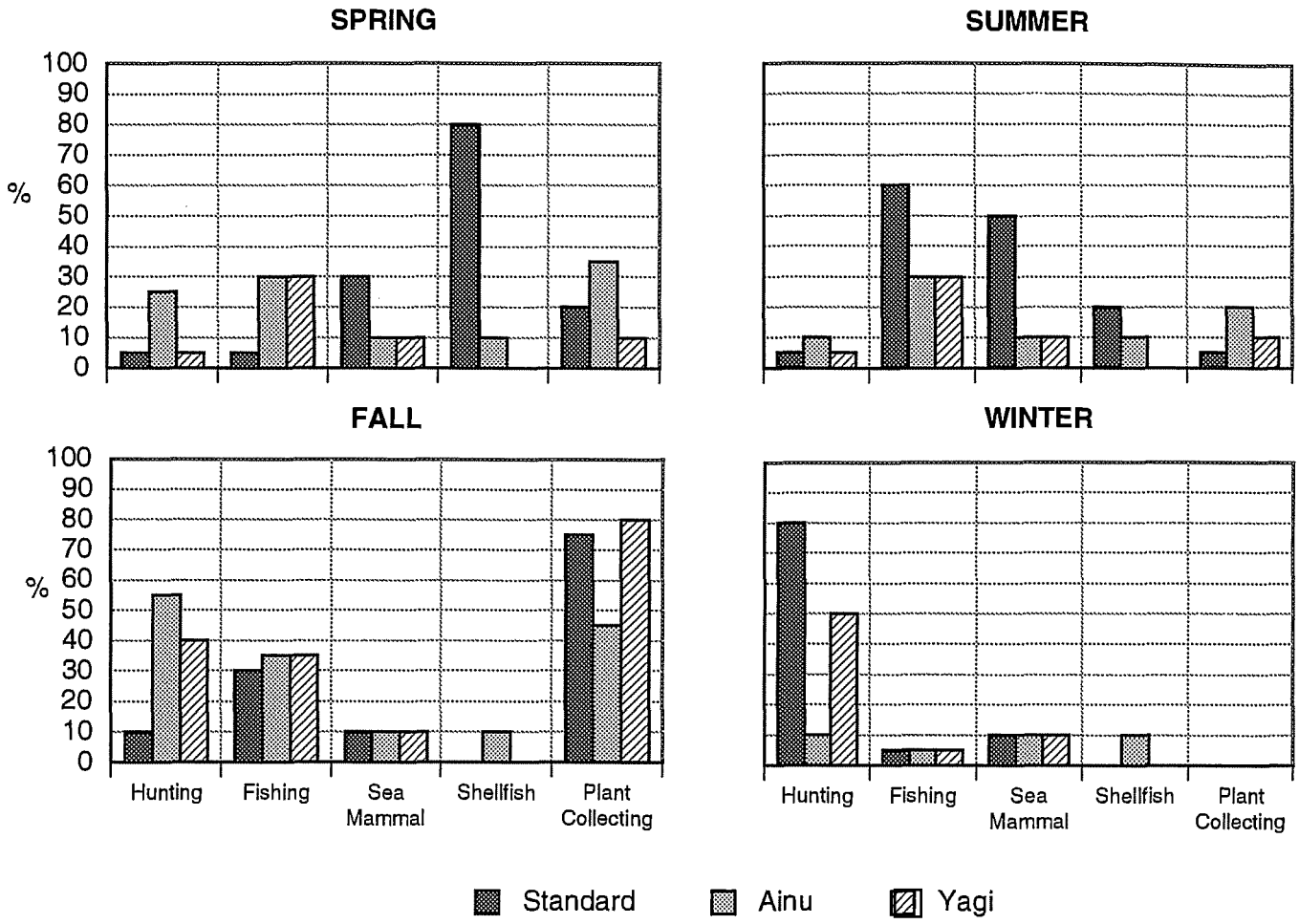

Figure 3. A comparison of the standard Jomon Calendar (Kobayashi 1986) with the Early Jomon Yagi site and Ainu scheduling interpretations.

