Prehistoric Transitions to Sedentarization and Agriculture in Temperate and Tropical Regions

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Prehistoric Transitions to Sedentarization and Agriculture in Temperate and Tropical Regions

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ABSTRACT

This paper examines the processes of transition to sedentarization and agriculture in two temperate regions (Near East and Japan) and a tropical region (Mesoamerica). Prehistoric sedentarization is connected with the gradual evolutionary process of human subsistence strategies. Sedentarization occurred quickly after the Last Ice Age in the temperate Near East and Japan; however, the pathways to the agricultural society were very different. In the Near East, wheat and barley farming was started quickly after sedentarization occurred, and an agricultural society had been established by ca. 8,500 cal BP. In Japan, however, transition to an agricultural society occurred in the Late Holocene, around 3,000–2,500 cal BP, with the acceptance of rice and millet agriculture from China, although there was knowledge about plant management and cultivation from the Early Holocene (ca. 9,000 cal BP). In tropical Mesoamerica, the domestication of maize and squash began about 9,000 years ago. However, the degree of sedentism did not increase until the Late Holocene (ca. 3,800–3,000 cal BP). These variations in prehistoric human mobility and subsistence change were affected ultimately by the environment, including natural and anthropogenic factors such as climate change and population expansion.

INTRODUCTION

After the last glacial period, most prehistoric hunter-gatherers opted for sedentary village life and agriculture. However, the timing and process of these lifestyle changes differed among various regions. This article presents a brief comparative study of recent archeological and archaeobotanical finds for the process and timing of prehistoric sedentarization and the transition to agriculture by hunter-gatherers in temperate and tropical regions. Data are derived from sites from the Natufian to Pre-Pottery Neolithic B (PPNB) periods in the Near East, the Jomon to Yayoi periods in Japan, and the Archaic to Preclassic periods in Mesoamerica (Figure 1). The prehistoric sedentarization and transition to agriculture of these

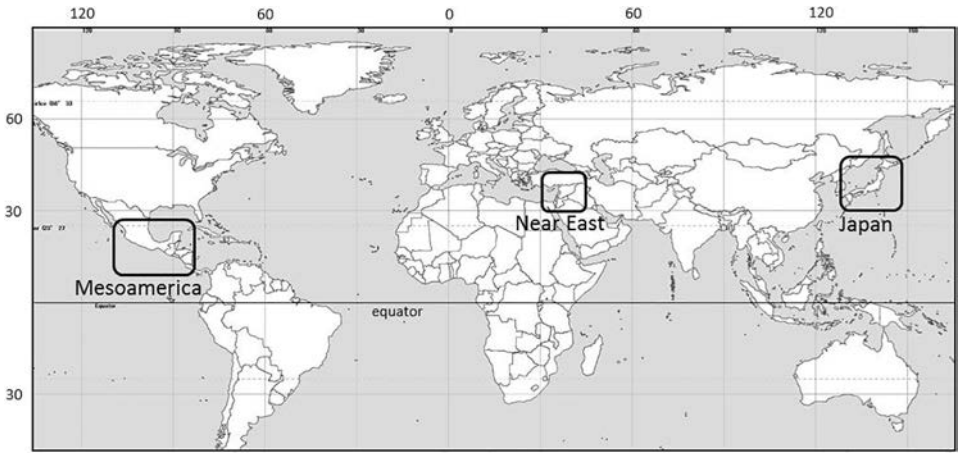

Figure 1 The study areas
Source: Made by the author

three regions has been well studied.

In the Near East, sedentarization occurred at the end of the Ice Age, which was soon followed by the transition to agriculture. In Japan, sedentarization also occurred at the beginning of the Holocene warm period; however, the transition to an agricultural society was very late until the introduction of agriculture from the continent in the Late Holocene. Neotropical Mesoamerica is where plant domestication occurred earlier, in the beginning of the Holocene. However, humans maintained mobile or semi-sedentary lifeways until the mid-Holocene. Why was the process of sedentarization so different in each region? What is the nature of the prehistoric sedentarization? In this article differences and commonalities in the timing and process of increasing sedentism in each region are discussed related to available natural resources, he transition to agriculture, and climate change.

Before comparing these three regions, the methods of measuring the degree of sedentarization and transition to agriculture are summarize from the archeological records (Table 1). Many scholars have already discussed prehistoric sedentism and mobility from the archaeological records (Rocek and Bar-Yosef 1998; Barnard and Wendrich 2008; Cummings et al. 2014). In this article, habitation patterns are categorized into three types: Mobile or nomadic, semi-sedentary (seasonal or lasting several years), and full-sedentary (permanent). Subsistence practices are also classified into five categories: Hunting, fishing, gathering, farming, and herding. These habitation patterns and subsistence practices involved gradual processes, thus making it difficult to categorize simply past human behavior. However, these categories are useful for constructing a working hypothesis on the issues involved.

