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Ainu Ancestors and Prehistoric Asian Agriculture

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Two problems resulting from research on the subsistence of the Sakushu-Kotoni River site, a prehistoric ninth-century AD, early Ainu (Ezo) site in Hokkaido, Japan are examined. Almost 200,000 carbonized cultigen seeds were recovered by water flotation of soils. Most of the remains are seeds of barley, wheat, two millets, adzuki and mung beans, hemp, beefsteak plant, rice, and melon. Two implications of these data are examined. The first is that research on crop evolution in East Asia lacks systematic studies on archeological cultigen remains. We report for the first time descriptive, taxonomic, and quantitative data on carbonized cultigen remains from northern Asia. In particular, the wheat is an unusually compact type. Second, the Ainu are usually portrayed as foragers who relied heavily on salmon and deer in historic times. The Sakushu-Kotoni River data demonstrate the existence of an agricultural phase early in Ainu history. We suggest that early Ainu village maintenance was facilitated by plant husbandry. The circumstances of the origins of Ainu agriculture are unresolved, and we question the complete disappearance of Ainu agriculture in the second millennium AD.

Keywords: SAPPORO, HOKKAIDO, JAPAN, HOKKAIDO UNIVERSITY, SAKUSHU-KOTONI RIVER, EZO-HAJI, SATSUMON, AINU, ARCHEOBOTANY, FLOTATION, BARLEY, WHEAT, MILLET, RICE, MELON, BEAN, HEMP, BEEFSTEAK PLANT.

Introduction

The agricultural history of mainland, northeast Asia (China in particular) suffers from a lack of systematic archeological crop studies. Such systematic studies do not exist in Japan either, although selected prehistoric cultigen taxa have been studied there (e.g., Sato, 1971). We report an extensive collection of prehistoric cultigen remains from northeast Asia for the first time here. Furthermore, the context of this assemblage requires a reassessment of early Ainu subsistence. Data in this paper demonstrate the existence of an Ainu agricultural phase some eight centuries earlier than popularly realized. The implications of the archeological cultigen data and their association with an early Ainu phase are examined.

Northern Asian agricultural origins are usually traced to the loess terraces of China, dating back to about seven millennia bp (Chang, 1977; Harlan, 1975). A few crops such as foxtail millet and broomcorn millet are thought to have had their origins in northern China (Chang, 1983; Harlan, 1975; Li, 1970), subsequently diffusing to the east, joining

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with other cultigens and ultimately reaching Japan in the first millennium BC. Limited gardening seems to have existed in Japan prior to this (Crawford, 1983; Kasahara, 1983), raising the possibility of indigenous Japanese plant domestication and husbandry. Barley and wheat from western Asia, and rice from tropical Asia were added to some northern Asian crop complexes at some time before 1000 BC. Southwestern Japanese cultures evolved intensive agricultural systems during the Yayoi period at the end of the first millennium BC. The major crops in Yayoi Japan were rice, barley, millets, melon and gourd. The transition to intensified plant husbandry eventually progressed northward. The popular view holds that the Yayoi had reached northern Honshu by AD 200, whereas Hokkaido remained the home of the hunting and gathering Ainu until the 19th century.

The plant remains are from the AD 800–50 Sakushu-Kotoni River site on the Hokkaido University campus in Sapporo, Japan. The majority of the almost 400 g of carbonized seeds are the remains of 10 cultigen taxa (Table 1). The cultigens are part of an eastern Asian complex of crops with diverse origins. The carbonized seeds, which number almost 200,000, constitute what is probably the largest collection of archeological cultigens from a single northern Asian site. Implications of these remains regarding cultigen history in Japan and, to some extent, in mainland Asia are discussed. The role of plant husbandry in Ainu subsistence is explored, although perhaps more questions are raised than answered concerning the problem at this point in our research. The emphasis in this paper is archeobotanical; forthcoming field work and analysis will be directed toward researching late prehistoric Hokkaido subsistence systems in general. The relative economic importance of the various crops is a complex issue to resolve. However, we suggest that barley and wheat combined were probably more important to the site occupants than millets. In China, wheat had become more important than barley by the time of Christ. Barley, by weight, is more common than wheat in our samples, so the opposite may be true in Hokkaido. Otherwise, the Sakushu-Kotoni River assemblage compares well with early first millennium AD, northern Chinese, historic data. Finally, the remains provide important comparative agricultural botanical data. The Sakushu-Kotoni River wheat, for example, is an unusually compact form, resembling Indian dwarf wheat rather than wheats from sites further to the west and north. The wheat, however, is probably a locally-evolved, compact type, because Indian dwarf wheat apparently never expanded its range eastward from India and Pakistan.

