ENVIRONMENT AND THE DISTRIBUTION OF SITES IN THE JAPANESE PALAEOLITHIC: ENVIRONMENTAL ZONES AND CULTURAL AREAS

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INTRODUCTION

There is a virtual mountain of literature on Japanese Palaeolithic archaeology and Pleistocene geography. There are about 3,000 known Palaeolithic sites in the country, a large proportion of them excavated, and there are hundreds of pollen sites. Only the fossil fauna sites are not overly abundant. In addition, Japan's Pleistocene environment was extremely varied regionally and temporally. Thus, Japan should be an ideal place to conduct detailed analyses of culture-environment relationships in the Palaeolithic.

Any study of Palaeolithic culture-environment relationships requires a good knowledge of the Pleistocene flora, fauna, climate, topography and geology on the one hand, and of cultural assemblages, artifact types and distributions, and regional cultural sequences and dating on the other. I recently examined a lot of the Japanese literature on each of these topics and found major problems with all categories of the necessary information. These problems were especially extreme and frustrating with the archaeological materials. And I did not find even one serious, scientific study, on a national scale, of correlations between Palaeolithic cultural variation and environmental differences. The one or two reasonably good studies I did find dealt with the correlation between cultural and environmental changes through time (but not space) in quite narrowly defined regions: Hokuriku (Okamura 1985) and eastern Kyushu (Tachibana and Hagiwara 1983). In the end, however, I was able to see a few possible correlations between Palaeolithic cultural areas and Pleistocene environmental zones, and between cultural change and environmental change.

SIGNIFICANT PROBLEMS IN THE DATABASE

On the whole, the floral reconstructions for the Late Pleistocene in Japan are relatively good and reasonably easy to use (Tsukada 1986; Yasuda 1978, 1990). The major problem I have encountered with the faunal data is simply the relative scarcity of good assemblages from the final glacial period (Kawamura 1985:350-1). But the archaeological

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data for the Japanese Palaeolithic suffer from just about every imaginable problem and are a real nightmare to try to figure out.

Two of the most damaging problems in the archaeological data are the chaotic use of tool types and the lack of accurate control of time. For example, some studies show as many as 27 types of Palaeolithic knife-shaped stone tools (Anbiru 1988:40-1), yet most studies of the distribution of knife-shaped stone tools use only five types: Sugikubo, Higashiyama, Moro, Kou and "Kyushu" types. Not a few studies reduce this to the uselessly broad categories of wide-flake and long-flake knife-shaped stone tools. Further, there are inexcusably few dated Palaeolithic sites in Japan, given the amounts of easily and inexpensively dateable obsidian that have been reported. Chronological information appeared to have been simply ignored in the distributional studies I found, thereby invalidating them.

Limits of the Present Study

Because of the many problems with the available information, I limited the present study to the Late Palaeolithic and the four main Japanese islands. Excavated and fully published Early Palaeolithic sites are still uncommon, and most of the materials are highly debatable (Oda and Keally 1986). A few recently reported finds in Kanto, said to be 35,000 to 50,000 years old (Tokyo-to 1987; Tateno 1989; Fujiwara and Fujimura 1990; Toda 1990), look reasonably good, but they are not yet fully published and consequently their validity could not be properly judged for inclusion here. The lower boundary of this study thus was 30,000 to 35,000 BP. I set the end of the Pleistocene, roughly 10,000 BP, as the upper time boundary.

I also set aside the Pleistocene archaeological finds in the Ryukyu Islands (Okinawa Prefecture) as too different and too problematic to deal with now. There are several sites in the Ryukyus that report Pleistocene fossil hominids, some possible bone/antler tools (Oshiro 1987) and a few questionable stone tools (Takamiya *et al.* 1975). Still, the Okinawan materials appear to be more closely related to the southern Chinese mainland than to Japan proper.

I excluded the small Izu Islands south of Tokyo because they lack Palaeolithic settlements (Otani *et al.* 1984), even though Kozu Island obsidian was being exploited by people crossing the water as early as 30000 BP (Kamaki *et al.* 1984:342).

One further limit was necessary for this study. I looked only for correlations between cultural areas and environmental zones. But I did not try to explain these correlations, nor did I try to reconstruct subsistence techniques or to speculate about origins. These are all separate questions well beyond the scope of my purpose here.

JAPAN'S MODERN GEOGRAPHY

The four main Japanese islands are Hokkaido in the north, then Honshu and Shikoku, with Kyushu in the southwest. Honshu is by far the largest - a long arc stretching from Hokkaido to Kyushu. Honshu is divided in the middle by the Japan Alps, a band of high sharp-peaked mountain ranges running north-south across the island from the Pacific to the Sea of Japan. Five major regions are named in Honshu. These are Tohoku in the north (or northeast); Kanto, the large plain and surrounding mountains that center on Tokyo in the east; Chubu, the central mountain district; Kansai, the area west of Chubu and centered on the historic cities of Nara and Kyoto; and Chugoku, the western part of Honshu. The names Hokuriku and Tokai are applied to the Sea of Japan and Pacific coastal areas respectively in the large Chubu region. The area around the Inland Sea between western Honshu and Shikoku is called Setouchi.

These four main islands today have a combined area of about 360,000 km^2 (Geographical Survey Institute 1977:1). The archipelago arches across 15° of latitude and three major vegetation zones (Tsukada 1986:Figure 7). Roughly 75% of the land is mountainous (Trewartha 1963:Table 4; Geographical Survey Institute 1977:5). Except for the central Alps, which cut laterally across Honshu, the mountain ranges on all of the islands tend to run parallel to the long axis of the archipelago, dividing the country into a Pacific side and a Sea of Japan side. The annual mean precipitation, cloud cover, hours of sunshine, humidity and snow fall are locally variable and are markedly different on the two sides of the archipelago, especially in the northern and central regions of Honshu (Geographical Survey Institute 1977:54-66; Trewartha 1963:52-60).

Although the mountains are steep, there are numerous intermontane basins. But the coastal plains account for most of the flatter land in Japan. The Kanto Plain at 13,000 km^2 is by far the largest of these coastal plains; the six next largest cover only 1,200 to 2,100 km^2 each (Trewartha 1963:18,27-8).

