

Why Didn't Agriculture Develop in Japan? A Consideration of Jomon Ecological Style, Niche Construction, and the Origins of Domestication.

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Abstract Over the course of some 12,000 years, Jomon cultures developed a highly refined adjustment to the Japanese landscape. Japanese archaeologists have exposed Jomon culture in great detail, but because it rested on wild resources, the Jomon era attracts little worldwide archaeological interest. This paper discusses Jomon ecological style in light of niche construction theory to consider the conditions that gave rise to agriculture and domestication. Jomon communities clearly managed much of their landscape and many plant and animal populations. Drawing on ideas from niche construction theory, we argue that qualities of potential domesticates are a central factor in the development of agriculture.

Keywords Niche construction · Agricultural origins · Jomon · Japan

The Jomon era represents more than 12,000 years of the Japanese past. It opened in the waning days of the Pleistocene and persisted as a continuous cultural entity until after 400 B.C. Research on Jomon sites has extended over nearly 150 years, involving thousands of excavations and resulting in a vast amount of literature. Indeed, given the depth of information available on the Jomon era, it has to be considered the most intensively studied and thoroughly known archaeological entity in the world. A number of English-language summaries of Jomon archaeology have appeared recently (Imamura 1996; Hudson 1999; Kendrick 1995), including excellent syntheses by Habu (2004) and Kobayashi (2004). It is ironic, then, that the Jomon era receives scant attention in Western archaeological thinking and syntheses of world prehistory.

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The common archaeological perception in Japan and elsewhere has been that although Jomon cultures had some remarkable complexities—notably large sedentary communities and very early ceramic tradition—they rested on a foraging base that persisted until wet rice agriculture spread from continental Asia into the Japanese archipelago during the Yayoi period after about 2500 B.P. The very long persistence of foraging lifestyles has made Jomon cultures seem irrelevant to one of the most important points of discussion in modern archaeology, the processes that gave rise to agriculture. That perception, and the nature of Jomon subsistence, has become the subject of discussion and debate after *World Archaeology* published a series of papers on Jomon subsistence between 2006 and 2008 (Pearson 2006; Matsui and Kanehara 2006; Crawford 2008). These articles presented recent developments in Japanese ecological research that indicate Jomon cultures cannot be adequately described as “affluent hunters and gatherers.” Richard Pearson (2006) described southwestern Japan as a “hot spot” that fostered the early appearance of innovative technologies—notably ceramics—and the development of social elaboration including sedentary communities and high population densities. Pearson supported his assertion with remarkable archaeological evidence, but he offered no theoretical support or principled basis to explain why southern Japan developed these elaborations. Matsui and Kanehara (2006) offer a different approach to Jomon subsistence. That paper used a consideration of debates about the existence of “Jomon agriculture” to present evidence that unquestionably shows that Jomon communities systematically altered their environments and unquestionably “cultivated” herbaceous and arboreal plant species. In a powerful assessment of Jomon and Ainu subsistence, Crawford (2008) moved discussion of Jomon subsistence even farther by presenting further evidence of Jomon management of environments and species. Significantly, Crawford also used the Jomon case to examine the general relationship between hunting and gathering and agriculture. He shows that research on Jomon subsistence offers clear evidence that the difference between foraging and agriculture is anything but a simplistic dichotomy.

This recent discourse on Jomon subsistence has shown that the excellent research and rich body of detailed information available on Jomon subsistence is relevant, not simply to the Japanese past but to the general consideration of the behaviors and processes associated with the origins of domestication and agricultural lifestyles. Beyond that, evidence that Jomon communities possessed intellectual and practical skills of food production raises the question of why agricultural lifestyles did not originate in Japan and only became dominant there after mature rice farming spread into the archipelago. This paper asks why agriculture did *not* develop in Japan for two reasons. First, this question offers a way of assessing the distinctive qualities of the Jomon era. Second, this question also provides a direct way of bringing Japanese research to bear on archaeological consideration of domestication and agricultural origins. In light of ideas derived from niche construction theory, well-documented achievements of the Jomon era raise basic questions about the conditions that gave rise to agriculture and why some cultures, but not others, became dependent on managed species.

