(SS29) Use and management of plant resources in prehistoric periods in East Asia

Date: August 27
Place: Room 5333 (oral), Room 6310 (poster)
Organizers: Shuichi Noshiro & Yuichiro Kudo
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Purpose: Human interaction with plant resources in prehistoric periods has been clarified dramatically in Japan and adjacent areas during the last ten years. We now know that the people in those periods were not plain hunter-gathers, but did manage plants resources around settlements and used them variously. In this symposium, we review the recent research results mainly carried out in Japan and deal with relevant environmental changes and use of various plant materials including timber, fruits, seeds, tubers, fibers, and lacquer, also touching upon introduction of plants from adjacent areas. Besides these reviews, we would like to present prospects for future research including topics such as identification of origins of plants and plant materials.

Oral Presentation

Aug. 27 [AM2] Room: 5333

Chair: Yuichiro Kudo

10:50-11:30 **[Keynote] Pre-agricultural management of plant resources during the Jomon period in Japan** SS29-O01 (375)

Shuichi Noshiro

Chair: Shuichi Noshiro

11:30-11:50 **Vegetation history of Japan since mid-glacial based on palynological data** SS29-O02 (390)

Nobuo Ooi

11:50-12:10 **Utilization of pant foods and the earliest Jomon pottery in the late Glacial Period** SS29-O03 (255)

Yuichiro Kudo

Aug. 27 [PM2] Room: 5333

Chair: Yuichiro Kudo

14:30-14:50 **Reconstruction of consumption of starchy food in prehistoric Japan from starch granules** SS29-O04 (468)

Ayako Shibutani

14:50-15:10 **Prehistoric selection of plant materials for various types of weaving in Japan** SS29-O05 (243)

Kazutaka Kobayashi, Shuichi Noshiro, Yuka Sasaki, Mitsuo Suzuki

15:10-15:30 **Establishment of chestnut resources around human settlements in prehistoric Japan deduced from the dispersal characteristic of its pollen** SS29-O06 (595)

Masanobu Yoshikawa

15:30-15:50 **Prehistoric change in the size of fruits and seeds implies human selection of plant**

resources SS29-O07 (594)

Junko Yoshikawa

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Chair: Shuichi Noshiro

16:20-16:40 **Mead, as an attractive prehistoric beverage back into the Bronze Age based on human coprolite studies from Sweden and Austria** SS29-O08 (340)

Dagfinn Moe, Klaus Oeggl

16:40-17:00 **Deforestation and surface environmental change since 8th century from vegetation reconstruction based on high-precisioin chronology at Tagajyo archeological site, northeastern Japan** SS29-O09 (593)

Akihiro Yoshida, Mitsuo Suzuki

Poster Presentation

Aug. 27 [PM1] Room: 6310

13:30-14:30 **New refinement of plant impressions using Replica-SEM Method** SS29-P01 (116)

Eiko Endo

Early agricultural evidences in Xiahe Site during the Neolithic, Shaanxi province, China SS29-P02 (466)

Xue Shang, Pengcheng Zhang, Xinying Zhou, Zhenwei Qiu, Yating Qu, Weilin Wang, Changsui Wang

SS29-O01 (375)

Pre-agricultural management of plant resources during the Jomon period in Japan

Shuichi Noshiro

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Human interaction with plant resources in prehistoric periods has been clarified dramatically in Japan and adjacent areas during the last ten years. In Japan pre-agricultural stone-tool age called the Jomon period starts in the late Glacial period and ends ca. 2500 years ago with the introduction of agriculture and metal tools from the Asian continent. Thus people in the Jomon culture mainly subsisted on collecting plants and hunting animals, but recent studies of their remains clearly show that they were not plain hunter-gathers, but did manage plant resources around settlements and used them variously. In Japan the management of forest resources is clearly recognized since ca. 7000 years ago at the beginning of the early Jomon period, when dominant use of chestnuts and lacquer trees as food, timber, and paint resources began. This preference for chestnut trees is shown to accord with the technical requirement of this stone-age period, and the established use of lacquer trees of this period indicates introduction of trees and lacquer technique from China before this period. The management of plant resources became more multilayered in later the Jomon periods with the invention of the complex processing methods of horse chestnut seeds and the construction of wooden structures for such processing around settlements. Furthermore, recent finds of seed and fruit remains indicate that this management system of plant resources also included selection for

useful traits and cultivation of useful strains, resulting in the production of some forms of cultivars. Although records of plant use before 7000 years ago are scarce at present, occasional finds indicate that people already use plant materials selectively and introduced some plants from the Asian continent. The selection of basket materials, for example, is shown to be established at least 8000 years ago, and this selection was maintained through the Jomon period. In this symposium, we review the recent research results mainly carried out in Japan and deal with relevant environmental changes and use of various plant materials including timber, fruits, seeds, tubers, fibers, and lacquer. We also touch upon introduction of plants from adjacent areas. Besides these reviews, we would like to present prospects for future research including topics such as identification of origins of plants and plant materials.