JAPAN'S LATE PLEISTOCENE GEOGRAPHY

Topography, Sea Levels and Landbridges

In the Late Pleistocene the mountainous topography of Japan was much as it is today, plus or minus a few river terraces. The lowered sea levels, however, exposed large coastal plains around most regions of the country, greatly expanding the amount of flat land (Ohshima 1980:34; Nihon Daiyonki Gakkai 1987), and connected Honshu, Shikoku and Kyushu into one landmass (Ota and Yonekura 1987:71). But there is general agreement today that the Tsushima Strait between western Japan and Korea, and the Tsugaru Strait between Honshu and Hokkaido, remained open throughout the Late Pleistocene, and that only Hokkaido in the north was connected directly to the continent by a landbridge (Ohshima 1980:35-6; Kamei and Research Group 1981; Mogi 1981; Kawamura 1985:352; Ota and Yonekura 1987:71; Kawamura *et al.* 1989).

General Floral Sequence

The warmer climate marking the interstadial between the early and late glacial periods of the Late Pleistocene became unstable about 40,000 BP, hesitantly turning cooler and drier (Yasuda 1982:263, 1987:Figure 8, 1990:112-3; Kamei and Research Group 1981). The temperate forest retreated from the lowlands of eastern Honshu, and the boreal coniferous forest of Hokkaido, northern Tohoku and the mountains of central Honshu expanded to the south and into lower elevations.

Full glacial vegetation - tundra in eastern Hokkaido and thick boreal or temperate coniferous forests in most other regions - appeared earliest in Hokkaido and the Chubu highlands, beginning around 25,000 BP in the north (Tsukada 1986:22; Yasuda 1990:120), and arriving in Kanto and western Japan around 23,000 to 21,000 BP (Tsuji 1983:18; Yasuda 1990:120).

Definite warming began about 15,000 BP, and wetter conditions were evident after 13,000 BP (Yasuda 1990:125). As the climate warmed, the coniferous forest slowly retreated in western Japan and deciduous broadleaf trees expanded both northward and higher (Tsukada 1986:33-4). Rapid change in the vegetation everywhere occurred around 10,000 BP (Tsuji 1983:19), but the exact date varied depending on the species and location (Tsukada 1986:35).

Flora at the Late Glacial Maximum

At the peak of the last glaciation around 21,000 to 18,000 BP, the eastern half of Hokkaido was tundra or park tundra (Tsukada 1986: Figure 7). A thick boreal coniferous forest covered most of northern and eastern Japan from western Hokkaido through northern Honshu to the central mountains, and into the highlands of western Japan. A temperate coniferous forest covered Kanto and most of western Japan, and extended northward along the coastal lowlands of Honshu as far as the present cities of Niigata and Sendai about the middle of Tohoku. A mixed broadleaf and conifer forest marked coastal strips in Kanto and western Japan, and a mostly coniferous forest existed in the Setouchi Basin. Both these forests were dominated by *Pinus*. Some studies, however, indicate that the Setouchi Basin was mostly treeless (Kamei and Research Group 1981:195). Warm temperate broadleaf evergreen forest at this time was found only on the emerged peninsula at the southern tip of Kyushu - today this forest covers most of western Japan and the Kanto plain.

Picea, Abies and *Larix* were the outstanding trees in the northern boreal forest. Specifically, these were *Picea glehnii, P. jezoensis* and *Larix gmelini* (Naora 1959:120). *Tsuga* and *Betula* also were common there, as often was *Pinus* (Igarashi and Kumano 1981; Yoshida *et al.* 1981: Figure 19; Yasuda 1987: Figure 6). The *Pinus* in this forest was probably *P. koraiensis*, which produces an edible seed. Lowlands along streams were favorable to small numbers of *Salix* and *Alnus*, the latter probably *A. japonica* and *A. hirsuta* (Ota and Saino 1990; Palynosurvey 1989), and possibly also some *Corylus* and *Juglans* (Naora 1959:120).

Species of *Picea*, *Larix* and *Abies* were also common in the full-glacial temperate coniferous forest of Kanto and western Japan, along with some broadleafs such as deciduous oak (*Lepidobalanus*) and *Corylus* (Tsuji 1983:18-9; Yasuda 1982; Palynosurvey 1989).

Plant food resources for humans were extremely limited in both the boreal and temperate coniferous forests at the glacial maximum. Small populations of *Fagus* were restricted to the lowlands in the extreme southwestern part of Japan (Tsukada 1986:25,29). *Cyclobalanopsis* and *Castanopsis* also were found only in small numbers on narrow strips of the southern coasts of Shikoku and Kyushu (Tsukada 1986:39,51). It is not clear how abundant *Pinus koraiensis* was in the boreal forest of the time, but it and walnuts were probably among the few potential food plants available for humans in eastern Japan.

In addition, both the boreal and temperate coniferous forests were dense (Yasuda 1978:150; Tsukada 1986:39), except in Hokkaido and the northern tip of Tohoku, and in a few widely scattered parts of the rest of the country, most notably northeastern Kanto and from the Setouchi Basin to eastern Kyushu (Kamei and Research Group 1981:193-5). This would greatly affect the distributions of fauna, and especially the numbers of the large grazing herbivores (Butzer 1971:144-5; Tsukada 1986:39).

Late Pleistocene Fauna

The faunal information for the Late Pleistocene in Japan is not as detailed as the floral data. Most reports generalize for the entire last glacial period without much regard for regional differences, and base their generalizations mostly on three or four sites: Hanaizumi in Iwate Prefecture in the northeast (16,000-28,000 BP), Nojiriko in Nagano Prefecture in the central mountains (15,000-35,000 BP) and Kumaishido F4 in Gifu Prefecture just west of Nagano (about 17,000 BP). The Kuzuu Upper fauna from North Kanto seems to be the basis for reconstructing the fauna of the interstadial prior to 35,000 BP.

The Kuzuu Upper fossils show that *Sinomegaceros yabei* (Yabe's elk), *Moschus moschiferus* (musk deer), *Cervus praenipponicus* (ancient Japanese deer), *C. nippon* (Shika deer), *Canis lupus* (wolf), *Ursus tanakai* (Tanaka's bear), *Panthera pardus* (leopard) and *Palaeoloxodon naumanni* (Nauman's elephant) were the outstanding species among the temperate animals that lived at least as far north as Kanto during the interstadial 50,000 to 35,000 BP (Kawamura 1985:350-1; Kamei *et al.* 1988:186).

During the last glacial period, there is no evidence of new animals arriving in Japan from the continent through the south, but a number of large boreal herbivores came into Hokkaido and Tohoku from the north (Kawamura *et al.* 1989). Among these new arrivals was *Mammuthus primigenius* (woolly mammoth), which is reported in three sites in Hokkaido only. But only one of the three sites is securely dated (Kamei *et al.* 1988:183). The 32,000-year age of that fossil, however, puts it well beyond the age of the first humans in Hokkaido, and mammoth possibly are not important to understanding Palaeolithic human adaptations in Japan.