Virtually all attempts to explain the origins of agriculture start with an assumption that it is a human achievement. Grand theories have cast agriculture as a cognitive breakthrough (Darwin 1876), as a cultural revolution (Childe 1951), or as the

realization of human potential (Braidwood 1960). Even recent discussions of how and why agriculture began emphasize human motivation (Smith 1995:16, 207; Tchernov 1998:220). Such emphases seem reasonable in light of well-documented efforts of recent farmers, although as Rindos (1984) pointed out, with no foreknowledge, humans could not have intentionally set out to make the innovations that resulted in agriculture. Human cultural and cognitive ability certainly supported the development of agriculture, but they cannot explain how domestication began.

Niche constriction theory offers an approach to explaining how and why agriculture began without dependence on human volition. Niche construction refers to the active, complex, and formative interactions organisms maintain with their surroundings (Bleed 2006; Laland *et al.* 2001; Laland and Brown 2006; Odling-Smee *et al.* 2003a, b; Smith 2007b). Recognition that organisms change their environments is an established part of ecological thinking (Pianka 1978:237), but niche construction goes a step farther. It focuses on adaptations organisms make to environmental modifications they have caused. In essence, it considers how organisms influence their own fitness. By focusing on underappreciated consequences of these activities, niche construction theorists have extended the well-established dual-inheritance model of cultural evolution (Boyd and Richerson 1985) to a “triple-inheritance” approach. That is, in addition to cultural and genetic inheritance, ecological modifications that species cause and pass on contribute to their own biosocial evolution. By calling attention to the integration of ecological communities, niche construction looks beyond simple coevolution. It encourages consideration of the heightened feedback and evolutionary cascades that result as organisms modify their environment. As a body, niche construction theory also suggests when and how donor-initiated environmental changes can be evolutionarily significant. Simply put, niche construction posits that organisms that actively, regularly, and specifically alter their environment in ways that enhance their short-term fitness will influence their own evolutionary future (Sterelny 2005:24–5).

Jomon Culture and Environment

Japanese archaeologists summarize the Jomon era with a chronological framework of six periods. The earliest of these, called the Incipient Jomon period, was the last to be recognized and is the most incompletely known. As the name implies, this period appears to have been when basic patterns of the Jomon era were developed. The five periods that account for the bulk of the Jomon era are usually rendered in English as the Initial, Early, Middle, Late, and Final Jomon. As amply explained in the summaries referenced above, the temporal limits of these periods are well established, and they have some distinctive qualities. In cultural terms, however, they overwhelmingly represent variations of basic Jomon characteristics. Each of the periods is further subdivided into finer units associated with distinctive ceramic assemblages that form the real categories discussed by Jomon researchers. With them, the Jomon era can be divided into blocks of a few centuries or much less. They also show strong regional patterning. The material diversity of the Jomon era must mean that it was ethnically diverse and complex in human terms. Jomon Japan was certainly not a single cultural entity.

In Japanese popular imagination, the Jomon environment is seen as wonderfully bountiful in part because archaeologists have presented largely positive reconstructions of Jomon lifestyles. Environmentally, however, the Jomon world was much less than uniform. As a long transect of north Pacific coast, the Japanese archipelago crosses an array of environments and climatic zones. There was a major environmental divide in central Honshu. In the pre-modern era, areas to the north and east were covered by deciduous forests. During the Jomon era, many rivers in this area supported large annual runs of salmon. The southern side of the archipelago was marked by broadleaf evergreens. Anadromous fish in this area tended to be smaller species (Matsui 1996). In the course of some 10,000 years, Jomon environment also underwent significant changes. Rising sea levels and climatic changes altered terrain and resources and changed habitable zones (Habu 2001). Indeed, it is fair to say that there were both many Jomon cultures and many Jomon regions. All of this diversity is interesting and significant, but it seems certain that in terms of density and elaboration, the Jomon world had a clear center from central Honshu to southern Hokkaido.