The degree of habitation patterns and subsistence practices are measured

Table 1 Archaeological evidence to estimate habitation patterns and subsistence practices

Habitation pattern	Subsistence practice
Mobile or Nomadic Semi-sedentary (Seasonal or a few years) Full-sedentary (Permanent)	Hunting Fishing Gathering Farming Herding
Evidence	Evidence
Pottery use House type Settlement pattern Size and weight of tools Existence of garbage and storage places Existence of commensals Seasonal variation of plant and animal remains	Proportion of domesticated and wild plants and animals Hunting and Agricultural tools and places

Source: Made by the author

using a combination of the following archeological evidence: Habitation patterns including "pottery use," "house type," "settlement pattern," "size and weight of tools," "existence of garbage and storage places," "existence of commensalism", and "seasonal variation of plant and animal remains" for measuring the degree of sedentism. However, modern ethnographic studies reveal that some of these cases are not applicable. For example, just the presence or absence of pottery is a weak indicator of the degree of sedentism, whereas increases in the amount and type of pottery would likely be more reliable indicators. It is preferable to consider multiple lines of evidence for measuring the degree of sedentism.

To measure the degree of dependence on agriculture, the "proportion of domesticated and wild plants and animals" and "hunting and agricultural tools and places" are preferable subsistence practices. Recent progress in archaeobotanical and zooarchaeological studies provides several clear examples of cultivation and domestication of plants and animals, in addition to the timing and process of the transition to agriculture for well-studied regions (Larson et al. 2014).

1) Near East

The Near East is the best studied region for understanding the processes of sedentarization and transition to agriculture (Figure 2, 3). Bar-Yosef and Meadow (1995) presented tentative reconstruction maps of socioeconomic entities in this region between ca.15,000 and 7,800 cal. BP (calendar years before present; the original dates show non-calendar year BP). Early Natufian people in the Levantine Corridor established semi-sedentary lifeways around the interstadial (Bølling–Allerød) warm period, 14,500 to 13,000 cal. BP. Activities included gathering wild nuts, growing pulses and cereals, hunting animals, and fishing. The presence of house mice and sparrows indicate sedentary or semi-sedentary occupations (Bar-Yosef 2009). However, during the subsequent Younger Dryas cold period