In contrast to the mammoth, *Palaeoloxodon naumanni* fossils are abundant and reasonably well dated to the last glacial in sites all over the country, from Hokkaido to Kyushu (Kamei *et al.* 1988:183-91). Although it is a temperate species it apparently survived the glacial maximum and became extinct only as the climate began to warm (Kawamura 1985:352).

Sinomegaceros yabei and *Cervus nippon* are reported in sites everywhere, exclusive of Hokkaido (Kamei *et al.* 1988:184-91). These also are temperate species that stayed on in eastern Japan through the glacial maximum.

Alces alces (moose), *Ursus arctos* (brown bear), *Bison priscus* (steppe bison), *Bos primigenius* (auroch), *Equus nipponicus* (Japanese horse), and *E. hemionus* (Asian wild ass) characterized the large arctic fauna of the tundra and boreal forest zones in eastern Japan during the last glacial (Kamei *et al.* 1988:184-7). These large hoofed animals and bear probably crossed from Hokkaido to Honshu before 20,000 BP (Kamei and Research Group 1981:191,202; Kawamura 1985:351; Kamei *et al.* 1987:88; Hasegawa 1983:23). The lack of small arctic fauna with them suggests they crossed an ice bridge at Tsugaru during the winter, and this in turn supports the case for no Late Pleistocene landbridge there (Kawamura 1985:352). *Alces alces* and *Ursus arctos* are reported as far south as the western part of the central mountains in Honshu (Nihon Daiyonki Gakkai 1987).

Cervus praenipponicus is possibly a species related to the temperate coniferous forest zone of western Japan. But I found only one report of it - at Kumaishido in central Honshu (Kamei *et al.* 1988:187).

Among the smaller animals probably living in most regions in eastern and northern Honshu were various species of *Sorex* (shrews), *Mogera* (moles), *Lepus* (hares), *Sciurpus* (squirrels), *Rattus* (rats), *Apodemus* (wood rats) and many other species of insectivores, rodents and the like (Kamei *et al.* 1988:198-9). *Martes melanpus* (yellow marten), *Mustela sibirica* (yellow weasel), *M. nivalis* (pygmy weasel), *Meles meles* (Old World badger), *Nyctereutes procyonoides* (raccoon dog), *Vulpes vulpes* (fox), and *Macaca fuscata* (Japanese macaque) are also widely reported.

The large hoofed animals from the north, and *Palaeoloxodon naumanni*, *Ursus arctos* and *Cervus praenipponicus* all became extinct on Honshu between 15,000 and 10,000 BP (Kawamura 1985:352-3). *Sinomegaceros yabei* declined rapidly after 15,000 BP but continued to exist in restricted regions of Japan until about 7000 BP. *Canis lupus* became extinct only recently. Most other smaller late glacial species are still part of the Japanese fauna today.

As the megafauna of eastern Japan disappeared with the warming climate after 15,000 BP, *Sus scrofa* (wild boar), *Capricornis crispus* (Japanese serow), *Selenarctos thibetanus japonicus* (Himalayan black bear) and other common modern species expanded from the small region along the Pacific coast of southwestern Japan where they had been during the glacial maximum (Kawamura 1985:353), and by the end of the Pleistocene they probably already occupied large areas of eastern Japan, much as they do today, especially in the lowlands along the coasts up to Kanto or beyond.

PALAEOLITHIC CULTURAL PHASES AND CULTURAL AREAS

35,000 to 30,000/27,000 BP

No more than a handful of sites have been identified with the oldest phase of the Late Japanese Palaeolithic (Suzuki and Yajima 1978:152; Oda and Keally 1979). Among these are Nishinodai Loc B Stratum X, Nakazanya Stratum X and Musashidai Stratum Xb on the South Kanto Plain near Tokyo, Ishikohara in the Chubu highlands, and possibly Shibiki Stratum 8 and Kitamae Strata 15 and 17 on the coastal plain in east-central Tohoku (Oda and Keally 1986:352).

These sites yield many small undifferentiated flake tools, a few larger amorphous flake tools and some large pebble tools (Oda and Keally 1979). The Musashidai Stratum Xb assemblage also contained several edge-ground axe-like stone tools, the oldest of their kind (Keally and Hayakawa 1987). All of these sites appear to be very similar and thus to be parts of a single culture, or cultural area. But the evidence is still quite insufficient for making any concrete statements.

The climate had become unstable at this time, following the peak of the interstadial, gradually cooling and drying. The Kanto and Tohoku sites were likely situated in a cool temperate forest consisting of both conifers and broadleaf trees. The Chubu highlands probably already had an alpine coniferous forest, but the site(s) there probably were in a cool temperate forest microenvironment (Nojiriko-Kafun Gurupu 1990:72-3).

30,000/27,000 to 23,000 BP

Sites of this age are stratigraphically below the AT marker tephra, now identified in many sites nationwide (Machida and Arai 1983:143-4). The sites are most common on the Musashino Upland in South Kanto, where the lithics are found in Strata IX to VII (Oda and Keally 1979). These sites yield pebble tools, large flake tools and large blade-flakes. Some of the blade-flakes are lightly retouched to form what are called knife-like tools. But the most distinctive artifacts from these sites are the many ovoid axe-like stone tools, many with clear edge-grinding.

The assemblage from Stratum Xa at the Musashidai site in Tokyo (Keally and Hayakawa 1987) had such axe-like tools together with many obsidian artifacts. This obsidian was identified to sources in Chubu and on Kozu Island in the Izu Islands south of Tokyo (Kamaki *et al.* 1984:342). This assemblage is the oldest evidenced use of obsidian in Japan, and the oldest concrete evidence of long-distance exploitation of raw materials, including procurement across water from a source on Kozu Island.

Sites of this age are also certainly identified in other parts of South Kanto (Suzuki and Yajima 1978), and in North Kanto, Chubu and northwestern Kyushu (Oda and Keally 1979), and as far north as the lowlands of Miyagi prefecture in east-central Tohoku (Oda and Keally 1986). Less certain, and probably relatively young within the phase, are sites in Akita Prefecture and in southwestern Iwate Prefecture, both in northern Tohoku (Fujiwara 1986a:37-8). The locations and probable ages of these latter sites suggest a gradual expansion of Palaeolithic peoples northward in Tohoku, as would be expected of a pioneer settlement of the Japanese islands.

At present levels of analysis, the materials from all of these sites look reasonably similar, suggesting all of them belong to the same culture and represent a single cultural area stretching from northern Tohoku in the northeast to Kyushu in the southwest. More thorough analysis in the future might reveal some regional cultural variation.

