Slouching Toward the Neolithic: Complexity, simplification, and resilience in the Japanese archipelago

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Abstract

This chapter explores very long-term trends in socio-ecological sustainability in the Japanese Islands with a particular focus on the Neolithic Jōmon period (c. 14,500 – 900 BC). Sustainability is analysed as a means of problem solving rather than as a default result of environmental abundance. Previous research has proposed three main outcomes of long-term problem solving: *collapse*, *complexity*, and resilience through *simplification*. Despite many examples of sudden social change in the Jōmon period, collapse may have been confined to the aftermath of major natural disasters such as VEI-7 volcanic eruptions. Although it has been argued that increasing complexity was a common response to social and ecological problems, the drawn-out process of Neolithicization in the Japanese archipelago suggests that early human societies were reluctant to choose Neolithic complexity when alternatives existed. Jōmon Japan presents perhaps the most contested trajectory towards Neolithicization anywhere in Eurasia.

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Introduction

In recent years questions of past sustainability have attracted a growing interest within archaeology. Although—as discussed below—sustainability has been understood in various ways, archaeologists have embraced the concept as a way to think about the future as well as the past (Hudson, 2013). Questions considered by archaeology in this respect have included the following: How do human societies build long-term strategies of sustainability within particular cultural and environmental contexts? Can we identify historical examples where such sustainability appears to have been maintained over long periods—and could such examples provide clues for building future policies and ways of living? This chapter will discuss these problems using the prehistory of the Japanese Islands as a case study.

Until recently, Japanese archaeologists payed little explicit attention to the natural environment as an independent factor influencing human history (Hudson, 2017). By contrast, the natural background has often been regarded as providing a determining context for the prehistory of the archipelago. Before the first Palaeolithic site was discovered at Iwajuku north of Tokyo in 1949, it was believed that active volcanism had made the Japanese Islands uninhabitable for Pleistocene humans (Takamiya and Obata, 2002). In the early post war period, archaeologists continued to stress the environmental challenges faced by human inhabitants of the archipelago. Since the 1980s, however, there has been a paradigmatic shift towards assuming the *affluence* of prehistoric Japan as a default condition (e.g., Koyama and Thomas, 1981). Writing about the hunter-gatherers of the Holocene Jōmon period, Bleed and Matsui (2010:359) note that, "the Jomon environment is seen as wonderfully bountiful in part because archaeologists have presented largely positive reconstructions of Jomon lifestyles."

An emphasis on the historical importance of Japan's natural affluence can be traced back to a 1937 pamphlet called *Kokutai no hongi* ('Fundamentals of Our National Polity'). This pamphlet argued that Japan boasts a "beautiful nature not seen in other countries" and

that, because the Japanese people possess a communal "exquisite harmony" with that same nature, the archipelago is a "paradise" for human habitation (Thomas, 1999, pp. 180-181). Although the more overtly nationalistic assertions of this wartime publication were rejected after 1945, its basic approach to the relationship between nature and the Japanese nation continues to influence understandings about Japan's past (Reitan, 2017). This relationship can be examined by considering the concept of sustainability.

The argument that sustainability emerges directly from environmental conditions is a common assumption in public debate and in sustainability research in general (Tainter, 2006). The Japanese word for 'sustainability' (*jizokusei*) is rarely used by writers who claim that condition for Japan's past. Instead, fuzzy expressions are widely employed, such as the "protection and preservation of the harmony between man and nature" (Yasuda, 1990, p. 2). When 'sustainability' *is* used, it is typically expressed in religious (Buddhist) terms as, for example, "the need for a heart which does not covet nature and *which can control its desires*" (Yasuda, 2010, p. 185, emphasis added). This last definition is especially ironic because sustainability has been described more precisely as 'the capacity to continue a *desired condition or process*, social or ecological' (Tainter, 2006, p. 92, emphasis added). If the very concept of sustainability begs the question of what we desire to sustain, writing about historical sustainability in Japan has typically made a series of very naïve assumptions in this respect. For instance, it has been claimed that 'traditional' rural practices such as wet rice farming, raising fish in paddy fields, avoidance of the consumption of domesticated animals, and supposedly ancient spiritual beliefs such as animism and Shinto have been associated with high sustainability (Umehara, 1999; Yasuda, 1990, 2010; cf. Reitan, 2017). However, none of these claims have so far been empirically supported in the archaeological or historical records. The desire to place such practices under the banner of sustainable 'harmony' is