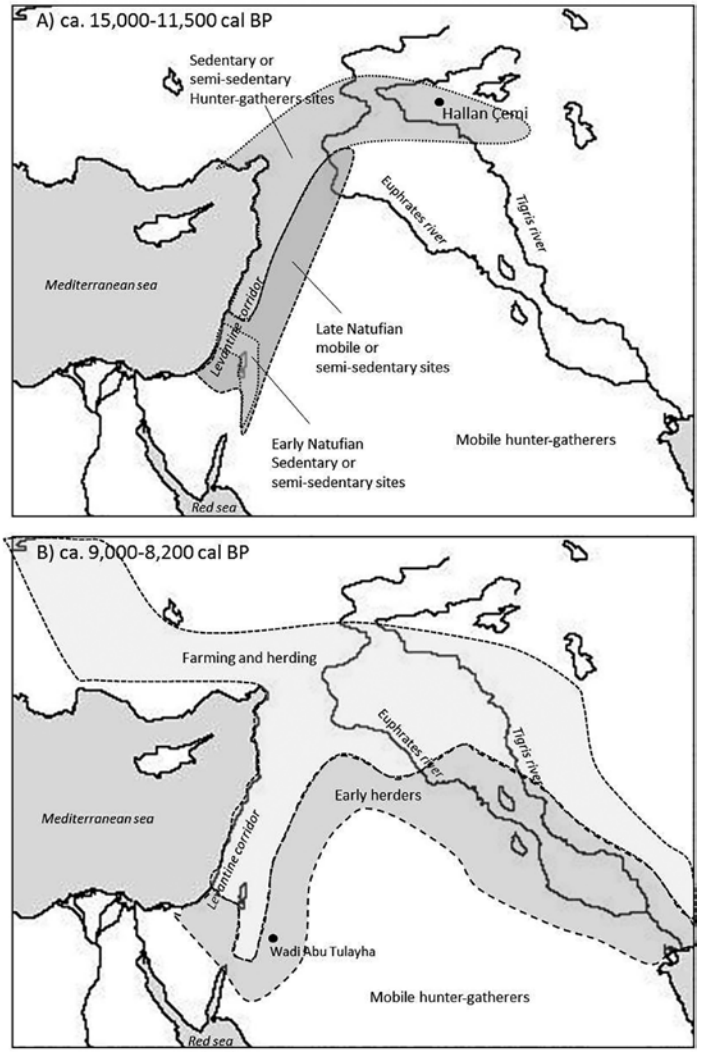

Figure 2 Tentative reconstruction maps of socioeconomic entities in the Near East, modified after Bar-Yosef and Meadow (1995). A: ca. 15,000–11,500 cal BP. B: ca. 9,000–8,200 cal BP. Black dots show archaeological sites mentioned in the text.

(12,800–11,500 cal BP), Late Natufian groups shifted to higher mobility patterns, probably owing to the temporal reduction of natural resources. In contrast, as exemplified by the Hallan Çemi, sedentary communities exploiting variable plant and animal resources presumably existed in southeastern Turkey (Rosenberg and Redding 2002). Bar-Yosef (2009) suggested that the Younger Dryas cold event affected the increase of both mobility and sedentism, depending on location.

Clear signs of cereal domestication, such as the presence of non-shattering

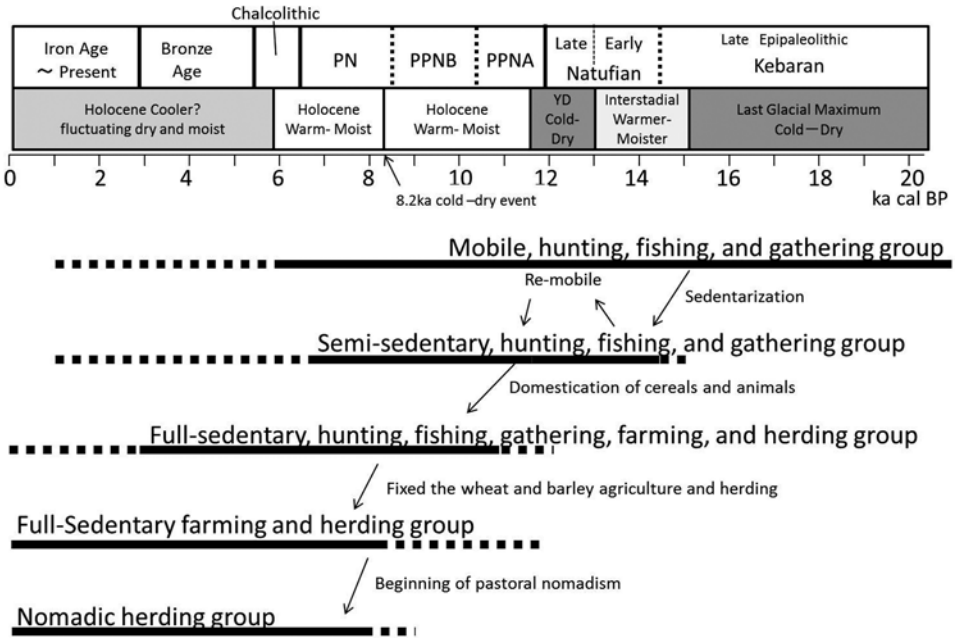

Figure 3 Evolutionary model of process of sedentarization and agriculture in the Near East
These line shows tentative estimate of the possible existence period of each different mobility groups. The solid lines indicate a not clear time range. The tentative chronology and climate data were abstracted from Rosen (2007).

spikelet bases of einkorn wheat (*Triticum monococcum*), emmer wheat (*T. dicoccum*), and barley (*Hordeum vulgare*) occur from the beginning of the Holocene warm period (Pre-Pottery Neolithic A, or PPNA), 11,000 to 10,000 cal. BP. However, a reliance on domesticated cereals increased gradually from 8,500 to 8,200 cal. BP (Tanno and Wilicox 2006; Fuller et al. 2014). The degree of sedentism also increased during the PPNB.