Binford (1980) and refined by others (Kelly 1983; Shott 1986, 1989), the stone tool assemblage appears to reflect the activities of a group that undertook a wide range of activities within the Yagi community. This is the technological adaptation predicted by the theoretical model of Yagi seasonality (Bleed 1992).

Integral to the Yagi Project subsistence research program is a third line of evidence, paleoethnobotanical data. Flotation samples were collected from as many context types as possible including a variety of in-house contexts such as fill layers, floors, and pits; pits outside houses; and sheet middens. About 7,700 liters of soil from Yagi were processed using a froth flotation machine. The Yagi subsistence research program was part of a more extensive program started in 1974 at the Hamanasuno site, a few kilometers from Yagi. Between 1974 and 1982 additional sites sampled include Usujiri B, Nakano B, and Locality 4 of the Hakodate Airport site. All in all, nine temporal components of the Initial through Middle Jomon of southwest Hokkaido, spanning between 4,000 and 5,000 years, have been extensively examined.

Throughout this period, plant remains assemblages are made up of mainly weedy grains and greens producers such as grasses (Poaceae) and knotweeds (Polygonaceae). Fleshy fruits and other seed remains such as sumac (*Rhus*) are next in rank order of density and relative (percent) abundance. Few nut remains are in the samples, with the exception of those from Initial and early Early Jomon contexts from Nakano B and

Yagi. A trend to less reliance on nuts and greater reliance on weedy annuals and perennials is apparent through the end of the sequence we have examined (end of the Middle Jomon or about 1800 B.C.). Furthermore, this quantitative, rather than qualitative, change is largely due to anthropogenesis (Crawford 1983, 1997). An aspect of this anthropogenic process is the probable domestication and husbandry of barnyard grass (*Echinochloa crusgalli*) (Crawford 1983). By the end of the Middle Jomon at Usujiri B, some caryopses of this grass are morphologically indistinguishable from barnyard millet (*E. utilis*) (Crawford 1983, 1992a, 1997).

The bulk of the plant remains at Yagi and the closely related Hamanasuno site represent seeds and fruits available in the fall, just as we anticipated (table 3). Some fruits, however, are available as early as summer. The only evidence for spring or more substantial summer collecting is secondary. Greens of many of the identified plants are readily available in the spring but are not preserved in the archaeological record (table 3). Most of the identified plant foods are storable over the winter. The scheduling evidence from the plant remains, or lack thereof, is similar at each of the Early through Late Jomon sites we have studied. The Ainu plant collecting schedule is not inconsistent with the results of this research. Spring collecting is only indirectly represented, but the interest in harvesting berries, nuts, and other plant foods is substantiated. Missing from the archaeological record, so far at least, is any evidence for collecting *uba-yuri*.

The details of the plant remains from all the Jomon sites we have studied so far are quite similar. This includes the material from the Middle Jomon Usujiri B and Tominosawa sites and the Late Jomon component at Kazahari (Crawford 1983; D'Andrea 1992). One possible significant developmental change from the Early Jomon through Late Jomon is the appearance of cultigens in the record. The data are sketchy and involve buckwheat, millets, and rice. The first southern crop, rice associated with foxtail (*Setaria italica* ssp. *italica*) and broomcorn millet (*Panicum miliaceum*), is in northeastern Japan at the Kazahari site, Aomori at about 1000 cal. B.C. (D'Andrea et al. 1995). One of us has made a case for the domestication of barnyard grass (*Echinochloa crusgalli*) at the Usujiri B site on the Kameda Peninsula just 150 km north of the Kazahari site. Buckwheat, too, may have been grown in Jomon period Hokkaido, but the evidence is still minimal (Crawford et al. 1978; Crawford 1983, 1997). We are unclear, at the moment, whether the commitment to crops increased over this period or whether crops were grown to a very limited extent throughout the period in question.

Another important issue is the extent to which elaboration of the sociocultural system through time involved elites and changes in redistribution patterns that could have impacted scheduling decisions. At least, both the animal remains and archaeobotanical record are indicative of a complex scheduling system. Its details are not resolvable presently, but the faunal and floral data are consistent with year-round habitation and a community of immobile collectors who were engaged in many different kinds of work that are unusual for foragers (Bleed et al. 1989).