reductionist and ahistorical and reflects broader anti-modernist desires in contemporary Japan (Morris-Suzuki, 1993; Ivy, 1995; Vlastos, 1998; Hudson, 2003).

Sustainability as Problem Solving

A series of particular geographic and environmental conditions can be assumed to have provided persistent problems for prehistoric humans living in the Japanese Islands. Many of those same problems continue to impact life in Japan today. Given its location on the Pacific Ring of Fire, tectonic activity has regularly resulted in major volcanic eruptions, earthquakes and tsunami (Barnes, 2015, 2017). Another obstacle is the archipelago's rugged, mountainous terrain with highly incised river valleys. Flat land covers only around 15 percent of the current total area of Japan (Reynolds and Kaner, 1990, p. 296). Mountains are mostly extremely steep and even today are rarely home to permanent settlements. Many rivers are precipitous torrents which are difficult or impossible to navigate by boat. Prior to ubiquitous concrete channelization in the twentieth century, the lower reaches of rivers were subject to frequent flooding and, when swollen by heavy rains, could form 'wildernesses of stones and gravel' several kilometres wide; the 'area of land kept permanently waste in Japan on this account is enormous' (Griffis, 2000 [1883], p. 24).

The mountainous topography of Japan also attenuated the difficulties faced by the premodern state in maintaining a sufficient tax base on limited areas of alluvial land. In the mountains and on the seas, the premodern Japanese continued a diversity of 'nonappropriable subsistence practices' to use James Scott's (2017, p. 135) term. All early states have a problem in preventing peasants from absconding, but Japan's insularity made maritime trade, exchange and piracy a default condition, only effectively regulated by extreme measures such as the Tokugawa 'closed country' policy in operation from the 1630s to the 1850s.

Humans have developed a wide range of solutions, often termed 'adaptations', to changing environmental and social conditions. Such solutions can be more or less successful in responding to the particular circumstances encountered by the society concerned. Path dependency can influence the range of solutions chosen but a resilient society will be able to match solutions to problems at an appropriate time scale (Berger et al., 2007). Based on historical case studies, Tainter (2006) argues that there are three main outcomes to long-term problem solving: ever increasing *complexity*, social *collapse*, or resilience through *simplification*. In hunter-gatherer studies, 'complexity' has become a frequently used term which is often conflated with material affluence. Tainter (2006), however, defines complexity as the increased differentiation of social systems—more parts rather than more nice objects. Collapse represents a rapid (decadal) simplification of a sociopolitical system (Tainter, 1988). This is distinguished from resilience through simplification wherein a society attempts to reduce the unsustainable costs of growth and undergoes a planned simplification.

This chapter analyses historical sustainability in the Japanese Islands as a means of problem solving rather than as a default result of environmental abundance. I use Tainter's work as a starting point to identify and analyse processes of complexity, collapse, and simplification in the Japanese past, focusing particularly on the Jōmon period (c. 14,500-900 BC) and the process of Neolithicization (Fig. 1). Approaching sustainability as a type of problem-solving forces us to ask what dilemmas were faced by people in the past. This in itself is a useful exercise since it is often easier to see the response rather than the original problem in the archaeological record.