Keywords: forest resources, Japan, Jomon period, management, plant use.

SS29-O02 (390)

Vegetation history of Japan since mid-glacial based on palynological data

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The pollen assemblages since the mid-glacial in Japan thoroughly compiled into the nine age bands named by their median ages, 40 ka, 20 ka, 14 ka, 12 ka, 9 ka, 7 ka, 5 ka, 2.5 ka and 0.8 ka. Twenty-six major arboreal pollen types are selected for analysis. Whole pollen assemblages are divided into 28 groups based on the dominance of pollen types. The pollen assemblages groups do not directly reflect vegetation types, but it is also true that a pollen assemblage definitely closed relation with vegetation. Distribution maps of pollen assemblage groups and major pollen types of each age band are illustrated to consider the history of vegetation and flora. Pollen assemblage changes roughly reflect climatic changes since the mid-glacial, however distribution of pollen assemblage groups did not simply shift latitudinal or altitudinal but expanded and shrunk. On the other hand, chronological successions of pollen types suggest that there is little evidence for plant migration in spite of vegetation changes revealed by pollen assemblage changes. Chronologically sequenced occurrence maps of *Fagus* and *Cryptomeria* pollen types apparently show their ranges had been changed little, whereas frequencies had been changed a lot. Warm temperate pollen types, such as *Castanea*/*Castanopsis*/*Lithocarpus*, and evergreen *Quercus* types, also show same features, although it is not clear because of the pollen identification problem. Pollen types which flourished under the cold and dry climate during the last glacial, such as *Picea* and *Larix* type decreased rapidly during the post glacial, but they might not move to northward. Present distribtuions of their mother plants quite restricted, for example *Picea* which abundantly occurred during the full glacial now fragmentary lived in restricted areas, and *Larix gmelinii* which widely distributed in Hokkaido are extinct from Japan. Vegetation changes since the mid-glacial were not caused by the plant migration, but by the increase of existing species. Another remarkable vegetation changes during the post glacial appeared in lowland. Pollen assemblage groups dominated by pollen types such as *Celtis*/*Aphananthe*, *Cryptomeria*, *Aesculus*, *Castanea*, *Ulmus*/*Zelkova*, *Juglans*/*Pterocarya*, and *Fraxinus*, collectively occurred in time and space. These groups refelct the vegetations on flood plains, alluvial fans, river terraces, and hill slopes, Inconstant occurrences of these groups not only affected by the river condition changes by sea level changes, but also disturbance and selection by human activities.

Keywords: floral change, last glacial, migration, pollen analysis, vegetation history.

SS29-O03 (255)
Utilization of pant foods and the earliest Jomon pottery in the late Glacial Period

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The emergence of pottery in Japan is generally linked with the climatic amelioration and vegetation changes during the Pleistocene-Holocene transition. However, the calibrated radiocarbon dates of the earliest pottery artifacts in the Japanese archipelago show that the pottery emerged at ca. 16 ka cal BP. This date preceded the vegetation change from the subarctic mixed coniferous and broadleaf forest to the cool-temperate deciduous broadleaf forest at ca. 14 ka cal BP at Lake Nojiri, contrasting to the GI-1 on Greenland, and at ca. 15 ka cal BP at Lake Suigetsu. Thus, in the central and northern parts of the Honshu Island, subarctic coniferous forests dominated when pottery was first utilized. The beginning of the pottery use is thought to have enabled use of a number of vegetable foods in cool-temperate deciduous broadleaved forests, such as nuts and acorns that require boiling to temper their harshness. Contrarily, the emergence of pottery and the expansion of cool-temperate deciduous broadleaved forest show no obvious causal connection. The succeeding linear-relief pottery group of the Incipient Jomon appeared in a warmer period (15–13 ka cal BP) of the Late Glacial. However, people in the eastern and northern parts of the Honshu continued to pursue hunting as the main subsistence activity rather than processing vegetable food, because hunting tools dominate in the contemporaneous lithic assemblages. Contrarily, in the southern part of Kushu Island, people of the Ryutaimon pottery group (14-13 ka cal BP) adapted to the cool-temperate deciduous broadleaved forest using a large quantity of pottery, grindstones, and hand stones to process vegetabale foods. The oldest acorns storage pit excavated at the Higashi-Kurotsuchida site contained acorns of *Quercus* subgen. *Lepidobalanus* directly dated 13.4 ka cal BP. Moreover, oldest charred bulbs (*Allium* sp.) and acorns directly dated 13.4 ka cal BP have been recently excavated from fire pits at the Oujiyama site. These discoveries indicate that people in the southern Kyushu already utilized these plant foods for their diet. To examine usage of these potteries, stable isotope and C/N ratio of the charred adhesion on the inside of the Ryutaimon pottery excavated from the Oujiyama site are being analyzed. Emergence of the pottery that enabled hunter-gatherers multilateral use of vegetable foods is regarded as the most crucial event to divide the Jomon from the Palaeolithic. However, human adaptation to climate change during Late Glacial seems to have been more diverse than the generally recognized use of pottery.