The Sakushu-Kotoni River Project

The plant remains forming the basis of our discussion are from the Sakushu-Kotoni River site in south-central Hokkaido (Figure 1). The Sakushu-Kotoni River excavation of 1982–3 was one component of a salvage project designed to mitigate damage from construction on the Hokkaido University Campus. The project uncovered an area of approximately 5900 m^2. All of our flotation samples are from the extensive early Middle Satsumon component that dates to AD 800–50. One of us (Yoshizaki) has revised the terminology for this period and prefers to call this phase late Ezo-Haji (Yoshizaki, 1984). Using this new scheme, the period from the eighth to the 18th century AD is referred to as Ezo. Ezo-Haji is the first half of this period, while Satsumon is reserved for the latter half. Assemblages from this phase contain indigenous pottery, but ceramics made by the Japanese (*wajin*) are present. The Ezo phase is restricted to northern Japan, in Hokkaido and parts of Tohoku. Three house pits and two smaller house-like pits comprise a small hamlet. Other features include a possible garbage pit, a mounded midden concentration, as well as 139 other smaller concentrations of burned organic material and seven clusters of 20–30 river cobbles (net sinkers?). Among the artifacts are an estimated 311 vessels, a number of spindle whorls, 17 clay beads, 77 obsidian flakes and tools, three pieces of metal (iron and tin), and one bone harpoon head. Two other components form occupations

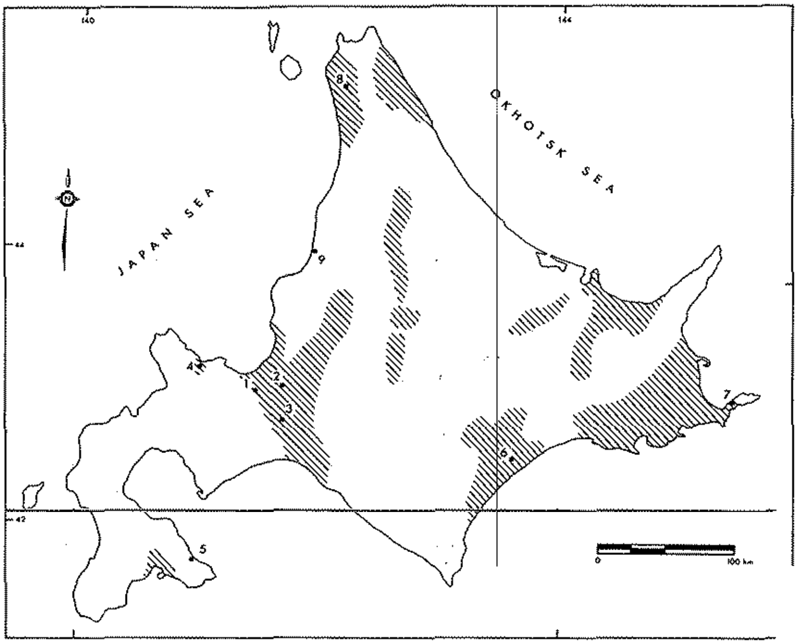

Figure 1. Hokkaido Prefecture, showing the Jomon and Ezo sites mentioned in the text and major lowlands and basins. 1, Sakushu-Kotoni; 2, Gotoh; 3, Kashiwagi-gawa; 4, Amauchi-Yama; 5, Hamanasuno; 6, Wakatsuki; 7, Nishitsukigaoka; 8, Toyotomi; and 9, Opiraushibetsu

earlier and later than this Ezo-Haji phase; a late Satsumon hearth and an estimated 12 vessels date to the early 10th century AD. The third component is represented by a few Epi-Jomon artifacts. The ninth century assemblage is similar to that from other Ezo sites.

The settlement pattern is not unique to this site. Ezo sites are usually situated along small tributaries, not major river courses. A number of Ezo sites are found on the Hokkaido University campus; they are on the banks of an abandoned river channel. Excavations transected the river bed and exposed a 10 m long fish weir to the south of the hamlet. Artifacts associated with the weir include an iron barb or hook, a wooden fish spear, a wooden foreshaft, and a few items of ambiguous function. At present, we do not know which of the two components the weir is associated with.