During this period, temperatures became colder, probably reaching close to the maximum cold of the last glacial. Temperate plants retreated to the lowlands of Kanto and western Japan, while boreal plants expanded from the north. Sites are found in both the temperate and boreal forest zones, but there are as yet no indications of cultural differentiation to meet the adaptive needs of different habitats.

23,000 to 20,000/19,000 BP

Sites roughly contemporaneous with the AT marker tephra, or slightly younger, yield flakes and flake tools, blade-flakes and true blades, and some pebble tools (Suzuki and Yajima 1978; Oda and Keally 1979). The first clear knife-shaped backed-blade stone tools belong to this phase. These knife-shaped tools are usually erroneously identified as "Moro" type. They are similar to the Moro type, but they do show some differences. In stratified sites, especially in South Kanto, they are clearly older but not obviously predecessors of the much younger true Moro-type knife-shaped tools (Oda and Keally 1979; Kanagawa Koko Dojinkai 1983; Magara 1990).

Mis-identification of sites belonging to this period has probably distorted our picture of their distribution. At the moment, known sites concentrate in South Kanto and Kyushu (Oda and Keally 1979) and a small concentration of sites on the Toyama Plain in Hokuriku on the Sea of Japan coast (Okamura 1985:21), with a sparse scatter of sites throughout the Japanese islands as far as the southern part of Hokkaido (Chiba 1985a:24, 1985b:28-9). Over this vast range, however, there are no outstanding differences in the cultural materials except in southern Hokkaido, where the sites yield predominantly small flakes and flake tools and lack the distinctive knife-shaped tools found elsewhere (Chiba 1985a:24, 1985b:28-9).

Sites of this glacial-maximum or near-maximum phase spanned at least three major environmental zones. The concentrations of sites in Kanto and Kyushu were located in the temperate coniferous forest. Those in Tohoku were within the dense boreal forest, and the unusual sites in Hokkaido were located in sparse boreal forest or park tundra. The large boreal herbivores and brown bear probably had already expanded their range into Hokkaido and Tohoku by this time.

The Tohoku and Hokkaido sites tend to be relatively unproductive, suggesting a very sparse and mobile population. The Tomizawa site in Sendai in east-central Tohoku, for example, yielded only about 100 lithic artifacts and some traces of small fires (Cultural Property Section 1989; Ota and Saino 1990). This site appears to have been a brief encampment on a damp lowland near a stream in a thick forest of boreal conifers such as *Picea glehnii*, *Larix gmelinii* and *Abies* sp., together with some *Betula*, *Salix*, *Alnus* and *Pinus koraiensis*, and marsh plants such as *Phragmites communis*. Some of the Hokkaido sites are found in localities where dunes were forming (and they were consequently stratified in dune deposits), indicating open, dry conditions (Sato and Kitazawa 1990; Goto and Tomikawa 1990).

It is easy to imagine that there were perhaps four or five cultural areas at this time: the distinct materials in southern Hokkaido, the sparse populations of the Tohoku boreal forest, and the concentrations of occupations in the Kanto, Kyushu and Hokuriku temperate coniferous forests. But it is not until the next phase that regional cultures first became distinct enough to be recognized archaeologically.

20,000/19,000 to 16,000/15,000 BP

The sites of this period are clearly younger than the AT marker tephra and in South Kanto the assemblages are found in the upper part of Stratum V (Black Band I) and lower part of Stratum IV (Suzuki and Yajima 1978; Oda and Keally 1979). Formal tools are more common than in earlier phases, but they still are not overly refined technologically. Backed tools, knife-shaped tools, trapezoids, small pebble tools and stones that look like pounders and grinders are found in most sites. But the characteristic artifact is the Kou-type knife-shaped stone tool made by blunting, or backing, the proximal end of a wide flake produced with the Setouchi technique (Matsufuji 1983). Large clusters of fire-cracked stones become common with this phase.

There is no question at all that sites with Kou/Setouchi tools concentrate in the Setouchi Basin from Osaka in Kansai to the northeastern part of Kyushu (Kato and Matsumoto 1982; Kato *et al.* 1982; Matsufuji 1983). Notably, this is the only period when sites are common in that region. Kou/Setouchi tools are also found in sites in other parts of Kyushu (Tachibana and Hagiwara 1983) and in most sites in South Kanto (Kanagawa Koko Dojinkai 1983), and as far north as the Etchuyama K site in Yamagata Prefecture in central Tohoku (Kato 1983:125-32). But so-called flake-points are distinctive of sites in Kyushu and extreme western Honshu (and in Korea) but not in other regions (Matsufuji 1989; Kotani 1990), and the Kou/Setouchi tools are not particularly outstanding in the sites in Kanto and Tohoku, where crude trapezoids and a few knife-shaped tools on long flakes were more important (Oda and Keally 1979; Kanagawa Koko Dojinkai 1983; Fujiwara 1986a:37-8).

Northern Tohoku was very sparsely settled and is hard to relate to other regions (e.g. the Odaino site; Kikuchi 1983:81-2,85-7). Sites in Hokkaido dated to this time are rare (Chiba 1985b:29) and, I feel, a bit problematic. If accurately dated, they show cultures based on blade-flakes and points and, later, predominantly on blade technology (Chiba 1985a:25, 1985b:29). Neither group shows much similarity to the materials on Honshu.

Environmental conditions were approximately those of the glacial maximum cold. The four (or five) identifiable cultural areas seem to correlate well with the major environmental zones. The Kou/Setouchi sites concentrate in and around the unique vegetation zone on the emerged Setouchi Basin: a temperate coniferous forest dominated by pines but probably with a lot of treeless space. The distinctive tool types and technology of the Kou/Setouchi culture spread to other regions throughout the temperate coniferous forest zone of western Japan and Kanto and to the southern part of the northern boreal forest zone in central Tohoku. But the temperate forests in Kyushu and Kanto differed somewhat and so did their cultures. How different the culture in central Tohoku was from that of the temperate forest in Kanto is not clear, but these two regions do appear to have had at least related cultures, if not the same culture. The thick boreal forest of northern Tohoku was very sparsely populated at this time and cannot be related at present to any other regions. Significantly, this area coincided with the distribution of large boreal herbivores and the brown bear. The Hokkaido materials, if validly assigned to this phase, are culturally distinct, and the sites are reported in the sparse boreal forest or park tundra zones all over the island.

For the first time in the development of the Japanese Palaeolithic, regional cultures are clearly recognizable and they correlate reasonably well with the known environmental zones of the period. The regional cultural variability became even more pronounced in the following period.