The standard model proposed by Kobayashi differs in a number of details from our reconstruction of Early and Middle Jomon scheduling in northeastern Japan. More hunting likely took place during the fall, fishing occurred throughout the year but with much less taking place during the winter, marine invertebrates were likely harvested all year with more collected during the summer, and spring plant collecting is less in evidence than the standard calendar proposes, although we suspect that much more plant collecting was going on during the spring than our data indicate (fig. 3).

The Central Hokkaido Zoku-Jomon

The K135-4 and K135-5 excavations were part of mitigation programs linked to the expansion of the Sapporo Railway Station. Excavations took place in 1984 and 1985 (Crawford 1987; Sapporo-shi Kyoiku Iinkai 1987). At the same time, Crawford was researching the Transition 4 Ezo-Haji (early Satsumon) period in Hokkaido with special regard to northern systems of food production (Crawford and Yoshizaki 1987; Crawford and Takamiya 1990; Crawford 1992a, 1992b). The K135-4 and K135-5 sites are Transition 2 Zoku-Jomon occupations, immediately predating the seventh- to eighth-century-A.D. Ezo-Haji expansion in Hokkaido, and therefore are examples of the last Jomon settlements in Japan.

Situated in the Ishikari Plain, the largest lowland in Hokkaido, the sites are some 250 to 500 meters from the now infilled Sakushu-Kotoni River, a tributary of the Toyohira River located about 4.5 km to the northeast. There is little topographic relief in the area, but three to four kilometers to the southwest, highlands rise abruptly to about 200 m. K135 is 16–17 meters above sea level. The Yagi and K135 occupations are both in a temperate forest zone, but their situations

TABLE 3

Identified plant taxa and their season of availability at Jomon sites in Hokkaido and Aomori, Japan

			Early Jomon		Middle Jomon		Late Jomon	Zoku-Jomon		
Common Name	Scientific Name	Season Available	Yagi	Hamanasuno	Usujiri B	Tominosawa	Kazahari	K-4	135-5	Mochiyazawa
Grains/Greens										
Grasses	gramineae									
barnyard grass	*Echinochloa crusgalli*	Sept.–Nov.	XX	XX	XX	X	XX			X
barnyard grass (rice mimic)	*E. crusgalli* var. *oryzicola*	Sept.–Nov.								XX
foxtail grass	*Setaria* c.f. *S. viridis*	fall	X		X	X				
rye/wheat grass	*Elymus/Agropyron*	Aug.–Oct.	XX							
panic grass?	*Panicum* c.f. *P. bisculatum*	fall	X	X						
panicoid grass	Paniceae	various-mainly fall		XX		X	XX			
unknown type	? XX									
wall barley	*Hordeum murinum*	late summer–fall						X	-	
knotweeds	*Polygonum* sp.	greens from early summer	X	X	XX	X	X	X	X	X
dock-leaved	*P. lapathifolium*	fall	X	XX	XX	X				
great	*P. sachalinense*	fall	X	XX	XX			X	X	
Japanese	*P. cuspidatum*?	fall	XX	X				X	XX	
	P. foliosum/persicaria?	fall	X	XX	XX					
	P. longisetum?	fall		X						
	P. densiflorum	fall				X				X
chenopod	*Chenopodium* c.f. *C. ficifolium/C. album*	late summer–fall	X	X	XX		X			XX
dock	*Rumex* sp.	late summer–fall	XX		XX					XX
amaranth	*Amaranthus retroflexus*	late summer–fall								
Fleshy Fruits										
Amur corktree	*Phellodendron amurense*	late summer–fall	XX	X	X			X	X	X
bramble	*Rubus* sp.	late summer	X	X	X		X			X
crowberry	*Empetrum nigrum*	summer–fall						X	-	X
dogwood	*Cornus* sp.	summer	X					X	XX	
elderberry	*Sambucus sieboldiana*	fall	X	X	X	X	X	X	XX	X

X: present
XX: clusters present

Table 3 continued on next page

TABLE 3 CONTINUED

Identified plant taxa and their season of availability at Jomon sites in Hokkaido and Aomori, Japan