There is little question that the Ezo are the ancestors of the Ainu. Although the Ainu used metal technology, it had replaced an indigenous technology in much the same way as native American technology was affected by European contact. Disposal patterns and fishing methods are similar to those of the Ainu. A character incised on a piece of trade ware has been identified as the word *Emishi* or "*I*". According to Takakuru (1960: 8), *Emishi* is derived from two aboriginal words, *emush* and *yumasa* meaning "sword". *Emishi* thus refers to the fighting qualities of the aboriginal, northern Japanese populations who eventually became known as the Ezo and then the Ainu. The Ainu and late prehistoric Hokkaido populations are biologically similar. The Ainu are not a population of non-Asians; recent genetic research demonstrates a close affinity to the Japanese, despite certain differences in physical characteristics (Misawa *et al.*, 1975).

As part of the project, 150 soil samples (about 1500 l) were collected from two of the houses, external house pits, and the middens outside houses as part of a study on the

Table 1. Cultigen taxa from the Sakushu-Kotoni River site

	Scientific name	English common name	Japanese common name
1	*Hordeum vulgare*	Barley	*ōmugi*
2	*Triticum aestivum*	Wheat	*komugi*
3	*Panicum miliaceum*	Proso or broomcorn millet	*kibi, inakibi*
4	*Setaria italica*	Foxtail millet	*awa*
5	*Oryza sativa* var. *japonicum*	Rice (short-grained)	*kome*
6	*Vigna angularis* var. *angularis*	Adzuki	*azuki*
7	*V. radiatus* var. *radiatus*	Mung bean	*ketsuru-azuki*
8	*Cucumis melo*	Melon	*uri, makuwa-uri*
9	*Perilla frutescens* var. *crispa*	Beefsteak plant	*shiso*
10	*Cannabis sativum*	Hemp	*asa*

Table 2. Wild and weedy plant taxa identified in the Sakushu-Kotoni River flotation samples

Scientific name	English common name	Japanese common name
Weedy grains/greens		
Chenopodium sp.	Chenopod, goosefoot	*akaza zoku*
Echinochloa crusgalli	Barnyard grass	*inubie, ta-inubie*
Gramineae	Grass family	*ine-ka*
Polygonum sp.	Knotweed	*tade zoku*
P. densiflorum		*inu tade*
P. sachalinense		*ō-itadori*
Rumex sp.	Dock	*gishi-gishi zoku*
Fleshy fruits		
Actinidia sp.	Silvervine	*matatabi/kokuwa*
Cornus sp.	Dogwood	*mizu-ki zoku*
Empetrum nigrum	Crowberry	*gankoran*
Phellodendron amurense	Amur corktree	*kihada*
Physalis sp. cf. *P. alkekengi*	Chinese lantern plant	*hōzuki*
Physiliastrum japonicum		*iga hōzuki*
Rubus sp.	Bramble	*ki-ichigo zoku*
Sambucus sp. cf. *S. sieboldiana*	Elderberry	*ezo-niwatoko*
Solanum nigrum	Black nightshade	*inu-hōzuki*
Vitis sp.	Grape	*budo zoku*
Others		
Allium cf. *A. monanthum*	Wild onion, leek	*negi zoku* cf. *himenira*
Juglans ailanthifolia	Walnut	*kurumi, onigurumi*
Ostrya japonica	Ironwood	*asada*
Potamogeton	Pondweed	*hiru-mushiro zoku*
Rhus sp.	Sumac	*urushi-zoku*

subsistence of the Ainu's ancestors. These samples were all processed by water flotation in order to isolate carbonized plant remains. Ten cultigens comprise over 90% of the estimated 200,000 seeds. (The term "seed" here refers to seeds as well as fruits such as achenes and bulbs of a wild onion, *Allium monanthum*. Wood charcoal and other remains such as cultigen byproducts are not included in the total.) At this time, about half the collection has been closely examined (Tables 1 and 2; Figure 2). Cultigen byproducts (rachis

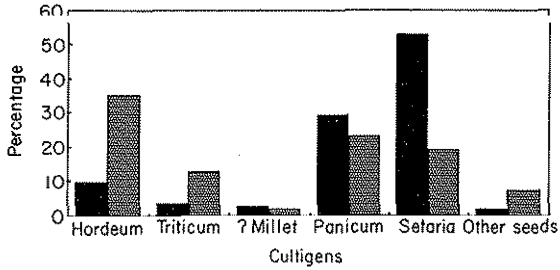

Figure 2. Chart showing cultigen types as a percentage of the total number of seeds and total seed weight (based on the collection examined to date). Solid area, percentage of total number (116,422), hatched area, percentage of total weight (196·88 g).

fragments, etc.), weed seeds, and seeds of other plants are present (Table 2), but these are not discussed in this paper. A more complete summary is available in Crawford (1986).