16,000/15,000 to 13,000/12,000 BP

This period saw the florescence of knife-shaped stone tools and related true blade technology, and it is the focus of the majority of cultural area studies I found in the literature (Ono 1969; Oda 1969; Tohoku Rekishi Shiryokan 1981: 38-9; Kato and Matsumoto 1982; Matsufuji 1985). The outstanding artifacts are the many types and varieties of skilfully made backed blades in shapes that resemble modern small-bladed knives (Oda and Keally 1979).

In South Kanto, other artifacts found with these knife-shaped tools include many kinds of small flake tools, but pebble tools or larger flake tools are uncommon. Small, dense clusters of fire-cracked stones are universal in the sites. Thumbnail scrapers and small unifacial or partially bifacial foliate points are found in the younger sites (such as Sengawa Stratum III) in South Kanto, and apparently in most other regions, but in Hokkaido a quite different cultural tradition based on microblade technologies was evolving from at least as early as 14,000 or 15,000 BP (Chiba 1985b:29-30; Keally 1990).

As many as 27 types of knife-shaped stone tools are identified in the late Japanese Palaeolithic (Anbiru 1988:40-1). Among these, the major types are the Higashiyama type found in sites in Hokkaido and Tohoku, the Sugikubo type common in sites especially on the Sea of Japan side of Tohoku and northern Chubu, and the Moro type (and the related Sunagawa technology; Anbiru 1983) abundant in sites in Kanto and to some extent in Chubu, but also found in sites in southeastern Tohoku and Hokuriku (Matsufuji 1985:357; Kato and Matsumoto 1982:44; Tohoku Rekishi Shiryokan 1981:38-9). The Hyakkadai type - the archtypical trapeze - is characteristic of sites in northwestern Kyushu (Oda 1969:227-228,235; Obata 1983:56), but it perhaps represents only a brief period within a longer phase characterized by knife-shaped stone tools made on long flakes, which are often identified as Moro type. Rare examples of trapezes very similar to the Hyakkadai type have been found as far away as southern Hokkaido (Miya 1985; Hata 1990), but their significance is not clear. The many other types and varieties of knife-shaped stone tools have mainly regional importance.

The emergence of this highly refined lithic culture based on blade technology and knife-shaped stone tools coincided rather closely with the onset of definite warming after the last glacial maximum and with the extinction of the Pleistocene megafauna. The recognizable cultural areas at this time also appear to have coincided rather well with the probable vegetation zones.

The developing microlithic technology and associate lithic assemblages found all over Hokkaido are unlike anything found elsewhere in Japan at the same time, and they correlate with the sparse boreal forest or park tundra zone that extended into Siberia. The remnant boreal forest zone of northern Tohoku was only thinly populated; the cultural materials there show affinity with those in both Hokkaido and central Tohoku.

The Sea of Japan side of central Tohoku was the focus of the Sugikubo cultural area. Recent investigations are rapidly increasing the density of known sites in southeastern Tohoku. The materials there show obvious relationships to those of Kanto, but they are not exactly the same.

The Kanto Plain clearly was the focus of the Moro cultural area, perhaps the most dynamic of the cultures at the time. The influence of this culture was widespread from southern Tohoku to Hokuriku and possibly to Kyushu. This vast cultural area correlates with the temperate forest zone. Southern Tohoku, Chubu and Hokuriku might have been relatively independent cultural regions within the large area influenced by the Moro culture of South Kanto.

Most of western Japan appears to have been very thinly populated during this phase. But sites in northwestern Kyushu are abundant. The cultural materials from these sites, characterized by the Hyakkaidai trapeze, are unique. This might reflect their coincidence with the broadleaf evergreen forest expanding on to the still emerged coastal plain there.

13,000 to 11,000 BP

For a very brief period near the end of the Pleistocene, microlithic technology was dominant in all regions of Japan (Oda and Keally 1979). I use the term microlithic here to refer to a narrowly defined technology and the artifacts produced by it, not broadly to include any kind of small stone tool.

The brevity of this phase, the lack of absolute dates for most sites and the differences in ages given by the radiocarbon, thermoluminescence, fission-track and obsidian hydration methods blur the details of cultural events at this time. I have relied for dating primarily on methods other than radiocarbon, but I have noted a rather consistent 2000-year gap between radiocarbon ages and ages obtained by the other methods; radiocarbon gives older ages (Keally and Muto 1982:256). Furthermore, since the assemblages associated with the different types of microcores are extremely varied and often poorly reported, I relied on the microcore types for defining cultural areas.

In the broadest division there are three major cultural areas defined by three broad types of microcores. Boat-shaped, or wedge-shaped, microcores made with the Yubetsu technique are found widely in Siberia and Hokkaido and as far south as Kanto and Chubu (Tohoku Rekishi Shiryokan 1981:38-9; Kato and Matsumoto 1982:43; Oda and Keally 1979). Conical microcores are found in Kanto and southern Chubu and westward to eastern Kyushu, but not on the Sea of Japan coast of Kyushu. Boat-shaped, or wedge-shaped, microcores made with the Fukui technique are distinctive of northwestern Kyushu.

If site density and the distributions of specific types of microcores are considered in detail, a clearer picture emerges. Microlithic sites are reported in all regions of Japan, but they presently concentrate in three regions: the central Sea of Okhotsk coast in Hokkaido, Chubu and South Kanto, and northwestern Kyushu. The many recognized types of microcores are associated primarily with one or another of these three centers.

Shirataki, Togeshita, Oshorokko and Rankoshi type microcores are found only in sites in Hokkaido (Tsurumaru 1989:Figure 1). Sakkotsu and Horoka microcores are also distinctive Hokkaido types, but they are also common in Tohoku. Further, the Sakkotsu type is found as far south as northern Chubu and Kanto; the Horoka type is found to the western edge of the central mountains. These six types are classified together as wedge-shaped microcores, and the Shirataki and Sakkotsu types are grouped more specifically under the Yubetsu technique (Kimura 1983). In addition, Shatekiyama/Hirosato and Momijiyama/Okedo type microcores are reported in Hokkaido (Kimura 1983), and recently a Pirika type microcore or technology has been proposed there (Tsurumaru 1989:63).

Saikai, Funano and Unehara type microcores are associated with northwestern, eastern and southern Kyushu respectively (Tsurumaru 1989:Figure 1). The Funano type is reported as far east as Chubu and Kanto (Suzuki 1983). Fukui-type microcores (probably the same as the Saikai type) are tentatively reported in a few sites in South Kanto (Yamada and Morino 1990:72-3).