Kobayashi (2004:94ff) famously presented the “Jomon Calendar” as an annual round marked by a staggered sequence of seasonal peaks (see also Price and Feinman 2003:176). The reality of Jomon life was certainly more complex than this model, but it elegantly shows that Jomon communities, especially those in eastern Japan, had access to clusters of fertile environments that annually presented a series of seasonal peaks of abundance. Few, if any, Jomon communities lived in areas that experienced prolonged seasons of low natural productivity. Among the sea, estuaries, rivers, and various inland zones, every part of Japan offered Jomon communities fairly solid resources in all parts of the year. And large-scale seasonal movement was not necessary to Jomon people. They lived in a zone that could support them as sedentary collectors.

Assessment of habitat quality is a knotty problem, but in terms of traditional societies, the Holocene Japanese environment has to be considered a beneficent zone. As a long transect of the north Pacific coast, the Japanese archipelago crosses an array of environmental zones and climates that presented Jomon populations with many different resources. Furthermore, although not a small area, the Jomon environment was compact in the sense that it presented many areas where littoral zones were close to well-watered, forested uplands or other terrestrial zones. Since the terminal Pleistocene, Japan has been covered by broadleaf forests and markedly seasonal climates. This means that the spring season of every year is marked by a burst of plant growth, and there are many nut- or seed-bearing plants. The forests of Jomon Japan also supported mid-size game animals—shika deer and boars. These were non-gregarious and non-migratory, although some populations “yarded” into winter groups in high-snow areas. Sea levels and coastlines changed during the Jomon era, but since the terminal Pleistocene, Japan has always been a network of islands. It was, however, never completely isolated. The bits of open sea that separated Kyushu from the Korean Peninsula and Hokkaido from Siberia via Sakhalin appear not to have been blocks to human contact. Furthermore, the north Pacific was a dynamic marine environment so that in pre-modern times, a great many wild populations moved by, to, or through Japan. These included migratory birds and sea life ranging from sardines to whales. Many rivers, especially in eastern

Japan, supported substantial annual runs of anadromous fish (Akazawa 1986; Matsui 1985, 1995). The marked peaks of these resources, especially when they occurred in relatively confined spaces like rivers, encouraged focused collecting techniques.

The physical scale and orientation of the Japanese archipelago must have contributed to the development of a distinctive Jomon style. In pre-modern terms, Japan was certainly large enough to support a large array of viable separate communities. At the same time, as occupants of an island chain with closest proximity to the rest of Asia only at the extremities, Jomon cultures may not have been easily drawn into trends, events, and developments made on the Asian mainland. The isolation was far from complete. There is hard archaeological evidence that continental people visited Jomon communities. At the Itoku site in Kochi Prefecture in southern Shikoku, both human and animal bones with modifications caused by metal tools were found in a deposit dating to 3200–2800 B.P. (Maruyama *et al.* 2004). The modifications appear to have been made by metal swords or knives and are consistent with violent conflict (Matsui 2005). The site also included the lid of a lacquered container that originated in southern China during the Warring States period (770–221 B.C.). These observations and artifacts can reasonably be interpreted as evidence that metal-using foreign invaders reached Jomon Japan. Less dramatically, stylistic similarities between Late and Final Jomon ceramics from western Japan and pottery from the Korean peninsula also suggest cultural contact (Habu 2004:208ff). Studies of material recovered on isolated islands show that Jomon cultures had the technological wherewithal to travel across large spans of open ocean and certainly could have reached the Korean peninsula. For all of these reasons, patterns of Jomon life cannot be attributed to isolation from “advanced” regions of East Asia.