			Early Jomon		Middle Jomon		Late Jomon	Zoku-Jomon		
Common Name	Scientific Name	Season Available	Yagi	Hamanasuno	Usujiri B	Tominosawa	Kazahari	K-4	135-5	Mochiyazawa
grape	*Vitis* sp. c.f. *V. coignaetiae*	summer–early fall	X	X	X		X	XX	XX	X
mountain ash	*Sorbus* sp.	summer–early fall								X
nightshade	Solanaceae									
black nightshade	*Solanum nigrum*	fall						-	X	
	Physiliastrum japonicum	fall							X	
silvervine	*Actinidia* c.f. *A. arguta*	late summer–fall	XX	X	X		X	X	X	X
udo	*Aralia cordata*	greens (shoots)-May, fruit-fall	XX	X	XX			-	X	
tara-no-ki	*A. elata*	greens (buds)-May, fruit-fall								X
Other										
asada	*Ostrya japonica*	late summer–fall		X	XX					
bean family	Fabaceae	various, mainly fall		X			X			XX
bulrush	*Scirpus* sp.	fall		X						
cleavers	*Galium* sp.	late summer–fall	X	X	X					
leek, wild onion	*Allium monanthum*	spring						X	-	
prickley ash	*Zanthoxylum* sp.	summer	X							
sedge	*Carex* sp.	various								
sedge 2 *F*	*imbristylus subspicata*	fall	X	X						
sumac	*Rhus* sp.	fall	X	XX	X	X		XX	-	X
Nuts										
acorn	*Quercus* sp.	early fall (periodic)					XX	X	X	XX
chestnut	*Castanea* sp.	Oct. (periodic)						XX		
walnut	*Juglans ailanthifolia*	Oct.–Nov. (periodic)	XX	X			XX	X	X	XX
Cultigens										

X: present
XX: clusters present

contrast in several ways. First of all, they are on opposites sides of the Kuromatsunai Line (fig. 1). This line marks the northern limit of beech, *sawagurumi*, grape (*Vitis flexulosa*), and *asunaru* (*Thujopsis dolobrata*). Northeast of this line grows mainly oak (*Quercus crispula*, *Q. dentata*), elm (*Ulmus davidiana*, *U. laciniata*), basswood (*Tilia maximowicziana*), maple (*Acer mono*), and *Kalopanax septemlobus*. The contrast is largely due the difference in winter low temperatures (Shidei 1974:97).

The fundamental difference between the Zoku-Jomon record and that of the preceding periods is the dominance of nuts in particular contexts. At the K135 localities, individual species of nuts are concentrated in five to ten meter square areas indicating specific processing events (Crawford 1987; Crawford and Takamiya 1990). This is the case at Mochiyazawa as well where specific pits and areas have very high densities of walnut remains, while other pits and areas do not (D'Andrea 1995b) (fig. 4). Concentrations of nuts, particularly single species, are likely a good indication of a short-term event such as nut processing, perhaps the eating of a portion of a harvest in the fall before storing the remainder over the winter. The Ainu collected walnut, chestnut, and acorns in a narrow time frame (shorter than a week), quickly processing and storing them. The nut distributions at K135 and Mochiyazawa are particularly striking when they are compared with those from Jomon sites in northeastern Japan, where flotation has recovered some nutshell (D'Andrea 1995b). In general at Transition 1 sites, nut remains are not common. The only sites from which any quantities at all have been recovered are from the Early Jomon Yagi site where nut remains come from only one concentration and from the Late Jomon occupation and Transition 2 Tohoku Yayoi component of the Kazahari site where small amounts of walnut have been retrieved from a variety of contexts.

We might also expect to see evidence of short-term events related to the gathering of other plants that could have been harvested during the late fall in the vicinity of K135. Concentrations of one species of