The Yadegawa, or Yasumiba, type microcore is characteristic of sites in Chubu and Kanto (Suzuki 1983). Under the name Nodake, this type is also reported in Kyushu (Tachibana 1983).

The correlation between cultural areas and environmental zones at this time seems reasonably clear. The Hokkaido microlithic phase spans a long period of time from about 15,000 BP to the end of the Pleistocene. Initially, the settlements were probably in park tundra, but by the end of the phase that region was probably dominated by a boreal forest. The microlithic in Tohoku appears closely related to that of Hokkaido (Fujiwara 1986b:28), and boreal species probably were still major elements in the Tohoku forest. The microlithic phase in Kanto and Chubu and in Kyushu spans a shorter period of time than in Hokkaido, beginning about 12,000 or 13,000 BP (radiocarbon indicates about 14,000 BP in South Kanto and Chubu and about 13,000 BP in northwestern Kyushu). A temperate broadleaf forest probably was well developed in Kanto, and an evergreen broadleaf forest probably covered northern Kyushu (Tsukada 1986:34). But the distribution of microcore types suggests close connections between these two regions despite the vast intervening area of sparsely populated territory in most of western Japan.

The End of the Pleistocene

Cultural change near and at the end of the Pleistocene is far too rapid to see any of the details with the presently available database. Large bifacial foliate spear points, often found together with partially ground adze-like stone tools in Tohoku, seem to precede development of a variety of smaller stemmed points in all regions of Japan (Oda and Keally 1979; Tohoku Rekishi Shiryokan 1981:38-9; Otake 1983). In Kyushu the microcore tradition lingered as pottery appeared in the assemblages. Consequently, it is generally thought that pottery appeared earliest in northwestern Kyushu in sites such as Fukui Cave (Kamaki and Serizawa 1967) and Sempukuji Rockshelter (Aso 1984). But recently equally old, or possibly older, pottery has been reported in sites in northern Tohoku (Odaiyamamoto site: Miyake 1977), northeastern Kanto (Ushirono site: Kawasaki and Kamoshida 1977) and southern Kanto (Maeda Kochi site: Keally and Miyazaki 1986). The Maeda Kochi site also yielded clear evidence for exploitation of salmon.

The forest in northwestern Kyushu at this time was most likely dominated by evergreen broadleaf trees. This forest zone was probably spreading eastward in parallel with the spread of quantitatively obvious amounts of pottery in the sites. The large bifacial points and ground adzes, together with very small quantities of plain pottery, are distributed roughly in the same regions as the expanding temperate forest. The culture of Hokkaido appears to have been rather different than the cultures to the south, and it occupied a different environmental zone, probably mostly boreal forest.

CONCLUSION

In 1969, Akira Ono published a paper evaluating regionality based on the knife-shaped stone tools of the Japanese Palaeolithic (Ono 1969). Absolute dates were almost non-existent then, making it extremely difficult for him to control for time. Nevertheless, he was able to delineate four regions, each distinguished by a specific type or types of knife-shaped tools, and to indicate evolutionary changes in each region. While noting that various causes had already been proposed to explain this regionality, Ono felt that the variations were most likely the results of different historical processes in technological development in each region (Ono 1969:24). He went on to say, however, that any valid explanations would require a careful look at environmental conditions that might have influenced the developmental processes (Ono 1969:note 53).

Since Ono wrote that paper, Japanese Palaeolithic archaeology has changed radically. Before 1969, excavations were small exploratory digs. After 1969, excavations became large strip-mining operations. Perhaps as much as 90% of all the information we now have on the Japanese Palaeolithic has been collected in the 20 years since Ono's paper was published - the other 10% was gathered in the 20 years from the discovery of the Japanese Palaeolithic in 1949 to Ono's paper in 1969. But as far as I can see, Ono's paper is still the best analysis of regionality yet published. Time is controlled no better today than Ono could manage in 1969, and absolute dates are still scarce outside of South Kanto and Hokkaido. And no one has yet taken a detailed and scientific look at the environmental data or the correlations between environmental zones and cultural areas. Nor has anyone looked at the distributions of cultural assemblages rather than of a few specific and outstanding stone tool types.

My own presentation here has had to rely too heavily on other people's analyses of regional cultural chronologies and artifact type distributions. I am now embarking on a project to do my own analysis of several hundred of the best excavation reports, covering the entire country. I will be very surprised if my views five years from now are not quite different from those just presented.

REFERENCES

Anbiru, M. 1983. Tatenaga naifugata sekki no seisaku. *Kikan kokogaku* 4:43-6.

------ 1988. Sekki jidai kenkyu no ayumi. In M. Anbiru (ed.), *Nihon jinrui bunka no kigen*, pp.14-54. Tokyo: Rokko Shuppan.

Aso, M. (ed.) 1984. *Sempukuji dokutsu no hakkutsu kiroku*. Sasebo City: Sasebo-shi Kyoiku Iinkai.

Butzer, K.W. 1971. *Environment and Archeology: an Ecological Approach to Prehistory*. (2nd ed.) Chicago and New York: Aldine, Atherton.

Chiba, E. 1985a. Nihon no kyusekki, daiikkai, Hokkaido (1). *Kokogaku janaru* 245:20-5.

------ 1985b. Nihon no kyusekki, daisankai, Hokkaido (3). *Kokogaku janaru* 249:28-31.

Cultural Property Section, Sendai City Board of Education 1989. Sendai-shi Tomizawa iseki (daisanjuji chosa no gaiyo). *Daiyonki kenkyu* 28:293-301.

Fujiwara, H. 1986a. Nihon no kyusekki, daihakkai, Tohoku (2). *Kokogaku janaru* 258:35-9.

------ 1986b. Nihon no kyusekki, daikyukai, Tohoku (3). *Kokogaku janaru* 259:28-31.

Fujiwara, H. and Fujimura, S. 1990. Fukushima-ken Kaminodejima iseki, Ohira iseki. *Daisankai tohoku Nihon no kyusekki bunka o kataru kai*, pp. 4-6. Yamagata: Yamagata Kenritsu Hakubutsukan.

Geographical Survey Institute (comp.) 1977. *The National Atlas of Japan*. Tokyo: The Japan Map Center.

Goto, T. and Tomikawa, T. 1990. Obihiro Kuko Minami A: a 20,000-year-old site in southwestern Hokkaido, Japan. *Current Research in the Pleistocene* 7:148-9.

Hata, H. 1990. Yunosato 4: a terminal Pleistocene burial site in southwestern Hokkaido, Japan. *Current Research in the Pleistocene* 7:150-2.

Hasegawa, Y. 1983. Dobutsuso. *Kikan kokogaku* 4:21-4.