The Ainu and Prehistoric Ezo

The Ainu, a native population of northern Japan and southern Sakhalin, are among a small group of northern Asian foragers who had high residential stability; in fact, the Ainu maintained year-round villages or hamlets (*kotan*) (Watanabe, 1967). Ainu subsistence is usually characterized by an emphasis on anadromous salmon, land mammals such as deer and bear, and a variety of plant foods (Watanabe, 1967, 1972; Yoshizaki, 1984). Watanabe (1967) suggests that Ainu residential stability was a result of dependency on salmon, but no research has been addressed at explaining Ainu sedentism.

The Ainu, in particular those of southern Hokkaido, have rarely been isolated from the Japanese. As a result, reconstructions of indigenous Ainu culture from 19th-century documents and interviews with Ainu informants who were alive in the early 20th century may be ambiguous. For example, the Ainu are generally accepted as an example of sedentary foragers (e.g., Harris, 1977: 220). However, there are reports of some Ainu in the Tokapchi and Azuma Valleys who had carried out small-scale farming (Watanabe, 1972). Households grew foxtail millet (*awa*) and barnyard millet (*hie*) in plots covering 1000–2000 m^2 on river banks. Hayashi (1975) has examined ethnohistoric data and has interviewed Ainu elders. He reports that the Ainu grew barnyard and foxtail millet, barley, wheat, adzuki bean, pea, soy bean, *daikon* (radish), hemp, *negi* (leek or onion, *himenira?*), cucumber, tobacco, Irish potato, and two types of American squash. Rice was known to the Ainu in the 19th century, but it is said to have been imported. Naked barley was the most important of the *mugi* group, which also includes wheat (*komugi*) and hulled barley. Wheat was a crop of lesser importance than barley. All of these plants except barnyard millet and foxtail millet were, according to Ainu myth, introductions (Sarashina & Sarashina, 1976: 260, 262). Two legumes, *Vicia* (vetch) and *Crotolaria* (rattlebox) were reportedly harvested from gardens as well. It is assumed that this agriculture dates from the end of the 19th century when the Meiji government forced the Ainu to become farmers. This change in subsistence was accompanied by the resettlement of more than 60% of the Ainu population, ostensibly to locate them in good farming areas (Watanabe, 1972). Today, the Ainu are assimilated to varying degrees within modern Japanese society.

Ninth-century AD plant remains

The new data from the Sakushu-Kotoni River site confirm that plant husbandry in Hokkaido appeared much earlier than ethnohistory has documented. Without the evidence of carbonized plant remains, the Ezo occupants of this hamlet would have appeared

Table 3. Mean dimensions of selected cultigens from Sakushu-Kotoni

	Mean length	Mean width	Mean thickness	*N*
Adzuki/mung bean	6·0(4·8–8·0)	4·1(3·0–5·7)	3·8(2·3–5·0)	13
Barley	5·9(4·6–7·5)	2·7(2·2–3·5)	2·3(1·6–3·0)	100
Broomcorn millet	1·8(1·5–2·5)	1·8(1·4–2·8)	1·4(1·1–1·8)	108
Foxtail millet	1·2(1·0–1·4)	1·0(0·9–1·2)	0·7(0·6–0·9)	105
Wheat	3·4(2·8–4·0)	2·2(1·5–3·0)	1·9(1·4–2·8)	106

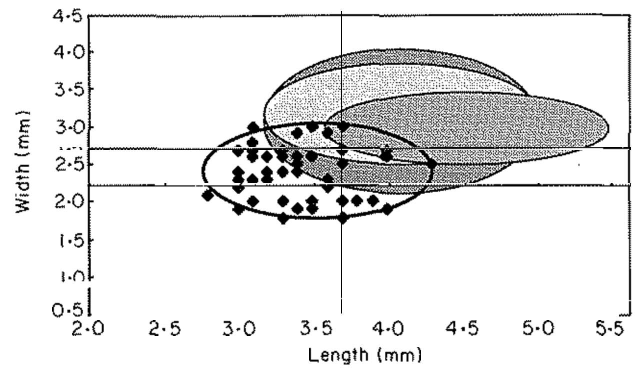

Figure 3. Width versus length (mm) plot of wheat caryopses from the Sakushu-Kotoni River site compared with compact wheat from Pirak, Pakistan (Costantini, 1979), Ichinohe, Iwate Prefecture, Japan (Sato, 1986), and Dorestad in the Netherlands (Van Zeist, 1968). *T. compactum*, Dorestad; Ichinohe site wheat; *T. sphaerococcum*, Pirak; Sakushu-Kotoni wheat.