Keywords: Incipient Jomon, acorn storage pit, chard bulbs, Ryutaimon pottery, charred adhesion on pottery.

SS29-O04 (468)
Reconstruction of consumption of starchy food in prehistoric Japan from starch granules

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Starch residue analysis, which is a relatively new method in archaeology, can provide significant evidence for plant food resources and processing tools as well as human interaction with plant resources in prehistoric Japan. This paper employed starch residue analysis of pottery to recover evidence for plant food consumption in hunting-gathering populations at the Shimo-yakebe site (ca. 5,300-2,800 cal BP) in the Kanto Plain, central Japan. From the Shimo-yakebe site, forty charred

plant remains adhering to the Jomon pottery were excavated and classified into five groups: scally bulb remains, fibre remains, fruit and seed remains, woven remains, and unidentified macro fossil remains. In this study, thirty-eight charred plant remains belonging to those five groups were examined to assess the preservation of starch residues. Starch residues in these assemblages were well preserved with features that resemble those seen in fresh specimens. Starch granules formed in amorphous plant tissues were also found from residues of the potsherds. This can be the empirical evidence for containing tuber plants into charred remains. Each starch granule was classified according to morphological type based on a range of geometrical forms that correspond approximately to the range of variation seen in published images of starch and in comparative modern starch reference collection. The most common form was circular, and some of these circular forms showed characteristics of starch granules seen into nut and acorn species. The co-occurrence of polygonal form with other forms of starch may indicate the presence of more than two plant species cooked by sampled pots. In the initial visual comparisons of ancient starch samples and modern reference samples, the starch granules found from the Shimo-yakebe site suggest that a mixture of bulbs (Liliaceae), horse-chestnuts (*Aesculus*), walnuts (*Juglans*), and acorns (*Quercus*, or others) were cooked in the pots. These results can show the cooking method of wild plants using pottery in the Middle to Final Jomon periods.

Keywords: Charred plant remains, Middle to Final Jomon periods, plant food, pottery, starch granules.

SS29-O05 (243)

Prehistoric selection of plant materials for various types of weaving in Japan

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The study of weaved items excavated from archaeological sites of the prehistoric and historic ages in Japan has mainly concentrated on their weaving techniques, and few studies has been carried out on their plant materials, although the identification of the plant materials is important for understanding the function and structure of these weaved items. This is probably because the sectioning technique needed for the identification of weaving materials, whose samples are often small and fragile, has not been well established and because comparative microscopic specimens of living plants for weaving, such as young stems, bark, vines, and ferns, were lacking. We have developed an appropriate sectioning method for such excavated weaving materials including constricted dry ones and those processed by PEG or higher alcohol for preservation. Based on the information about weaving materials from Japanese folklore in recent and modern ages, possible living plant materials and their related species have been collected and made into microscopic specimens. Based on a database of living plant materials that we have collected, we are trying to identify excavated plant materials of weaving items. We will present recent findings about weaving materials of prehistoric periods in Japan. The basket materials excavated from the Higashimyo site (late of the earlier Jomon period; ca. 7,000 cal BP) in Saga were tape-shaped torn woods of *Sapindus mukorossi* (Sapindaceae) and *Ficus erecta* (Moraceae), and vines of *Sinomenium acutum* (Menispermaceae) and *Trachelospermum asiaticum* (Apocynaceae). At the Nakamuramachi site (the early and middle Jomon period; ca. 5,600-5,000 cal BP) in Fukuoka, tape-shaped woods of *Quercus* subgenesis *Cyclobalanopsis* (Fagaceae) were identified. At the Shimoyakebe site (the middle-latest Jomon period; ca. 5,300-2,700 cal BP) in Tokyo, tape-shaped woods of dwarf bamboos were identified. These results show that prehistoric plant choice and processing technique for weaving materials

differed between districts in Japan and that their choice has not been handed down to the present. We plan to discuss the correlation between prehistoric selection of plant materials and surrounding vegetation in those periods. It is being clarified that the major materials of baskets are broadleaf trees and vines in Kyusyu District, coniferous trees in Hokuriku District, and bamboos in Kanto District.