Where sedentism increased with farming and herding in the Fertile Crescent, nomadic herding communities were probably common 8,500 to 8,200 cal. BP around the steppe and desert regions (Cauvin 2000). The excavation of the Late PPNB site of Wadi Abu Tulayha, in the Jafr Basin of southern Jordan revealed that small-scale sheep/goat transhumance was practiced at the hunting outpost in the western steppe or desert region (Fujii 2009; Hongo et al. 2013). Nomadic herding communities probably evolved from such transhumance groups during the end of the Late PPNB or beginning of the Pre-Pottery Neolithic (PPN) period. The 8,200 cal BP cold event may have been a key factor behind social changes, such as the onset of nomadic herding or use of pottery. However, more precise chronological data on the cooling event and archeological records are required to confirm this. Also, importantly, mobile hunting-gathering groups were still coexisting at this time (Bar-Yosef and Meadow 1995).

2) Japan

The first modern humans (*Homosapiens sapiens*) arrived in the Japanese archipelago during the Marine Isotope Stage 3 (MIS3), approximately 38,000 cal. BP (Tsutsumi 2012). The climate had been cooling gradually toward the last glacial maximum (LGM) (Kudo and Kumon 2012) (Figures 4 and 5). People were mobile, and they practiced hunting, fishing and gathering by using edge-ground axes.

At the end of the LGM cold period, the earliest pottery shards are found at the Oodai-Yamamoto Site, Aomori Prefecture, dating from ca. 16,000 cal. BP, during the Incipient Jomon period (Kudo 2012). Although pottery use is one

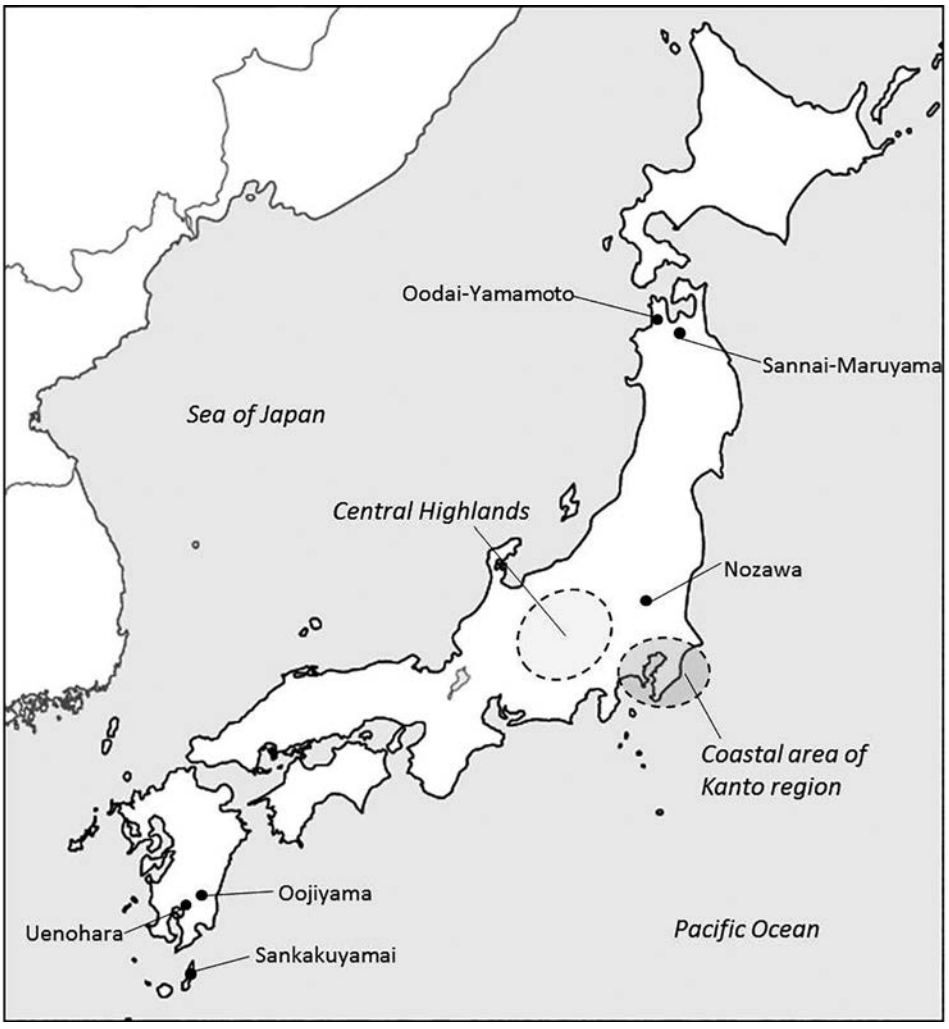

Figure 4 Location of the Jomon sites in Japan mentioned in the text
Source: Made by the author