Jomon Ecological Style

The richness of the Jomon archaeological record and the specific complexity of Jomon culture and environment make archaeological synthesis difficult. No summary can be complete. No synthesis can address all of the issues that have been raised by Jomon specialists. But ecological research which has emerged as an important thrust in Jomon studies offers means of organizing and looking beyond the welter of specific information on Jomon culture. Indeed, considered in broad terms, the most distinctive feature of the Jomon era may not be its temporal, regional, and stylistic variants, but a foraging economy based on a distinctive ecological style that was the basis of life in Japan for some 10,000 years. We believe that three ecological patterns can help to understand distinctive developments of the Jomon era.

Adjustment to an Anthropogenic Environment

Archaeological surveys that cover essentially all of Japan show that the entire archipelago was occupied by Jomon communities. The size and density of these settlements varied through time and space (Habu 2002, 2004:79ff; Imamura 1996:93; Koyama 1978). Some Jomon settlements may have lived in near-isolation and some regions appear to have been largely depopulated at some times.

In other cases, the Middle Jomon of the Chubu and Kanto districts, for example, Jomon communities formed regular networks. The dearth of flat lands in many parts of hilly Japan concentrated settlements in relatively small areas. Whether they were used as bases for foraging or focused resources collecting (Habu 2004:7ff), the size, durability, and density of Jomon settlement in many areas make it easy to believe that zones around and between settlements were consistently subject to human modification (Crawford 1997; Matsui and Kanehara 2006).

Palynological and paleoethnobotanical investigation into the environments around Jomon site has been actively pursued in recent years, but not presented a simple picture. Pollen columns from diverse portions of eastern Japan suggest to Yasuda (1978, 1995) that Jomon communities existed in deciduous forests that were anything but stable or uniform. Some researchers have cited high frequencies of chestnut pollen as specific evidence that they may have been either “cultivated” or at least encouraged. Alternative views of palynological and botanical evidence appear to show that large portions of Jomon Japan were marked by plant communities that were richly diverse in ways that would be consistent with regular anthropogenic disturbances (Crawford 1983, 1997). In ecological terms, then, the immediate contexts for human communities of the Jomon era were subject to consistent, pervasive human manipulation. The palynological data strongly suggest that the nature and intensity of human impact around Jomon communities varied in different regions and at different times, but they persisted for several millennia. For that reason, anthropogenic zones around Jomon communities were durable enough to present selective environments for plants, animals, and humans. In those terms, it seems accurate to view humans as the “keystone species” in Jomon Japan (Mills *et al.* 1993; Wright and Jones 2006). Their impacts on the composition and distribution of organism within Japan exceeded their relative abundance.

As outlined by Matsui and Kanehara (2006: 268), human impact on Jomon environments had diverse implications. In some cases, human disturbances enhanced the natural productivity of the zone around settlements. In a classic analysis, after noting that many of the mollusk shells from several Jomon shell middens showed signs of growing on sticks, Sakazume (1961) suggested that occupants of the site had “cultivated” oysters. Modern researchers now doubt that Jomon folks intentionally set out to modify the beaches where they gathered shells, much less that they intended to “cultivate” specific mollusk species. Occupying the littoral zones at the scale of a major Jomon community did, however, unintentionally introduce enough artificial detritus to improve mollusk reproduction. With or without intention, this kind of environmental disturbance would have been an enhancement for both mollusks and Jomon folks.

The major land animals taken by Jomon hunters—deer and boars—appear also to have been impacted to human alternations of the Jomon environment. Boars (*Sus scrofa*) were the largest land animals in western Japan and may have had a particularly close relationship with Jomon people and communities. The distribution of boars on small islands such as the Hachijo and even Hokkaido, where they were not native, reflects transport by Jomon people (Kobayashi 2004: 87ff). And even if evidence of pig herding is scanty, a couple of lines of evidence suggest that Jomon people drew heavily on pig herds that operated near human settlements. Carbon and nitrogen isotope analysis of *Sus* bones from Jomon sites in Okinawa are different

from samples from Neolithic sites in China and Korea. Jomon pig bones are characterized by relatively high ^{15}N content. This makes them similar to contemporary human bones and suggests that the pigs were eating fish and other seafood that might be available from human leftovers and excrement (Matsui *et al.* 2002). Wild boars may have been attracted to areas around Jomon communities because, in addition to food, humans and the dogs they kept may have scared away large predators—wolves, bears, and even wild cats—found in more isolated zones. In addition to being stable and distinctive, areas around Jomon communities may have been relatively safe.