Igarashi, Y. and Kumano, S. 1981. Hokkaido ni okeru saishu hyoki no shokusei hensen. *Daiyonki kenkyu* 20:129-141.

Kamaki, Y., Higashimura, T., Warashina, T., and Miyake, H. 1984. Kokuyoseki, sanukaito-sei sekki no sanchi suitei ni yoru kobunka koryu no kenkyu. In Kobunkazai Henshu Iinkai (ed.), *Kobunkazai no shizen kagakuteki kenkyu*. Tokyo: Domeisha Shuppan.

Kamaki, Y. and Serizawa, C. 1967. Nagasaki-ken Fukui doketsu. In Nihon Kokogaku Kyokai Doketsu Iseki Chosa Tokubetsu Iinkai (ed.), *Nihon no doketsu iseki*, pp.256-265. Tokyo: Heibonsha.

Kamei, T., Kawamura, Y. and Taruno, H. 1987. Honyu dobutsuso. In Nihon Daiyonki Gakkai (ed.), *Nihon Daiyonki chizu kaisetsu*, pp.86-9. Tokyo: Tokyo Daigaku Shuppankai.

------ 1988. Nihon no Daiyonki no honyu dobutsu kaseki ni yoru buntai. *Chishitsugaku ronshu* 30:181-204.

Kamei, T. and Research Group for the Biogeography from Wurm Glacial. 1981. Saishu hyoki ni okeru Nihon retto no doshokubutsuso. *Daiyonki kenkyu* 20:191-205.

Kanagawa Koko Dojinkai (ed.). 1983. *Shinpojium Minami Kanto o chushin to shita naifugata sekki Bunka no shomondai*. Kanagawa koko 16.

Kato M. 1983. Etchuyama iseki. In M. Aso, S. Kato and T. Fujimoto (eds), *Nihon no kyusekki bunka. Vol. 2. Iseki to ibutsu 1* (2nd ed.), pp.112-137. Tokyo: Yuzankaku.

Kato, S. and Matsumoto, M. 1982. Sekkigun ni miru chiikisei. In R. Takeuchi, T. Inoue, T. Esaka, S. Kato, T. Kobayashi, H. Sakazume and M. Sahara (eds), *Nihon rekishi chizu*, vol. 1, pp.41-4. Tokyo: Kashiwa Shobo.

Kato, S., Tsurumaru, T. and Matsumoto, M. 1982. Sendoki jidai sekkigun no hensen. In R. Takeuchi, T. Inoue, T. Esaka, S. Kato, T. Kobayashi, H. Sakazume and M. Sahara (eds), *Nihon rekishi chizu*, vol. 1, pp.32-9. Tokyo: Kashiwa Shobo.

Kawamura, Y. 1985. Saishu hyoki iraku no Nihon no honyu dobutsuso no hensen. *Gekkan chikyu* 7:349-53.

Kawamura, Y., Kamei, T. and Taruno, H. 1989. Koki koshinsei no honyu dobutsuso. *Daiyonki kenkyu* 28:317-326.

Kawasaki, S. and Kamoshida, A. 1977. Ibaragi-ken Ushirono iseki. In S. Otomasu (ed.), *Nihon kokogaku nempo 28 (1975 nemban)*, pp.33-6. Tokyo: Nihon Kokogaku Kyokai.

Keally, C.T. 1990. Hokkaido Pleistocene archeology and the earliest Americans: some comments. *Current Research in the Pleistocene* 7:143-6.

Keally, C.T. and Hayakawa, I. 1987. The 30,000-year-old lithic components from the Musashidai site, Tokyo, Japan. *Current Research in the Pleistocene* 4:61-4.

Keally, C.T. and Miyazaki, H. 1986. A terminal Pleistocene salmon-fishing and lithic worksite at Maeda Kochi, Tokyo, Japan. *Current Research in the Pleistocene* 3:96-7.

Keally, C.T. and Muto, Y. 1982. Jomon jidai no nendai. In S. Kato, T. Kobayashi and T. Fujimoto (eds), *Jomon bunka no kenkyu. Vol. 1. Jomon-jin to sono kankyo*, pp.246-278. Tokyo: Yuzankaku.

Kikuchi, K. 1983. Odaino iseki. In M. Aso, S. Kato and T. Fujimoto (eds), *Nihon no kyusekki bunka. Vol. 2. Iseki to ibutsu 1* (2nd ed.), pp.79-95. Tokyo: Yuzankaku.

Kimura, E. 1983.Saisekki (Hokkaido chiho). *Kikan kokogaku* 4:70-2.

Kotani, R. 1990. Hakuhen sentoki no kenkyu: shu to shite tokeigakuteki shuho ni okeru bunseki. *Kyusekki kokogaku* 40:5-30.

Machida, H. and Arai, F. 1983. Koiki tefura to kokogaku. *Daiyonki kenkyu* 22:133-148.

Magara, H. 1990. Review of *Tsubakibora iseki*, Gifu: Gifu-shi Kyoiku Iinkai, 1989. *Kyusekki kokogaku* 40:81-4.

Matsufuji, K. 1983. Kou-gata naifugata sekki no seisaku. *Kikan kokogaku* 4:47-50.

------ 1985. Saishu hyoki no kyusekki to bunkaen. *Gekkan chikyu* 7:354-9.

------ 1989. Chosen hanto kara Nihon retto e: hakuhen sentoki no keifu. *Kikan kokogaku* 29:39-43.

Miya, H. 1985. Misato dokutsu iseki shutsudo no daigatayo sekki ni tsuite. *Kokogaku janaru* 244:24-6.

Miyake, T. 1977. Aomori-ken Odai Yamamoto I iseki. In S. Otomasu (ed.), *Nihon kokogaku nempo 28 (1975 nemban)*, pp.36-9. Tokyo: Nihon Kokogaku Kyokai.

Mogi, A. 1981. Tsushima kaikyo tairikudana no chikei hattatsu: Tsushima rikkyo ni kanshite. *Daiyonki kenkyu* 20:243-259.

Naora, N. 1959. Yiwate-ken Hanaizumi-machi Kanamori no kasekirui to jinrui ibutsu to kososareru kokkakki. *Daiyonki kenkyu* 1:118-124.

Nihon Daiyonki Gakkai (ed.) 1987. *Nihon Daiyonki chizu, II, senshi iseki, kankyo zu*. Tokyo: Tokyo Daigaku Shuppankai.