to be hunters, fishers, and gatherers. Salmon bones, for example, constitute a significant proportion of the animal remains from the site. Cultigens apparently formed a significant part of the occupants' diet as well.

The smallest grains, *Panicum* and *Setaria*, are the most numerous (Figure 2). Weight, rather than number of seeds, probably gives a better approximation of the relative importance of each grain. Although the weight of the two millets in total is still proportionately high relative to the other grains, barley and wheat by weight combined comprise about 50% of the sample (Figure 2). Few of the grain specimens retain their hulls. The *Hordeum* is six-rowed; both hulled and naked grains are present, whereas the wheat is a free-threshing variety. Asian barleys form a group having a number of unique characteristics compared to other barleys (Takahashi, 1964). Although Takahashi (1964) reports that Asian barleys are small-seeded, the Sakushu-Kotoni River barley is not (Table 3).

The Ezo wheat, on the other hand, is a compact form (Figures 3 and 4). The remains of this wheat are all carbonized, naked kernels, making detailed evaluation of its taxonomic status difficult. The two compact wheats reported in archeological collections are *Triticum aestivum* ssp. *compactum* (*Triticum compactum*, club wheat) and *Triticum aestivum* ssp. *sphaerococcum* (*T. sphaerococcum*, Indian dwarf wheat) (see Kislev, 1984, for a discussion of wheat nomenclature). Carbonized club wheat grains tend to be slightly longer than those of Indian dwarf wheat (Figure 3). Kernels of the latter wheat are more spherical, having lower length : thickness ratios (Table 4). One other population of carbonized wheat approximately contemporaneous with the Sakushu-Kotoni River sample is from the Ichinohe site, house 6 (1110 ± 190 bp) in Iwate Prefecture (Sato, 1986). Mean length :

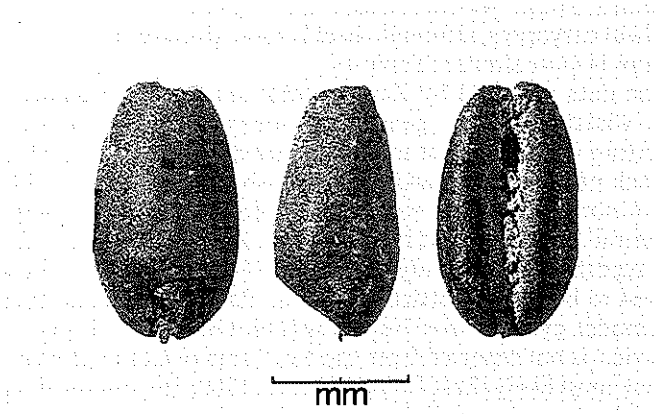

Figure 4. Wheat caryopsis from the Sakushu-Kotoni River site showing dorsal (left); lateral (centre) and ventral (right) surfaces.

Table 4. Mean proportions of carbonized wheat caryopses from selected sites

	L : W(B)	L : T	T : W(B)	Site (reference)
Club (uncarbonized)	1·87	1·98	0·94	(Percival, 1921)
Club	1·37	1·94	0·91	Dorestad (Van Zeist, 1968)
Club	1·37	—	—	Zolotaya Balka (Pashkevish, 1984)
Club	1·35	1·98	0·68	Altyn-Depeh (Janushevich, 1984)
Indian dwarf (uncarbonized)	1·53	1·51	0·98	Plant Gene Resources, Ottawa ($n=40$)
Indian dwarf	1·46–1·55	1·78–1·79	0·81–0·88	Pirak (Costantini, 1979)
?	1·47	1·82	0·81	Ichinohe (Sato, 1986)
?	1·54	1·79	0·86	Sakushu-Kotoni River

L, length; W(B), width (breadth); T, thickness.