Shika deer (*Cervus nippon*) were the major land animals taken by Jomon hunters in eastern Japan. There is certainly no evidence that deer were ever assertively managed by Jomon folks, but humans and deer do appear to have operated in close association. With rich browse and low numbers of wild predators, disturbed plant communities near active and recently abandoned Jomon communities may have been attractive to deer and, for that reason, prime hunting territories. The primary terrestrial hunting weapons of the Jomon era were bows and stone-tip arrows, but in continuity with patterns that reach back to the later Paleolithic, those relatively light projectile systems were used in conjunction with pit traps (Imamura 1996:79ff). Effective intercept hunting involved systemic use and placement of traps and hunters. In that regard, it is significant that networks of deep, narrow pits, sometimes fitted with pointed stakes at the bottom, have been found in a number of areas and frequently on the margins of community sites. It is hard to see how this placement could have functioned as an effective means of funneling game movements while people were occupying the village. Instead, it appears that Jomon hunters recognized and made use of the potential of disturbed environments. As further evidence that Jomon folks kept track of abandoned village sites, Habu (2004:198) points out that there are instances of Jomon folks using cemeteries near communities that were no longer occupied.

Technologically Enhanced, Sedentary Collecting

The Jomon era was marked by a core of durable technologies that supported bulk collection of wild produce. Ceramic assemblages present clear evidence of bulk food processing. Jomon ceramics, especially those that date from after the Middle Jomon period, came to include many specialized forms. There can be little question that although Jomon cuisine included refined dishes and elaborate presentation, for the entire era, large, open cooking vessels were the dominant form. Large batches of stews, soups, and other mixed and simmered dishes must certainly have been the staple of the Jomon diet.

With a great many biodegradable components, Jomon hunting and fishing kits are known in less detail, but littoral, estuary, and upland forest zones that hunters visited provided an array of produce. Investigation of wet sites has flourished in recent years and exposed essentially new facets of Jomon material culture. Notably in that regard, the Initial Jomon middens at Higashi-Myo in Saga City (Saga-shi Kyoiku Inkai 2006) and Awazu (Iba *et al.* 1999) on the bottom of Lake Biwa show that from the very beginnings, bags and large baskets, well-suited for assembling masses of unprocessed materials, were an element of Jomon material culture. At Higashi-Myo,

sealed below saturated clay marine sediments dating from before 7000 B.P., more than 500 baskets and woven artifacts were found. More than 80% of these were made from the bark of broadleaf trees, and the rest were made from systematically recovered vines or roots. In addition to the regularities of production, the fact that the baskets were fairly standardized suggests they were part of highly patterned harvesting (Nishida *et al.* 2006).

Jomon communities also present clear and consistent evidence that plant and animal stores were assembled and processed in bulk. Storage pits that were designed to hold masses of chestnuts, acorns, as well as other nuts and plant foods and dried or smoothed fish are very common in Jomon sites after the Initial Jomon period. Posthole arrays that appear to reflect drying racks are nearly ubiquitous in Jomon, and in eastern Japan, there is ample evidence that raised pole storage structures were a common feature of residential areas.

Active Management of Plants

Investigation of ecofactual materials, and especially plant remains, has emerged as a major thrust of Jomon research. Systematic recovery of ethnobotanical remains (D'Andrea *et al.* 1995; Crawford 1983, Matsui and Kanehara 2006; Sato *et al.* 2003), investigation of wet sites, and sympathetic analysis of “perishables” has revealed a complex Jomon vegetal technology and that Jomon diets were rich in plant foods.