Nojiriko Kafun Gurupu 1990. Kannoki-so oyobi kabu Nojiriko-so no kafun kaseki gunshu to jobu Nojiriko-so III (Ajishio) kazanbai-so taisekiki igo no kokankyo hensen. In Nojiriko Hakkutsu Chosadan (ed.), *Nojiriko no hakkutsu* 5 (1987-9), pp.61-76. Chidan kensempo 37. Tokyo: Chigaku Dantai Kenkyukai.

Obata, H. 1983. Daigata sekki. *Kikan kokogaku* 4:56-9.

Oda, S. 1969. Some aspects of Japanese preceramic age: the microlithic tendency in the southwestern parts of Japan. *Jinruigaku zasshi* 77:224-245.

Oda, S. and Keally, C.T. 1979. *Japanese Paleolithic cultural chronology*. Privately published monograph.

----- 1986. A critical look at the Palaeolithic and "Lower Palaeolithic" research in Miyagi Prefecture, Japan. *Jinruigaku zasshi* 94:325-361.

Ohshima, K. 1980. Kaikyo chikei ni kisareta kaisuijun hendo no kiroku. *Daiyoki kenkyu* 19:23-37.

Okamura, Y. 1985. Hokuriku o butai to shite nimannen mae no dekigoto. *Kokogaku kenkyu* 32(4):14-48.

Ono, A. 1969. Naifugata sekki no chiikisei to sono hyoka. *Kokogaku kenkyu* 16(2):21-45.

Oshiro, K. 1987. Okinawa kyusekki jidai. *Kokogaku janaru* 284:4-8.

Ota, A. and Saino H. 1990. Tomizawa iseki (daisanjuji chosa) ni okeru kyusekki jidai no seikatsu kankyo. *Nihon Kokogaku Kyokai daigojurokkai sokai kenkyu happyo yoshi*, pp.22-5.

Ota, Y. and Yonekura, N. 1987. Kaigansen. In Nihon Daiyonki Gakkai (ed.), *Nihon Daiyonki chizu kaisetsu*, pp.70-2. Tokyo: Tokyo Daigaku Shuppankai.

Otake, N. 1983. Sentoki. *Kikan kokogaku* 4:60-3.

Otani, T., Hayakawa, I., Oda, S., Kawasaki, Y., Kamijo, T., Sato, I. and Kobayashi, S. 1984. Kaku shima no iseki gaiyo. *Bunkazai no hogo* 16:3-27.

Palynosurvey Kabushiki Kaisha. 1989. Nogawa Nakasu Kita iseki shokubutsu kasekiso no taiseki kankyo to shokusei. In Koganei-shi Iseki Chosakai (ed.), *Nogawa Nakasu Kita iseki: shizen kagaku bunseki hen*, pp.69-94. Tokyo: Koganei-shi Iseki Chosakai.

Sato, K. and Kitazawa, M. 1990. Kamiitaira: dating a stratified site in southeastern Hokkaido, Japan. *Current Research in the Pleistocene* 7:154-6.

Suzuki, J. 1983. Saisekki (Honshu chiho): Kanto, Chubu nambu o chushin ni. *Kikan kokogaku* 4:67-9.

Suzuki, J. and Yajima, K. 1978. Sendoki jidai no sekkigun to sono hennen. In H. Otsuka, M. Tozawa and M. Sahara (eds), *Nihon kokogaku o manabu. Vol. 1. Nihon kokogaku no kiso*, pp.144-169. Tokyo: Yuhikaku.

Tachibana, M. 1983. Saisekki (Kyushu chiho). *Kikan kokogaku* 4:64-6.

Tachibana, M. and Hagiwara, H. 1983. Kyushu ni okeru kazanbai sojun to kyusekki jidai sekkigun. *Daiyonki kenkyu* 22:165-76.

Takamiya, H., Tamaki, M., and Kin, M. 1975. Yamashitacho doketsu shutsudo no jinko ibutsu. *Jinruigaku zasshi* 83:137-150.

Tateno, H. 1989. Tama New Town no. 471-B iseki no chosa seika. *Nihon kokogaku nempo 40 (1987 nendoban)*, pp.393-6. Tokyo: Nihon Kokogaku Kyokai.

Toda, M. 1990. Tochigi-ken Nasu-machi Nanamagari iseki. *Daisankai tohoku Nihon no kyusekki bunka o kataru kai*, pp.1-3. Yamagata: Yamagata Kenritsu Hakubutsukan.

Tohoku Rekishi Shiryokan (ed.) 1981. *Kyusekki jidai no Tohoku*. Tagajo City: Tohoku Rekishi Shiryokan Shinkokai.

Tokyo-to Maizo Bunkazai Senta Chosa Kenkyubu. 1987. Tama New Town no. 471-B iseki no chosa gaiyo. *Gekkan bunkazai* 12:17-23.

Trewartha, G.T. 1963. *Japan: a Physical, Cultural and Regional Geography*. Madison: The University of Wisconsin Press.

Tsuji, S. 1983. Shokuseiso. *Kikan kokogaku* 4:17-20.

Tsukada, M. 1986. Vegetation in prehistoric Japan: the last 20,000 years. In R.J. Pearson, G.L. Barnes and K.L. Hutterer (eds), *Windows on the Japanese Past: Studies in Archaeology and Prehistory*, pp.11-56. Ann Arbor: Center for Japanese Studies, The University of Michigan.

Tsurumaru, T. 1989. Higashi Ajia ni okeru saisekijin seisaku gijutsu. *Kikan kokogaku* 29:62-5.

Yamada, I. and Morino, Y. 1990. Saitama-ken Sunagawa iseki hakken no saisekkaku. *Kyusekki kokogaku* 40:71-5.

Yasuda, Y. 1978. Prehistoric environment in Japan: palynological approach. *Science reports of the Tohoku University*, 7th series (geography), 28(11):117-281.

------ 1982. Fukui-ken Mikata-ko no deido no kafun bunsekiteki kenkyu: saishu hyoki iraku no Nihonkai gawa no kan/shitsu no hendo o chushin to shite. *Daiyonki kenkyu* 21:255-71.

------ 1987. Saishu hyoki no kanrei kiko ni tsuite: nambu Yoroppa to no hikaku. *Daiyonki kenkyu* 25:277-294.

------ 1990. *Kiko to bummei no seisui*. Tokyo: Asakura Shoten.

Yoshida, T., Ito, S., Shirase, M., Horiuchi, T., Manabe, K., Suzuki, K., Takeuchi, S., Nonaka, T., Nirei, Y. and Nirei, N. 1981. Abukuma sanchi chuobu ni okeru Daiyonki to shokubutsu kasekigun: saishu hyoki ni okeru Tohoku nambu no shokusei hensen no ichirei. *Daiyonki kenkyu* 20:143-63.