Keywords: identification of plant materials, Jomon period, basket material, sectioning method, archaeological sites.

SS29-O06 (595)

Establishment of chestnut resources around human settlements in prehistoric Japan deduced from the dispersal characteristic of its pollen

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Based on the dispersal characteristics of *Castanea crenata* Sieb. et Zucc. (Japanese chestnut tree) pollen, distribution of *Castanea crenata* forests around settlements in the Jomon period was reconstructed. In the present surface pollen assemblages in and around the *Castanea crenata* forest, *Castanea crenata* accounted for > 60% of tree pollen in the inner areas of the forest more than 25m from the edge, > 30% in the outer areas less than 25m from the edge, but, outside the forest, 5% at 20 m and <1% at 200 m from the edge of the outermost tree crown (Yoshikawa, 2011). Furthermore, the number of total airborne and fallen pollen grains during the flowering period of *Castanea crenata* trees decreased rapidly within 15 m from the edge of the *Castanea crenata* forest. Based on these dispersal characteristics of *Castanea crenata* pollen, the distribution of *Castanea crenata* forests around the Sannai-maruyama site in northern Honshu was reconstructed by the spatial investigation of fossil pollen spectra. The distribution of *Castanea crenata* pollen revealed that *Castanea crenata* forests covered most of slopes and edges of the plateau of the Sannai-maruyama site in the late phase of the early to the middle Jomon periods (Yoshikawa, 2011). *Castanea crenata* forests expanded at the Unoki site in central Honshu in the late phase of the earliest Jomon period (ca.8500-7000 cal B.P.). Thus, *Castanea crenata* forests were distributed widely in and around settlements in central to east Honshu in the early to the middle Jomon periods (ca.7000-4420 cal B.P.). It is presumed that Jomon people conserved *Castanea crenata* trees positively in the earliest Jomon period and began to plant *Castanea crenata* trees around settlements in the early Jomon period.

Keywords: *Castanea crenata* forest, chestnut, dispersal of *Castanea* pollen, Jomon period, prehistoric Japan.

SS29-O07 (594)

Prehistoric change in the size of fruits and seeds implies human selection of plant resources

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The size change from wet fruits to carbonized cotyledons was investigated to compare the size of fossil fruits of *Castanea crenata* in different conditions from various Jomon sites. Both in height and

width the size change from wet fruits to carbonized cotyledons had a linear regression. To critically compare fossil fruit size, a volume index for *Castanea crenata* fruits was calculated as the square root of height multiplied by width, because the cubic root of weight and the volume index showed a linear regression. The volume index of *Castanea crenata* fruits slightly increased during the early to late Jomon periods with narrow variation within populations, but varied greatly both between and within population in the final Jomon period.

Keywords: carbonized cotyledon, Jomon period, size of *Castanea crenata* fruits.

SS29-O08 (340)

Mead, as an attractive prehistoric beverage back into the Bronze Age based on human coprolite studies from Sweden and Austria

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Human coprolites have been found, dated, and palynological studied as a part of interdisciplinary works. Pollen of insect pollinated taxa dominates. Significant high values of *Filipendula ulmaria* together with honey suggest mead as a part of historic and prehistoric diet. A proper survey of the use of the plant is so far lacking. Export and import of honey may have been important. Import of honey from south Baltic areas is suggested for the Birka site (Sweden). A survey of records of use of mead known so far is made based of archive documents and published data also from the year AD27. Except for coprolites, traces of old mead are found as crustal crust on the inner side of pots and other earth ware used as important funeral gift from at least from 27th-25th century BC.

Keywords: honey, *Filipendula ulmaria*, Birka (Sweden), Dürrnberg (Austria), Georgia.