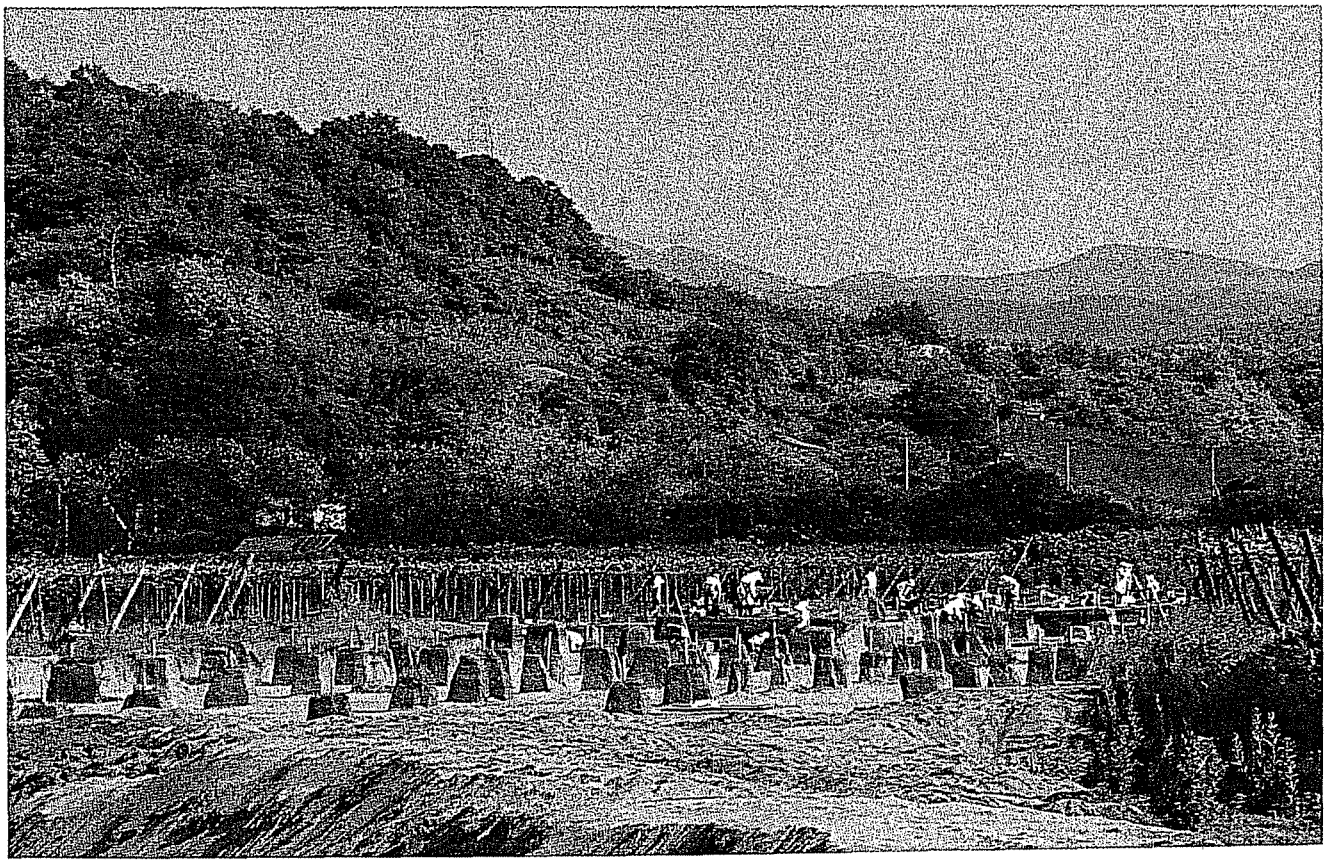

Figure 4. The Mochiyazawa site setting.

knotweed, *Polygonum cuspidatum*, occur in K135-5 units A and B only. Elsewhere at K135, this knotweed is only sporadically represented by a few achenes each in the samples in which it occurs. The only other plant remains found in substantial concentrations in particular contexts are a few fleshy fruits: grape (*Vitis*), elderberry (*Sambucus*), silvervine (*Actinidia*), and dogwood (*Cornus*). Including the knotweed, these are all available around the time nuts would be harvested and support our contention of a series of short-term, special purpose occupations at K135.

The animal remains are concentrated by species in certain deposits as well at K135. The K135 localities are stratified. Flood deposits separate occupations of nearly the same time period. The earlier levels have primarily salmon bones while later ones have deer. Furthermore, the Zoku-Jomon occupations do not show the same investment in dwelling construction (no pit houses). Instead, the sites consist of burned soil lenses (hearths?), small pits, and other pits usually interpreted as burials (fig. 5). The K135 localities appear to have been used at certain times for specific purposes. They are not year-round habitations. Thus scheduling by Zoku-Jomon peoples is of a different sort than that of the preceding Jomon.