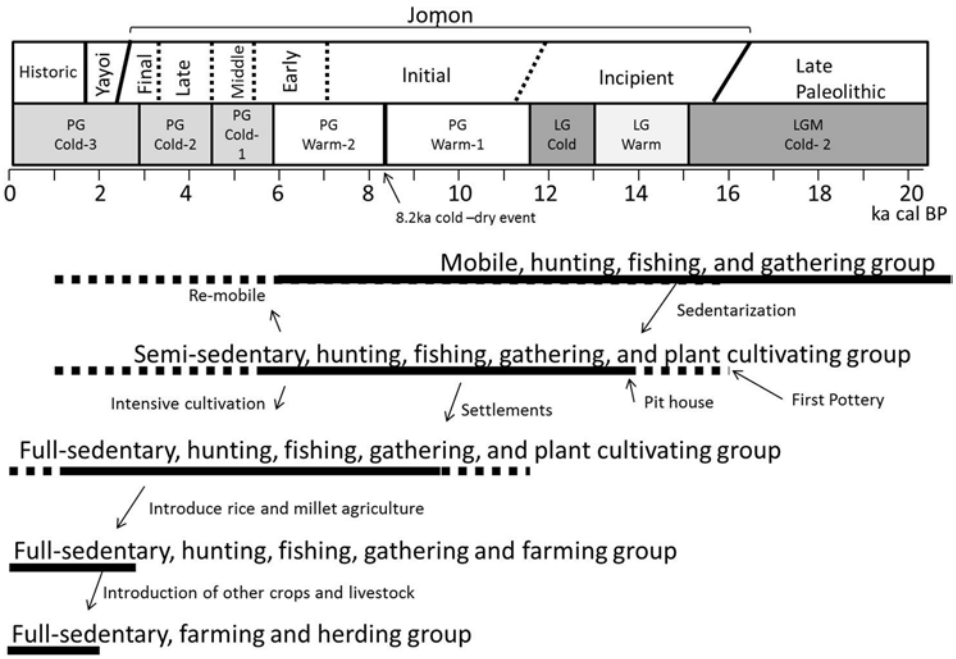

Figure 5 Evolutionary model of the process of sedentarization and agriculture in Japan
These lines show a tentative estimate of the possible existence period of each different mobility group. The solid lines indicate a not clear time range. The tentative chronology and climate data were taken from Kudo (2012).

indicator of sedentarization, no clear evidence of dwellings exists in this stage, so the degree of sedentism was likely low.

Early pit dwellings are found from the Nozawa Site, Tochigi Prefecture, the Sankakuyama I Site, Kagoshima Prefecture, and the Oojiyama Site, Miyazaki Prefecture, all dating to approximately 13,500 cal. BP during the Bølling–Allerød interstadial. These pit dwellings provide more probable evidence of semi-sedentary life.

The earliest large settlement is found at the Uenohara Site, Kagoshima Prefecture, approximately 9,500 cal. BP during the Holocene warm period, also known in this region as the Initial Jomon. Most Initial Jomon people probably practiced sedentary lifeways based on hunting, gathering, fishing, and exploitation of rich natural resources. In addition, the Initial Jomon groups already began cultivating plants, such as the "Urushi" lacquer tree (*Toxicodendron vernicifluum*), "Asa"hemp (*Cannabis sativa*) for fiber and oil, and "Hyoutan" bottle gourd (*Lagenaria siceraria*) for use as water containers (Fuller et al. 2010; Crawford 2011; Kudo and National Museum of Japanese History 2014; Noshiro and Sasaki 2014). Some domestic herbs, such as "Egoma and/or Shiso" perilla (*Perilla frutescens*), were probably also cultivated in the Early Jomon period for use as oil or herbal seasoning.

From the Middle Jomon period, these cultivated plants as well as the chestnut (*Castanea crenata*) were probably managed. Recent archaeobotanical studies revealed a gradual increase in the enlargement in seed size of chestnuts (Minaki 1994; Yoshikawa, J. 2011). Pollen analysis data from the Sannai-Maruyama Site also indicated chestnut management, based on high percentages of chestnut pollen in this period (Kitagawa and Yasuda 2004; Yoshikawa, M. 2011). Specific use of chestnut wood for construction and other purposes (Noshiro and Sasaki 2014) also supports this idea. Cultivation of barnyard millet is also possible in this period (Crawford 1983, 2011; Yoshizaki 1997), although further evidence is needed.