breadth and length : thickness ratios are similar to both those of carbonized Indian dwarf wheat from Pirak and the Ezo wheat (Table 4). The shape of the archeological Japanese wheat is unlike that of club wheat. The Ichinohe site wheat is almost identical in shape and size to Indian dwarf wheat, but the extremely small size of the Hokkaido wheat caryopses is unusual. The measured sample is from a refuse dump and could conceivably be made up entirely of tail grain. Analysis of the grain size variation throughout the site will be conducted in the near future. The Sakushu-Kotoni River wheat kernels bear some resemblance to the small, rounded, hexaploid Indian dwarf wheat rather than the hexaploid club wheat from sites further to the west. However, the history and known distribution of Indian dwarf wheat suggests that the archeological Hokkaido wheat is a previously unreported compact form.

Club wheat is best known from prehistoric Europe, while Indian dwarf wheat is from Pakistan and India (Percival, 1921), where it apparently originated (Zeven & Zhukovsky, 1975: 66). A sphaerococcoid form of wheat appears as early as Period II at Mehrgarh, Pakistan and by Period V, *T. sphaerococcum* is the dominant hexaploid wheat (Costantini, 1984). Carbonized Indian dwarf wheat caryopses from the second millennium bp occupation at Pirak, Pakistan (Costantini, 1979) are, for the most part, larger than the Ezo phase wheat caryopses, although there is some size overlap. The shape of the kernels in the two groups is quite similar (Table 4).

Genetic data reported by Zeven (1980) are further evidence for a unique Japanese compact wheat. However, genetic relationships of East Asian wheats to western and central Asian wheats are not well understood (Zeven, 1980). This is compounded by the virtual lack of research on archeological wheat in East Asia. Wheat did not have much success in northern China, according to Ho (1969), until spring wheat was introduced from Central Asia during the Han Dynasty. Zeven (1980) finds no contradictory evidence for this hypothesis in his study of necrosis (Ne) genotypes. Central Asian wheats are not considered to be closely related to Indian–Pakistani wheats. Indian dwarf wheat, using Zeven's model, evolved after Ne_1^w wheat moved eastward, since Indian dwarf wheat (an Ne_1^w carrier) is not reported from the Ne_1^w area of China (Zeven, 1980), which is "South China and, most likely, East China" (Zeven, 1980: 25). For the time being, few conclusions can be made about the small, rounded, wheat from Japan until more comparative studies on archeological eastern Asian wheats have been made.

Foxtail and broomcorn millet fall into the size range reported from other collections outside eastern Asia (Percival, 1921). Broomcorn millet is the second most abundant grain by seed number and weight at Sakushu-Kotoni River (Figure 2). Barnyard millet (*hie, Echinochloa utilis*) was expected to be an important crop here because of ethnohistoric descriptions of its husbandry by the Ainu (Sarashina & Sarashina, 1976). Although no archeological barnyard millet has been identified in Hokkaido (Matsutani, 1984), it may exist in our collection. The distinction between cultigen *Panicum* and *Echinochloa* caryopses is subtle, so for the time being, we cannot rule out the presence of barnyard millet at Sakushu-Kotoni. Barnyard millet has been reported from three first millennium AD sites in southwest Japan (Matsutani, 1984).

The Sakushu-Kotoni River rice is all short-grained (length : thickness ratio = 1:6). All the prehistoric rice recovered so far in Japan is short-grained (Sato, 1971). Two types of cultigen legume are present: adzuki and mung beans. The two species of *Vigna* are difficult to separate, but mung appears to be rare. Hemp is relatively abundant at the site (136 achenes). The plant can be used as an oil, food, fiber, and drug source, although hemp grown in the north is not usually used as a drug. The Ainu used hemp to make clothing and baskets. The melon seed is broken, but it compares well with reference specimens of cultigen melon. One genus of melon is indigenous to northern Japan, *karasu-uri* (*Trichosanthes*) (Ohwi, 1965), and its seeds are distinguishable from cultigen melon seeds. The beefsteak plant appears to be the red-leaved rather than the green-leaved form (*Perilla frutescens* var. *japonica* or *egoma*).