During this period evidence for the products of farming is found—barley, rice, and related weeds such as the rice field weed, *Echinochloa oryzicola*, a type of barnyard grass that mimics rice in many phenotypic traits. It is at this time that the first potential spring product is recognized in the archaeobotanical record in our area: *Allium monanthum*, or wild onion/leek bulbs

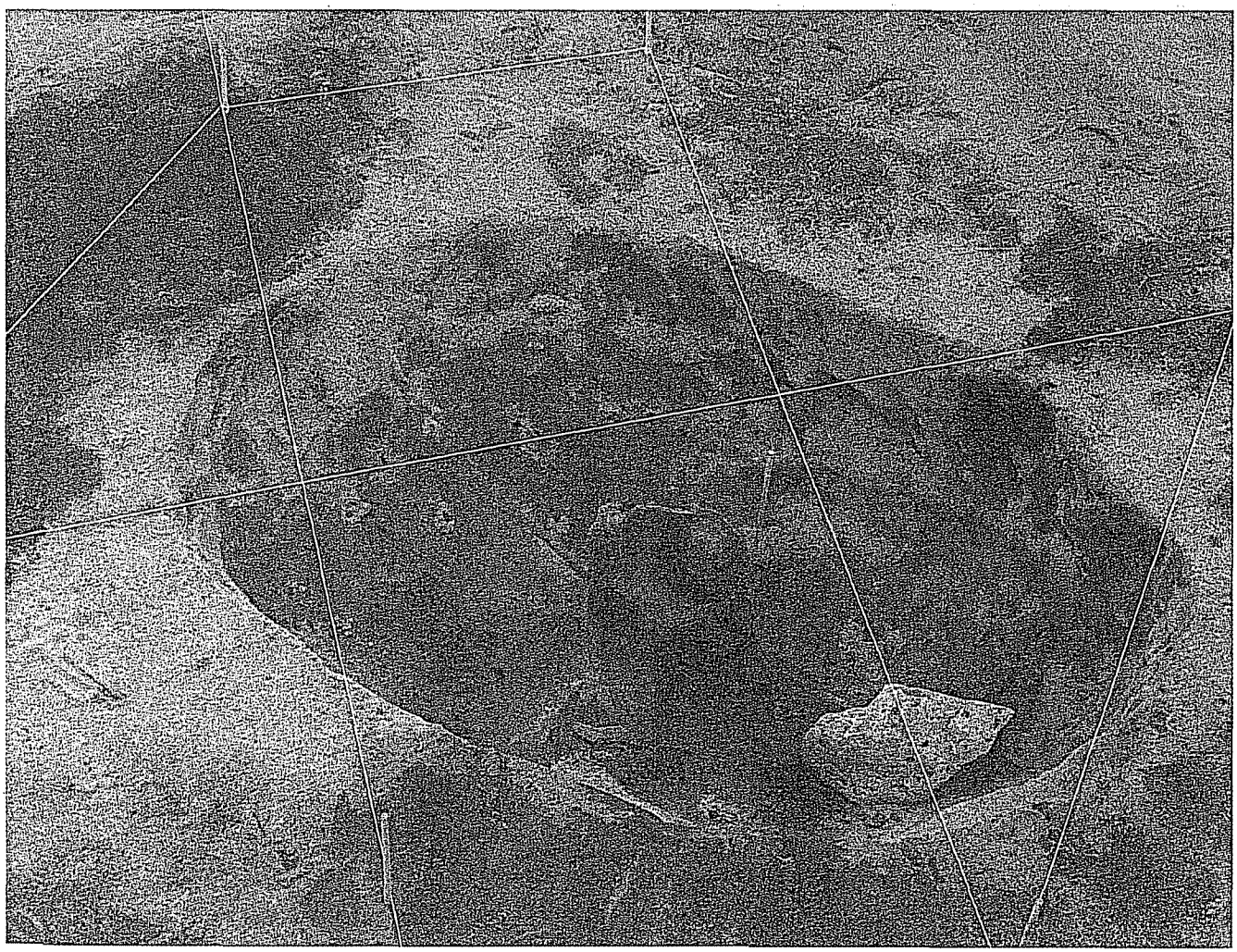

Figure 5. A probable Zoku-Jomon burial pit at the Mochiyazawa site.