In addition, there has been a recent accumulation of evidence of possible cultivation and domestication of soybean and adzuki bean during the Middle Jomon period (Obata 2008, 2011; Nakayama 2009, 2010; Nasu et al. 2015). The seed size of both soybean and adzuki bean increased from the Early to Middle Jomon periods, demonstrating that Middle Jomon people likely cultivated and domesticated soybean and adzuki bean around their settlements. Such intensive plant management or cultivation suggest that the degree of sedentism during the Middle Jomon was very high, at least in the central highlands of Japan.

However, the degree of sedentism probably varied spatiotemporally. Habu (2004) highlighted that some sedentary Jomon groups in the Kanto region returned to a mobile lifestyle from the end of the Early Jomon to the beginning of the Middle Jomon. Probably, this was connected to a marine regression during the end of the Early Jomon. Decreasing marine resources such, as shellfish, affected negatively the stable life of sedentary coastal hunter-gatherers, perhaps leading to the return to increased mobility among some groups. Although detailed data are required to reconstruct the climate during this time, climate change is a likely cause of social change. Some groups returned to mobile lifeways, whereas others began intensive plant management and cultivation in sedentary villages. Habu (2014) argued that Early Jomon sedentism was not necessarily practiced throughout the year, but was more likely seasonal. In addition, the degree of sedentism changed over a short time period.

Such sedentary or semi-sedentary lifeways gradually shifted to full sedentism after the introduction of rice and millet agriculture, at the end of the Final Jomon period. Cereal crops were introduced to Japan from China via Korea. Although the timing of the introduction of agriculture is still debated, reliable archaeobotanical evidence of rice and millets (e.g., chaffs, charred remains, seed impressions, and phytoliths) do not extend to the end of the Final Jomon (Nakazawa 2009, 2013; Nasu 2014; Nasu and Momohara 2016).

However, the transition was neither sudden nor drastic, but a gradual evolutionary process. Abundant archaeobotanical evidence suggests that the first farmers in the Japanese archipelago were not rice monoculture groups, but broad spectrum subsistence strategy groups (Takahashi 2009) practicing hunting, fishing, gathering, and cultivating of rice, millets, and other plant cultivars. The fully sedentary agricultural groups likely coexisted with semi-sedentary or mobile

hunting, fishing, and gathering groups.

3) Mesoamerica

The emergence of plant cultivation and domestication occurred 9,000 to 6,000 cal. BP in Mesoamerica (Piperno 2011) (Figures 6 and 7). The earliest reliable evidence of carbonized maize (*Zea mays* ssp. *mays*) cobs from Guilá Naquitz Cave, in Oaxaca, Mexico, dates back to 6,250 cal. BP (Piperno and Flannery 2001). However, molecular phylogenetic analysis of Simple Sequence Repeat (SSR) markers of modern maize in the Americas shows that maize was probably domesticated from teosinte (*Zea mays* ssp. *parviglumis*) native to the Balsas River Valley on the Pacific slopes of Mexico (Matsuoka et al. 2002). Using mutation rates of SSR markers, the divergence time between maize and teosinte was also estimated to be later than 9,000 years ago. However, because the most primitive surviving species are from the semi-arid and cool Mexican highlands, Matsuoka *et al*. (2002) assumed that domestication occurred first in the highlands and later spread to the lowlands of the Balsas Valley. Starch grains and phytoliths of maize and squash (cf. *Cucurbita argyrosperma*) were recently found dating from 8,700 cal. BP from sediments in the Xihuatoxtla Shelter, located in the Central Balsas Valle (Piperno et al. 2009). Although the geographical origin of maize is still