Complexity, collapse and simplification in the Japanese past: general comments

Archaeologists and historians have long been fascinated by the collapse of ancient civilisations and there is a huge literature on this topic. Tainter's contribution here has been to

use economic modelling to analyse the *costs* of complexity in terms of energy, labor, money, and time (Tainter, 1988, 2006). Economic 'overshoot' provides a useful way of understanding many past examples of social collapse, including that of the western Roman empire (Tainter, 1988; Tainter and Crumley, 2007). Of Tainter's three concepts, however, 'collapse' is the most controversial and is difficult to apply to many historical cases where significant continuities straddle periods of sudden change (McAnany and Yoffee, 2009). Japanese history has numerous examples of more or less sudden social change but it is hard to identify cases of collapse *sensu* Tainter. Even at the end of Japan's wartime empire in 1945, major economic and environmental crises (Tsutsui, 2003) did not result in social collapse; in fact, there was a generally smooth handover of social control to the American Occupation forces after Japan's military surrender (Dower, 1999).

Perhaps the closest examples of at least regional collapse in prehistoric Japan are associated with volcanic eruptions in southern Kyushu. VEI-7 eruptions of the Aira (ca. 30,000 cal BP) and Kikai (ca. 5300 cal BC) calderas had major impacts on Kyushu and other parts of the archipelago (Ono et al., 1999; Ikeya, 2017). The Aira (AT) tephra is found across all of Japan except for Okinawa and Hokkaido (Izuho and Kaifu, 2015). On both occasions, large areas of Kyushu probably became uninhabitable for decades or centuries, and the Kikai eruption influenced Jōmon groups as far east as Mount Fuji (Barnes, 205; Ikeya, 2017). Sometime after the Aira eruption, Kyushu may have been re-colonised by populations from the Korean peninsula bringing a distinctive type of stemmed blade point (Morisaki, 2015). However, this lithic culture also disappeared quite abruptly, perhaps as a result of further volcanic eruptions in the Kagoshima area (Morisaki, 2015).

Another candidate for regional social collapse might be the population decline in central Honshu between the Middle and Late phases of the Jōmon. Based on Koyama's (1978) estimates, the total population of Japan (excluding Hokkaido and Okinawa) declined

by almost 40% between these two phases, while the decline was almost 60% in the Chubu and Kanto regions of central Honshu. If confirmed, such rates would be similar to the effects of the Black Death in Europe and demographic historians such as Kitō (2000) have modelled the Middle-Late Jōmon decline as the biggest population crash in Japanese history. While Koyama's figures are no more than estimates based on site and house numbers, later research has supported the general *trend* he identified (Imamura, 1996; Hudson, 1999, p. 140; Yano, 2004; Abe et al., 2016; Crema et al., 2016), although—as discussed below—debate continues over possible causes of this apparent 'collapse'.

While there are few other examples of sudden change in Japanese history which could be termed a 'collapse', Japan's past does display trends which might be usefully analysed using Tainter's concept of simplification. Since the Meiji Restoration (1868) and the rapid industrialisation of the late nineteenth and twentieth centuries, Japan has used fossil fuels and import substitution of wood, food and other resources to engage in ever-increasing complexity. For the premodern era, however, future research could compare the costs of complexity *versus* simplification for areas such as agricultural production, centralised military power, and the isolationist policies of the Tokugawa period. As a general trend, premodern Japan appears to have often been characterised by simplification through decentralisation wherein the central state consigned the costs of growth to 'feudal' actors and structures and, from the seventeenth century, to a growing merchant class. In comparison to Europe, it would also be interesting to compare the costs and benefits of overseas trade in promoting complexity. For European historians, any disruption to long-distance trade is seen as an economic disaster (e.g., Campbell, 2016). In Japanese history, in contrast, the supposed benefits of isolation as a type of simplification are sometimes endorsed (e.g., Cullen, 2003).