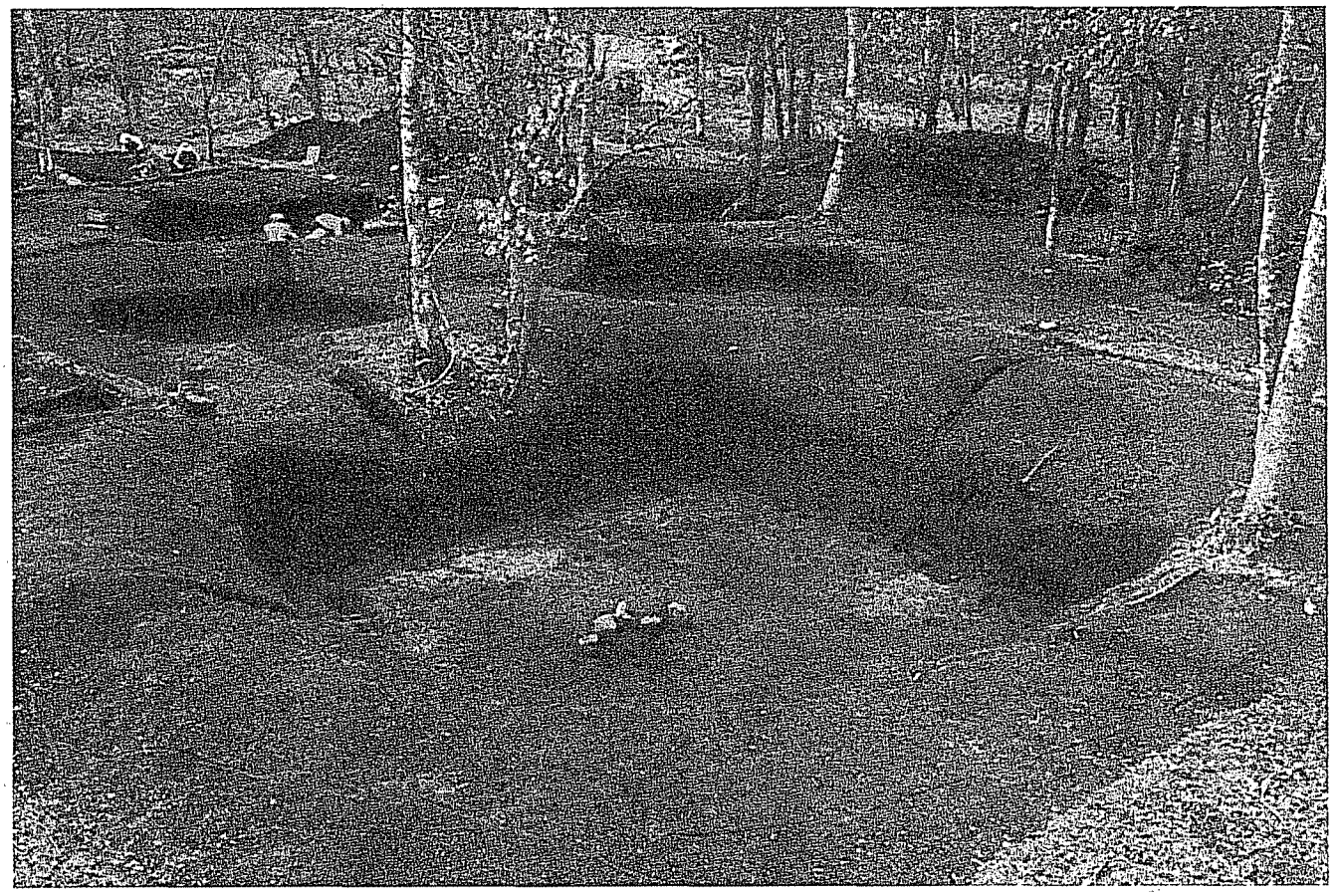

Figure 6. Ezo-Haji rectangular pit houses.