In technology, the cord marking that gives Jomon (rope pattern) pottery its name is a clear evidence of production and the use of vegetal fibers. Systematic investigation of impressed pottery made it clear that Jomon folks made several kinds of nets, fabrics, and textiles, as well as woven, twined, and coiled baskets (Yamanouchi 1964; Ito 1966). Recent research, and especially the systematic exploration of wet sites (Matsui 1992, 1999), has revealed that fiber usage went far beyond cord marking on pots. Recovery of preserved fragments shows that a great deal of Jomon clothing was made of twisted nettle and false nettle (*Boehmeria*) fiber (Ozeki 1996) that was woven into sheets on weighted warp-frame looms. The same sorts of fibers were used for burden bags, large fishing nets, and a variety of baskets and mats. Fibers made from bark, bast, and woody stems were also used for the production of baskets. Dugout canoes, bow staves, tool handles, and other carved or bent objects recovered from several sites indicate that Jomon people had a rich woodworking technology and that they were adept at making effective use of structures presented by different species and particular pieces.

The archaeological record also presents strong evidence that Jomon artisans were adept at processing plants to make them useful (Matsui and Kanehara 2006:264ff). In addition to the cooking, storage, and transportation facilities already mentioned, querns, grindstones, hoes, and axes that are common from the Early Jomon period onward present graphic evidence that Jomon folks were well equipped to assemble and use plant food. But perhaps the clearest evidence of sophisticated plant processing during the Jomon era is presented by lacquered artifacts. Starting at least by the Early Jomon period, lacquer was used to finish and decorate objects of wood, fiber, and ceramics. Lacquering is an intrinsically complex task since it involves the use of the sap of *Rhus verniciflua*—poison oak. Only individuals who have worked

long enough with the sap to overcome the natural reaction to its toxicity can do this work, so lacquer artifacts must reflect social and economic complexity. It also reflects deep understanding and enduring management of specific plants. Even if the trees seed themselves, rendering sap from lacquer trees requires clearing competitors, pruning the main stem to make it straight, and flowing. Then the tree has to be tapped by repeatedly scarring and regularly visiting to collect the sap. It is anything but random “gathering.” And that brings up another kind of evidence on the relationship between Jomon cultures and plants.

Beyond simply using a large number of plants with intensity and skill, a couple of lines of evidence indicate that Jomon folks actively managed plants they used. It is hard to believe that simply understanding the potentials and characteristics of plants, even treating them in highly regularized ways, would have been enough to let Jomon people produce the things and volumes they did. Sweet chestnut groves appear to have been encouraged in areas surrounding Late Jomon communities. Lacquer ware and a number of other Jomon crafts could not have been produced in the form and amount they were with “wild” resources. Instead, Jomon folks must have been involved in the management of the plants and plant communities they drew on. They must have tended a number of plants and plant communities and systematically influenced the reproduction and productivity of plant communities. The Jomon archaeological situation is interestingly amplified by a recent ethnographic description of traditional resource management techniques of Native groups in North America (Anderson 2005; Gilmore 1932; Wagner 2003) who increased the productivity and utility of desirable plants by regular burning, pruning, coppicing, sowing, weeding, selective harvesting, transplanting, tilling, seed scattering, and other techniques. Direct archaeological evidence of such practices is difficult to recover, but a few examples suggest that they can safely be inferred as elements of Jomon culture, especially if nonfood plants are considered. Making bows that would fit with the highly regularized 10,000-year-long Jomon archery tradition would have required the use of staves that were carefully harvested from plants nurtured during growth (Wilke 1993). The dozens, even hundreds, of regular mats and baskets that must have been present in large Jomon communities required huge amounts of straight, regular fibers, and stalks. These might be “found” in nature, but realistically they could only have been available in bulk as a result of pruning and coppicing plants (Anderson 2005:193ff). Similarly, the current rather sparse distribution of wild nettles in Japan cannot fit the recognition that nettle fibers were a major source of Jomon clothing (Ozeki 1996). The California example (Anderson 2005:160ff) suggests that to clothe themselves, Jomon communities increased the abundance of the vital resources they drew on.