Buckwheat or *soba* (*Fagopyrum esculentum*), whose presence as early as 5000 bp in Hokkaido is suggested by one carbonized seed from the Hamanasuno site (Crawford, 1983), is represented by pollen from at least six Ezo sites (Okada & Yamada, 1982). The only carbonized seeds purported to be buckwheat from an Ezo site (Kohno, 1959) were misidentified. One of us (Crawford, 1985) examined the seeds and identified them as safflower (*Carthamus tinctorius*). The achenes were found in the fill of a burned Ezo/Satsumon house at the now destroyed Toyotomi site. Some Ezo agricultural tools have been found as well. These include iron sickles excavated from Amauchi-Yama, Gotoh, and Kashiwagigawa, either a hoe or ploughshare from Toyotomi, a hoe from Kashiwagigawa, and ploughshares from Gotoh and Opiraushibetsu (Okada & Yamada, 1982).

Discussion

Sporadic reports of carbonized cultigen remains from a few other Ezo phase sites support our contention that plant husbandry was widespread before AD 1000 in Hokkaido.

Such remains have fortuitously come to light from at least three other Ezo sites: Nishitsukigaoka, Wakatsuki, and Toyotomi (Okada & Yamada, 1982). Broomcorn millet (*Panicum miliaceum*) appears at all three locations. In addition, barley and *shiso* (*P. frutescens*) were recovered from Wakatsuki. Adzuki bean (*Vigna angularis*) has been identified among the Toyotomi remains (Kohno, 1959). Reports of foxtail millet besides that from the Sakushu-Kotoni River collection have been disclaimed (Matsutani, 1984).

The cultigens from the first millennium AD in Hokkaido are either components of the China–Japan centre of cultigen diversity (Zeven & Zhukovsky, 1975) or are known to have been in the centre by the first millennium AD. Buckwheat and safflower are conspicuous in their absence from the Sakushu-Kotoni River samples. For five of the cultigens (wheat, foxtail millet, rice, melon, and *Cannabis*), the site is their northernmost confirmed occurrence in prehistoric Japan. *Oryza, Cucumis, Triticum,* and *Setaria* are reported for the first time from prehistoric Hokkaido. Until now, rice was known to have reached Aomori Prefecture, 200 km south of Sapporo, by the third century AD (Kuraku, 1984). Melon has been reported about 550 km to the south in Miyagi Prefecture by the ninth century (Fujishita, 1984).

Northern temperate Asian agriculture apparently emphasized millets in its earliest stages, with barley and wheat added later (Chang, 1983; Li, 1970). Wheat apparently came to be more important than barley in China after the time of Christ (Li, 1970), but millets were still significant. The Sakushu-Kotoni River assemblage is not entirely incompatible with these observations. Foxtail and broomcorn millet form a substantial part of the Ezo assemblage; however, barley is more abundant than wheat (by number and weight). The two millets by weight comprise slightly less of the collection than barley and wheat combined.

Whether or not this assemblage bears similarities to other archeological Asian assemblages is unknown. Cultigen history in northeast Asia outside Japan is inadequately known. Barley and wheat are found in China by 3000 bp (Ho, 1977), foxtail millet is reported from a Yangshao site *c.* 6000 bp (Chang, 1983), but broomcorn millet from the same period is unconfirmed (Chang, 1977). The earliest rice in China appears to date to 5000 bp (Chang, 1977), and only one report of rice from prehistoric northern China exists (Anderssen, 1934). We are without systematic studies of archeological plant remains from northern China (An, 1985). All of the Ezo taxa (except for safflower) have some antiquity in Japan. Barley and rice are present by 3000 bp (Kotani, 1981), while wheat appears by 2300 bp (Sato, 1971). Foxtail millet was in southwest Japan in the early third millennium bp (Kasahara, 1984). Broomcorn millet may have been present at the same time; Kim reports that this millet was in Korea in the early Bronze Age (Kim, 1982). Melon seeds are abundant from the late third millennium bp in Japan (Fujishita, 1984). Several taxa in the Hokkaido collection are evidenced even earlier. *Vigna, Perilla,* and *Cannabis* are reported from the fifth millennium bp (Kasahara, 1983). The well-known Middle Jomon carbonized cakes are now considered to be made from *Perilla* (Matsutani, 1984). Barnyard grass (*Echinochloa crusgalli*) is an important component of a 4000 bp, Middle Jomon assemblage from southwest Hokkaido, and the caryopsis size increase of this population suggests that domestication was occurring (Crawford, 1983). Barnyard grass caryopses from the Sakushu-Kotoni River site are all wild size. China may, therefore, not be the single northern Asian centre of plant domestication it is often considered to be. Antiquity for several Asian cultigens is greater in Japan than for the mainland, but this may be an artifact of research activity.