Discussion

The three patterns outlined in this chapter, the Early through Late Jomon (Transition 1), Zoku-Jomon (Transition 2), and Ezo-Haji (Transition 4), indicate that a variety of strategies met with success in northeastern Japan. The Ainu in the Tokachi region represent a fourth pattern, which is distinctive in that the emphasis on agriculture seems to have been less than that of the Ezo-Haji a millennium earlier in the Ishikari Plain and Oshima Peninsula.

In Transition 1, hunting, collecting, fishing, and a variety of other tasks evidence a complex of activities to be scheduled by resident, year-round populations. An optimal model for the Early Jomon Yagi site indicates a significant degree of correspondence to the archaeological record. Kobayashi's orthodox view, although a good starting point, does not adequately represent what we have found to be the case in northeastern Japan during the earlier Jomon periods. Ours is not the only view that offers evidence contradictory to Kobayashi's model. Shell remains from the Kidosaku site in southwestern Japan show that shells were collected year-round, but early spring and summer dominate (Koike 1986:44). About 60 percent of the shellfish were collected in these seasons because tidal flats are exposed longer then. The drop in late spring is thought to occur during the rainy season (Koike 1986:82).

The Zoku-Jomon is not the continuing Jomon that the name suggests (*zoku* means "continuing" in Japanese). The name actually refers to the continued use of cord-marking on pottery along with stone technology and to the fact that this culture is not the rice-based Yayoi. The period represents a major break in subsistence and mobility patterns from what we see earlier in the archaeological record of Hokkaido and Aomori Prefecture. The ecofactual material from the two K135

localities in Sapporo and from Mochiyazawa are consistent with the intensive collection of a few plant resources, mainly nuts, over short periods of time. Subsequently, the Zoku-Jomon territory became the territory of the ancestral Ainu Ezo-Haji peoples who had made a significant commitment to agriculture. While the archaeobotanical record at these sites is dominated for the most part by cultigens, the evidence for wild resource use is strong. These resources are much the same as those that were used throughout the Holocene in northeastern Japan.

Finally, hypothetical scheduling conflicts have been invoked to explain why agriculture was not readily adopted by populations in northeastern Japan (Akazawa 1982; Aikens and Akazawa 1992). The suggestion is based on a commendable research program that is a rare attempt to broadly interpret important events in Japan's prehistory from an environmental perspective. Our data have not played a role in this model, however. The model compares data from the Tokyo Bay area and regions to the southwest and northeast. The Tokyo area sites are thought to have been occupied by marine/animal oriented peoples. To the southwest, people are thought to have been much more plant oriented. Wet sites such as Torihama have extensive plant remains supporting this view. Fishing was central to people on the northeast coast based on analysis of the Miura Caves artifacts and related collections. A rapid change to agriculture in the southwest occurred, according to Aikens and Akazawa (1992:79) because of local Jomon experience with plants and therefore, because it entailed minimal scheduling conflicts. Conflicts between the rice planting and weeding seasons and the fishing and shellfishing season in the northeast, however, supposedly mitigated against the quick adoption of crops in the northeast (Aikens and Akazawa 1992:79).

Our data, however, evidence a complex and flexible scheduling capability in the northeast. None of the sites we are working on show the predominance of fishing and shellfish collecting that Tokyo Bays sites do. Plants were, indeed, a significant part of northeastern lifeways, at least in our research area. The evidence indicates gardening has likely existed in the northeast from the middle Holocene and that rice appeared as far north as Aomori Prefecture by 900 cal. B.C. In fact, we cast serious doubt on the slowness with which agriculture was incorporated into northeastern lifeways (Crawford 1992b; Barnes 1993). All indications are for an adoption of agriculture not much slower than in southwestern Japan. If anything, scheduling capabilities of northeastern peoples did not stand in the way of the intensification of agriculture. In fact, the variety of data we have outlined for northeastern Japan provides insights as to why the northeastern populations committed to food production so rapidly. Nevertheless, these issues are important and we encourage more extensive research.

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Note

1. Transition 2 refers to the consolidation of agriculture throughout Honshu and also includes the southwestern Japan classic Yayoi. Transition 3 is the development of Ezo-Haji agriculture in Tohoku. Neither the classic Yayoi nor Transition 3 are discussed here.

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