Ecological research also makes it clear that plant food formed a central part of the Jomon diet. From the Initial Jomon period onward, stores of carefully selected nuts—including chestnuts, horse chestnuts, acorns, walnuts—are a feature of Jomon sites (Matsui and Kanehara 2006:268). Seeds and other parts of edible plants have also been reported from a great many Jomon sites. Carbonized bits of processed plant material with nut fragments—popularly described as “Jomon cookies”—have been recovered from Early and Middle Jomon sites in eastern Honshu (Barnes and Okita 1999). Finally, seeds and other parts of edible plants have also been reported from a great many Jomon sites. An illustrative, but certainly not exhaustive, list of

edible plant species recovered from Jomon sites (Kobayashi 2004:235; Miyamoto 2000: 121) includes the following:

Lily bulbs	Green gram	Taro
Arrowroot	Green soy beans	Vetch
Bracken and other ferns	Common millet	Yam
Burdock	Foxtail millet	Goosefoot
Buckwheat,	Japanese barnyard	Upland rice
Crimson glory vine	Millet	Beans (<i>Vigna</i> spp.)
Elderberry	Beefsteak plant	

If Jomon people were working with plants, archaeologically recovered materials indicate that some plants were responding to their effort. Observations made by Crawford (1983:31–34) indicate that barnyard grass was regularly used by Early and Middle Jomon folks in southern Hokkaido and, furthermore, that during this time span, seed size increased. This result should serve as a spur for expansion of long-term trends of ethnobotanical materials. Certainly, the fact that several Jomon plant foods persisted as cultigens in pre-modern Japan can be taken as evidence that they had a long-term relationship with humans.

Nothing is as remarkable about the Jomon era as its end. After developing a refined lifestyle that persisted for some 10,000 years, Japan experienced dramatic human change in the closing centuries of the last millennium B.C. when a distinctively new cultural complex took root in northern Kyushu and spread to the north (Matsui and Kanehara 2006:271). Named after materials that were originally discovered in the Yayoi district of Tokyo, this new cultural complex was marked by a number of exotic, “continental” customs. These include some ceramic and stone working patterns, but those innovations are overshadowed by the appearance of iron and bronze artifacts and wet rice farming. Once in Japan, the Yayoi cultural complex was adjusted to local conditions and incorporated into locally adjusted subsistence activities (Takahashi 2009). Paddy field rice agriculture spread across western Japan so that by 2,000 years ago, this style of farming had spread to central Japan and leapfrogged to the northern end of Honshu. The speed of the spread may be witness to the maturity of the Yayoi agricultural complex, but it certainly also means that Yayoi communities were able to quickly determine areas that were suitable for cultivation. In that light, the end of the Jomon lifestyle may itself be a reflection of the refinement of the Jomon ecological style. When the Yayoi period began, Japan was anything but “wild.” It appears instead to have been thoroughly explored, well-assessed, and largely managed.

Discussion—Why Didn't Agriculture Develop in Japan?

Interest in the origins of agriculture has generated a great deal of research and a large body of information about where and when people began to subsist by managing the reproduction of plants and animals. The process seems to have started, or at least taken off, as the Pleistocene was ending (Richerson *et al.* 2001)). It proceeded at a slower pace in some regions than others (Smith 2007a) so that during Holocene

times, late emerging agricultural systems were swamped by the spread of older, more mature agricultural systems (Smith 1995). In addition to being less than completely simultaneous, agricultural origins have a spotty distribution. Observers disagree on what to consider agriculture or how to count systems that were tentative or less successful than others, but in no more than seven to ten regions (Vavilov 1992; Smith 1995, 2001; Zeder 2006) did humans begin to live off the produce of plants and animals they managed. Those regions varied in climate, altitude, latitude, biotic potential, and human history. They include many river valley corridors, lake margins, and springs (Smith 2007b), but many such areas saw no moves toward domestication. In fact, the main feature these regions share was the development of a close, cooperative ecological relationship between people and small suites of other species.