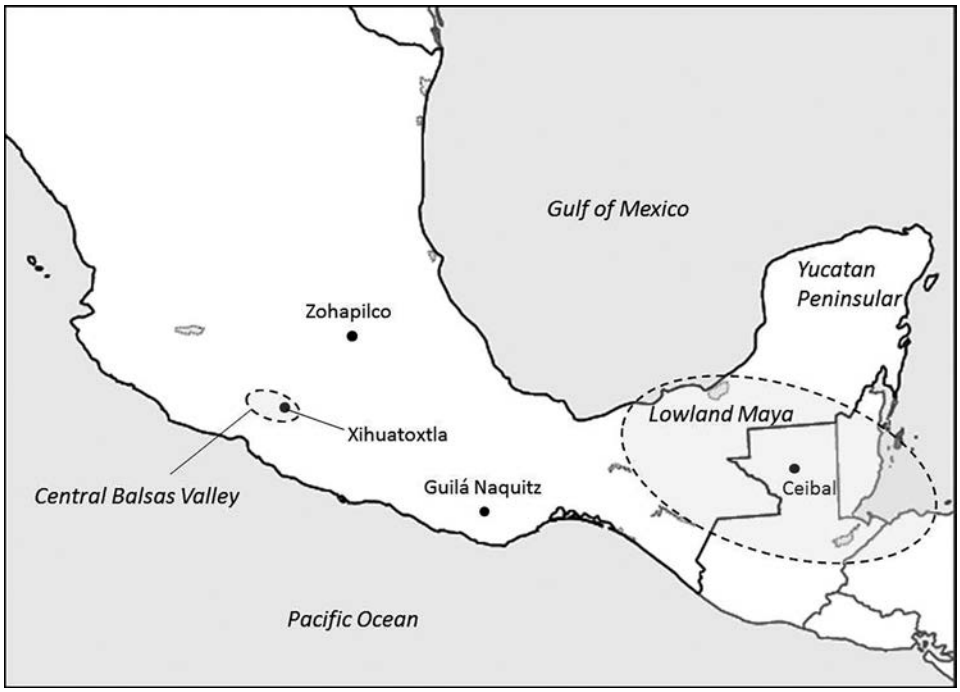

Figure 6 Location of Archaic and Preclassic sites in Mesoamerica mentioned in the text
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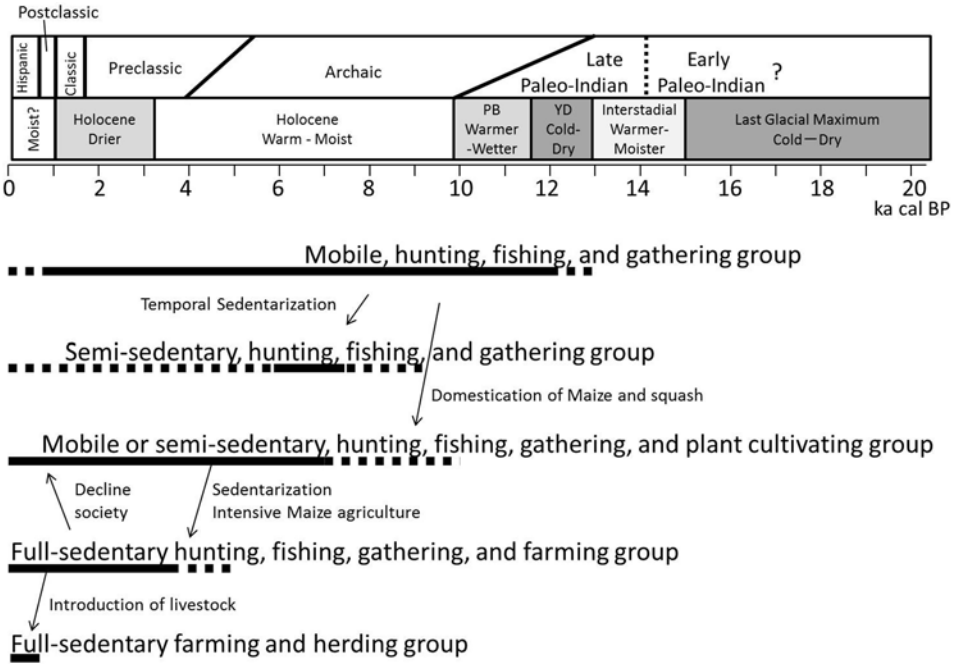

Figure 7 Evolutionary model of process of sedentarization and agriculture in the Mesoamerica
These lines show a tentative estimate of the possible existence period of each different mobility group. The solid lines indicate a not clear time range. The tentative chronology and climate data were taken from Voorhies and Metcalfe (2007), Hodell *et al*. (2008), and Wahl *et al*. (2014).

being debated, this evidence refocuses archaeobotanical investigations on the tropical lowlands.

Although the emergence of domesticated plants occurred early in Mesoamerica, the degree of sedentism remained low. The groups that cultivated early maize and squash were believed to live in rock-shelters or small open-air sites. Most likely, the early stage of maize and squash cultivation involved low productivity, thus requiring mobility to explore other natural resources. However, locations rich in natural resources contained some sedentary villages, e.g., Zohapilcoon on the lakeshore of the Mexico Basin, dating to 7,500 to 5,500 cal. BP (Grove 2000). The village lacks clear evidence of domesticated plants; however, its inhabitants exploited numerous natural resources, such as lake fish, birds, deer, rabbits, amphibians, and wild plants including teosinte. Similarly, inhabitants of coastal sites probably practiced more sedentary lifeways based on collecting shellfish (Clark and Cheetham 2003).