A number of other problems remain. The circumstances under which Ezo agriculture developed are unresolved. We do not know that the Sakushu-Kotoni River collection is the earliest of its kind in Hokkaido. Was agriculture introduced quickly with the full range of cultigens and agricultural technology, or was there a longer phase of development? No evidence suggests that the Sakushu-Kotoni River occupants were *wajin* pioneers; they were a local population who had plant husbandry rather than a foraging subsistence base. In the seventh, eighth, and ninth centuries AD, the Ezo were known to the early Japanese (*wajin*). In AD 659, a government post was established at Shiribishi on "Watarishima", usually considered to be Hokkaido (Takakura, 1960: 10). Takakura notes that the post was established in order that the Japanese could watch and oppose the Tungus Ju-chen, who dominated the continental Japan Sea coast and who raided the northwestern Japanese coast (1960: 10). Takakura also cites records of the Ezo having brought tribute to Kyoto in the eighth century. Cultigens may have been introduced to Hokkaido through this early interaction between the Ezo and the Japanese. Another possible route of introduction is from continental Asia via the Ju-chen. Furthermore, some of the cultigens may have a long history in prehistoric Japan, including Hokkaido. The Ezo phase may represent a substantial expansion of indigenous, small-scale gardening. For now, we have little confirmatory evidence for these suggestions. At any rate, the maintenance of year-round villages in ninth century Hokkaido was facilitated by plant husbandry rather than by fishing and hunting alone.

Archeobotanical questions which are still unresolved include the taxonomy of Ezo wheat and its relationship to other Asian wheats. It seems to be a distinct Asian variety. This would not be unusual, because wheat has a long history in Asia. Its sphaerococcoid appearance is puzzling. The collection needs to be carefully examined for the presence of barnyard millet, and the legumes of the genus *Vigna* require closer examination to resolve questions of interspecific variation.

Finally, we question the apparent disappearance of plant husbandry in Hokkaido in the second millennium AD. Did agriculture completely disappear from the island, to be reintroduced by the Japanese, or did some gardening remain? Whatever the case, plant husbandry played an important role in the history of the Ainu. Research on Ezo phase subsistence and paleoethnobotany is currently underway in order to answer these and other questions.

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Note Added in Proof

The distribution of a compact wheat, according to some literature we recently uncovered, included Korea and southwestern Japan as well as Tohoku and Hokkaido. A sample of 100 wheat caryopses from the AD 700–800 Puyo site in Korea averages 4·1 × 2·2 × 1·8 mm (Naora, 1956). Some non-compact wheat is also reported from the same site. Naora (1956) also reports late Yayoi wheat from the Haranotsuji site on Iki Island in Tsushima Strait between Korea and Japan, but he provides no measurements. Wheat from the Kofun period Sohara site, Yamanashi Prefecture, also appears to be a compact type averaging 4·4 × 3·5 × 2·8 mm (Naora, 1956: 283). Compact wheat continued to be grown in Japan until at least the end of the 19th century. Three caryopses come from a Heian period well (contemporaneous with Sakushu-Kotoni River) at the Otakuroda site, Wakayama city, and measure 3·3 × 2·3 × 1·7 mm, 4·0 × 2·4 × 2·0 mm, and 4·5 × 3·0 × 2·7 mm (Sato, 1971: 200). Okada Fumio (1985) reports 23 specimens of Heian period wheat from a well at the Nishiohji-Shichijo site in Kyoto. No measurements are provided, but one of us (Crawford) was able to examine the specimens and they are similar in size and shape to the Ezo wheat. The same wheat occurs in samples from the Kyoto area from the early 10th century until the end of the Edo period (late 1800s) (Okada Fumio, pers. comm.).

Analysis of the remainder of the Sakushu-Kotoni River samples has brought to light a single safflower achene from pit 4. The number of rice grains now totals 19 from three separate garbage areas. In addition to the sites mentioned in the text, three more Ezo period sites with cultigens have been reported. These are the Kamoenai site in the Shakotan Peninsula where one foxtail millet grain is reported from one small flotation sample, the Satsumae site in the Matsumae Peninsula where rice, foxtail millet, broomcorn millet, barley, and possibly sorghum were recovered (Yamada, 1986), and the Kagawa site in Tomamai where we recovered barley, broomcorn millet, and foxtail millet in a flotation sample from 10th century AD house floor. Finally, the name of the Opiraushibetsu site was changed recently to Obiratakasago.

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