Jomon Japan is not counted among the areas where agriculture developed, although the richness of the Jomon record and the complexity of Jomon ecological adjustment casts that simple assertion into question. To be sure, resources that presented themselves naturally were the basis of subsistence throughout the Jomon era. Still, the evidence of dogs and pigs indicates that Jomon people understood the benefits and mechanics of animal domestication. The fact that plant species Jomon communities engaged—bottle gourds, barnyard millet, beans, burdock, and more—were among secondary domesticates of historic Japan shows that cultivation reached back to Jomon times. In fact, the evidence of active and expert Jomon involvement in plant and animal communities is so clear that it neatly frames the basic question of agricultural origins. Why did some cultures become agriculturally based while others did not?

The niche construction perspective is easily applied to the Jomon era since there is ample evidence that Jomon folks changed their environment in ways that impacted their own fitness—or at least supported their subsistence activities (Crawford 2008:454). They altered the growth and reproduction of plants and animals in ways that increased their abundance. And they developed effective harvesting and processing equipment that allowed them to thrive in the environment they had created. The Jomon era is an especially well-documented example of a constructed niche, but comparably “domesticated landscapes” have been described in other parts of the world (Terrell *et al.* 2003; Wagner 2003; Yen 1989). Indeed, enough examples of aggressive management of plants and animals have been observed archaeologically and ethnographically (Duer and Turner 2005; Lentz 2000) to suggest that human-constructed environments were common, perhaps nearly ubiquitous, by the Mid-Holocene. Smith (2007b) uses niche construction to suggest that “human experimental interventions” in such zones offered a context for initial human domestication.

Using niche construction theory to focus on the human role in the creation of these environments offers a means of understanding their development, but it cannot explain the origins of agriculture. Jomon Japan shows that sensitive, expert, and extensive human investment in natural systems was not sufficient to result in agriculture. A better use of niche construction is to consider how non-human species interacted with—and shaped—human environmental adjustments. Agriculture has two sides, cultivators and cultigens. What Jomon Japan lacked was not human endeavor but species that could respond to human manipulation in ways that encouraged increased investment.

Domesticates are plants and animals that are fit for human management. They are not common since, as Diamond (1999:132) shows, a handful of species support the world's population. Their fitness has two sides (Bleed 2006). First of all, domesticates must be able to live with people. This excludes species that are overly aggressive, that require large spaces or isolation, or that do not deal well with human company. Cape buffalo, whales, and poison ivy fit in this category. They contrast with the fairly large number of species that are "tamable" or capable of surviving around humans.

Beyond survival together with people, successful domesticates must also be able to outcompete other species that attract human attention. This is the second side of domesticate fitness. Species that responded to human interaction with increased abundance of sustenance or some other vital resource could draw people away from other pursuits and into activities that supported their own survival. This response rested on genetic or behavioral plasticity that let domesticates change rapidly enough to influence human behavioral plasticity. Niche construction can help understand how agricultural systems originated by exposing the factors that allowed successful domesticates to enter and thrive in the human niche. In that sense, agriculture is an ecological niche operated by people, but was "constructed"—at least partially and initially—by species that interacted with humans. Agriculture grew as successful domesticates directed human effort toward themselves and away from other resources.

Agriculture did not develop in Japan because no Japanese species were able to so command the attention of Jomon communities that they stopped fishing, hunting, and harvesting other resources that were available to them. Given its wonderful archaeological record, Jomon Japan is a good place to observe how hunter-gatherers could engineer ecosystems (Smith 2007a). It also presents evidence about why and how the hunter-gatherer lifestyle could flourish without agriculture. Jomon communities certainly interacted in active ways with any number of plant and animal species. Some of those became minor crops in historic times, but none of them are species that became central to modern agriculture, in Japan or elsewhere.

The Jomon example shows that, by itself, intensive, assertive, and deliberate human supervision of other species does not explain the origins of the kind of agriculture that expanded across much of the world in Holocene times. The Japanese case indicates that an important part of understanding the development of vigorous agricultural systems is recognizing that some species had qualities that so attracted human investment that people became committed to their survival. In that effort, niche construction promises to provide useful insights.

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