From 3,800 to 3,400 cal. BP, the emergence of durable permanent residences and potteries demonstrate that more sedentary villages existed from Chiapas, on the Pacific Coast, to the Oaxaca region (Clark and Cheetham 2003). Several pollen diagrams from lake sediments around Mesoamerica reveal that intensive maize agriculture started from 4,000 to 3,000 cal. BP (Pohl et al. 1996; Wahl et

al. 2014). In the lowland Maya region of the central Yucatan Peninsula, sedentarization was delayed slightly. Recent intensive excavations along with numerous radiocarbon dates from Ceibal, an early center of lowland Maya society, place the start of sedentarization approximately 3,000 cal. BP. This may have resulted from scarce natural resources in the poor tropical karst region until maize productivity increased.

Intensive maize agriculture led to full-sedentarization and the beginning of civilizations such as the Maya. However, the development of sedentism was likely a complex process involving interactions among diverse groups (Inomata et al. 2015). Some of the population at Ceibal remained mobile even after the introduction of pottery and the subsequent construction of ritual and communal architecture.

Overall, the process of sedentarization in the prehistoric Mesoamerican region occurred as follows (Figure 4). Domestication of maize and squash occurred between 9,000 and 6,000 cal. BP. Although there were some sedentary villages based on hunting, gathering, and fishing the rich resources in lakeshore and coastal areas, most people probably led mobile or semi-sedentary lives until the productivity of maize increased. Intensive maize agriculture, pottery use, and durable dwellings increased from 3,800 to 3,000 cal. BP, indicating the presence of more sedentary villages at the time. However, the timing was not simultaneous and depended on local environmental conditions. Even after the full-sedentary villages were established, different levels of mobile groups probably coexisted and interacted with fully sedentary groups (Inomata et al. 2015).

DISCUSSION

In a broad sense, the degree of sedentism was likely most connected with subsistence strategies in all three regions. Ultimately, it was associated with the amount of available natural resources or domesticated foods. Degrees of sedentism in the temperate Near East and Japan were higher than in tropical Mesoamerica from at least 9,000 to 5,000 cal. BP. In the Holocene warm period, the temperate and humid climate of Japan, and its advantageous geographical situation of being surrounded by the sea provided rich natural resources that enabled sedentary life. In the Near East and Mesoamerica, natural resources were less available than in Japan overall, despite the presence of some resource-rich locations. However, in the Near East, early successful plant domestication and animal herding allowed an increase in sedentary communities. In contrast, the degree of sedentism was lower until 3,800 cal. BP in Mesoamerica. That is because, although the timing of maize domestication was early similar to the Near East, the productivity of early maize was lower. The productivity of maize in Mesoamerica increased from 3,800 to 3,000 cal. BP. Although the reasons underlying this increase remain unclear, they were likely associated with either or both the genetic change of maize and/or climate change. A climatic drying in the lowland Maya region in this time would

have enabled the expansion of a habitat suitable for maize cultivation (Wahl et al. 2014), which formed a solid foundation for the increasing sedentary groups.

Variation in prehistoric human mobility probably was connected with subsistence change. Several positive and negative factors were involved, such as a reduction in food and resources, or the emergence of a new and rich resource. Subsistence change was affected ultimately by the environment, including natural and anthropogenic factors such as climate change, sea level change, natural disasters, forest disturbance, and population expansion. In the case of the Natufian, in the Near East, and the Jomon, in Japan, when prehistoric sedentary groups faced environmental change, some turned to a mobile lifestyle. In contrast, some groups increased their sedentism either by using innovative new technology or finding new resources.

CONCLUSIONS

This article has attempted to compare the sedentarization process of three regions—the temperate Near East and Japan, and tropical Mesoamerica—to understand the nature of this event in the human past. Prehistoric sedentarization is connected with the gradual evolutionary process of human subsistence strategies; reconstructing this aspect of past human lifeways is the key to estimating the degree of sedentism. The degree of sedentism is assumed to vary with the amount of natural resources in the regions of concern. Archaeological evidence from the Early Neolithic of the Near East, Jomon to Yayoi periods of Japan, and the Archaic to Preclassic periods of Mesoamerica show that the degree of sedentism was relatively higher in the resource-rich periods and locations. Sedentarization was also connected with intensive farming; however, it was also depended on the productivity of cultivated plants. To confirm this hypothesis, other regions, such as China, North and South America, Southeast Asia, and Africa, must be compared. Moreover, in future research, detailed chronological comparisons of archeological data and high-resolution environmental change data are required to evaluate causal relations.

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