SS29-O09 (593)

Deforestation and surface environmental change since 8th century from vegetation reconstruction based on high-precisioin chronology at Tagajyo archeological site, northeastern Japan

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We reconstructed palaeo-enviromental changes during the Late Holocene at Tagajyo archeological site, northeastern Japan, from pollen a wooden remains profiles derived from a robust chronology based on AMS radiocarbon dates and tephra ages of deposits. The profiles indicated vegetation history for hilly areas in the region as follows: 1) before construction of the Tagajyo castle as documented in AD724, a cool temperate deciduous broad-leaved forest consisting of *Quercus* subgen. *Lepidobalanus* and *Carpinus* was naturally distributed; 2) after construction of the castle, spreading grasslands by deforestation; 3) in the mid-8th century, increasing secondary forest *Pinus densiflora*; 4) from late 8th century to early 9th century, secondary forest of *Quercus serrata*, *Q. crispula* and *Fagus crenata* due to mitigate deforestation. On the alluvial plain areas, large-scale rice paddy and upland cultivation started after the construction of the Tagajyo castle. Our pollen results

and documented records may imply that Moraceae was cultivated around the site. The excessive deforestation in hilly areas caused a decrease of vegetation cover and soil erosion, leading to the development of landform in the alluvial plains during the late Holocene.

Keywords: pollen analysis, ancient, cultivated plant, deforestation, Tagajyo.

SS29-P01 (116)
New refinement of plant impressions using Replica-SEM Method

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This paper presents a method of replicating and observing technique for archaeobotanical remains. Flotation has been a breakthrough for macrobotanical recovery in several decades. Before this method has been invented, impressions from pottery and daub were popular archaeological materials to detect plant remains. However, recently impression is evaluated as unreliable, superficial, and non-quantifiable. Hence the author introduces an innovated impression method, Replica-SEM Method, which has been invented by Prof.T.Ushino, and shows how effective this method is to resolve two serious problems; deformation and contamination. Positive replicas are copied from impressions on potsherds using silicone rubber resin, and those replicas are observed with scanning electron microscopy (SEM). Details of surface on replicas are observable under high magnifications (500x and more) due to the high transcription of pottery's clay. Therefore the specific identification based on not only grain size and shape but also anatomically detailed surface texture is much reliable than charred remains. Subsequently, this method is especially effective to small grains like millet which sizes are almost half of barley or rice. Those small grains are very fragile and blurred because of charring. However with Replica-SEM Method, we can observe the whole shape and the fresh surface of grain before charring. Generally, millets are identified with their sizes, shapes, and scutellum lengths, but those criteria are not adequate enough, because morphological changes of charring are complicated depend on the temperature, duration, and amount of moisture. On the contrary, for example, the replicas of domesticated *Setaria italica* are able to divide from those progenitors *Setaria viridis* with their non-ridged papillae on surfaces. Another merit is dating. Using typological sequence of potteries, archaeologists can discuss the chronological placement of the identified grains in the archaeological context. Usually, high-concentration of impressions of chaff is interpreted as temper, but from the condition of replicas covered with the upper lemma and the palea the author infers another formation process that grains are dropped into pottery's clay coincidently during daily food activities like storage, dehusking, or cooking in the houses or around the houses where the pottery were produced. Replica-SEM Method applies to not newly excavated artifacts but those have been secured for a long time, and even for unidentified impressions already reported. Although strategraphic flotation is at the top of the list of priorities, with the high resolution of grains surface, Replica-SEM Method is able to reinforce to grasp the general view of macrobotanical remains.

Keywords: Replica-SEM Method, plant impression, macrobotanical remains, *Setaria italica*, flotation.

SS29-P02 (466)
Early agricultural evidences in Xiahe Site during the Neolithic, Shaanxi province, China

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Archaeobiological proxies such as pollen and seed remains could be used to reconstruct the local vegetation of prehistoric human settlement, crop types and agricultural characteristics, providing valuable information for archaeobiological research. In this study, the vegetation characteristics and agricultural activities are reconstructed using the archaeobiological proxies of pollen and seed remains from Xiahe site in Shaanxi Province between 5300-4800 cal a BP. Compared with low percentage of tree pollen such as *Pinus*, the high percentage of herb pollen such as *Artemisia*, Chenopodiaceae, Compositae indicates that the vegetation in this region was dominated by sparse-wood grassland during the mid-Holocene, and trees were only developed in the valley and mountains. Seed results show that Neolithic agriculture in this region was dominated by foxtail millet (*Setaria italica*) during the late Yangshao age to the early Longshan age, rather than common millet (*Panicum Miliaceum* L.). Charred rice grains (*Oryza sativa*) from ash pit dated about 3900 cal a BP indicate rice cultivation in this region. Meanwhile, numerous sweet clover seeds (*Melilotus officinalis* (Linn.) Pall.) , recovered from the profile and ash pit, imply animal husbandry in this region. However, more evidence is still needed.

Keywords: archaeobiological proxies, pollen, seed, vegetation, human adaptation.