Unwrapping the Neolithic Package

In the second half of this chapter, I use Tainter's approach to the costs of sustainability to examine the Neolithic. A central problem with the Neolithic was beautifully expressed in the 1960s by the hunter-gatherers in Richard Lee's (1968, p. 33) ethnographic research: 'Why should we plant, when there are so many mongongo nuts in the world?' Fifty years later, James Scott (2017, p. 93) asks the same question: 'Why would foragers in their right mind choose the huge increase in drudgery entailed by fixed-field agriculture and animal husbandry unless they had, as it were, a pistol at their collective temple?' Since Binford (1968), archaeologists have attempted to explain this 'pistol at their temple' in a variety of ways, invoking over-population, climate change, feasting, and other factors. Meanwhile, research over the last five decades has only extended our understanding of the negative aspects of the Neolithic in terms of the well-being of humans and other animals (Scott, 2017).

The shift from foraging to farming involved profound shifts in social arrangements as Neolithic societies became more competitive and independent, severing 'extensive webs of social connections in order to create circumscribed communities who shared access to a body of collective wealth, and the "socialization" of a wider range of non-human entities, including animals, artefacts, and architecture' (Thomas, 2015, p. 1087; see also Barnard, 2007). In terms of Tainter's approach to sustainability, recent research on the Neolithic suggests that hunter-gatherers are more flexible in their potential responses to social and ecological change than are early farmers or complex civilisations. This conclusion is supported by the analysis of Japan in this chapter. Archaeological research is increasingly showing that, while the Neolithic may have been revolutionary in its eventual outcomes, historically it represented a slow and often convoluted process of mosaic change. Over the 'Long Neolithic', different elements of the Neolithic 'package'—such as pottery, agriculture and sedentism—appear in different places at different times. The relative significance of these elements is debated (Gibbs and Jordan, 2016; Kuzmin, 2013; Crawford, 2008; Stevens and Fuller, 2017), as are

the reasons why they were adopted within particular historical contexts (Robb, 2013). This diversity is nicely captured by Fuller and Carretero's (2018) term 'Neolithicities' (Table 1).

Table 1 Neolithicities in Jōmon Japan.

Neolithic trait	*Overview*	*Key references*
Pottery	First appearance ca. 14,500 BC followed by quick geographic spread. Extreme decorative ornamentation peaked in the Middle Jōmon. Increase in functional variety of vessels from Late Jōmon.	Kobayashi (2004); Kaner (2009)
Polished stone tools	Polished axes are common and often associated with woodworking. Chipped stone axes are also found in large numbers, especially in Middle Jōmon central Honshu, and are sometimes associated with cultivation.	Imamura (1996)
Sedentism	Early seasonal sedentism in southern Kyushu from the Incipient phase. Sedentism more widespread from the Early Jōmon. Very large settlements in the Middle followed by a more decentralised pattern in the Late-Final phases.	Pearson (2006); Habu (2014)
Agriculture	Cultivation of soybeans, adzuki beans, barnyard grass (*Echinochloa crus-galli*), lacquer, bottle gourd and Perilla herbs. Many of these plants show evidence of domestication from the Middle Jōmon.	Crawford (2018); Nakayama (2010); Obata (2016)
Animal domestication/ management	Dogs possibly introduced before 7300 BC but oldest directly-dated finds are canine burials at 5400-5300 cal BC. Jōmon dogs were not domesticated from native wolves but introduced, presumably from Korea. Wild boar translocated to the Izu Islands by the Initial and to Hokkaido in the Late Jōmon.	Hongo (2017); Price and Hongo (2019)
Ritual	Rich record of ritual features and artefacts including clay figurines, clay masks, phallic stone rods, stone and wood circles, and highly decorated ceramics.	Naumann (2000); Kobayashi (2004); Kaner (2011); Mizoguchi (2017)

According to Andrew Sherratt, cited in Çilingiroğlu (2005), the term 'Neolithic package' was first used in British prehistory to emphasise the functional relatedness of elements of Neolithic culture. This approach was criticised by Thomas (1991) and others, but to what extent did the Neolithic in Japan in fact consist of a package? After the appearance of pottery, stone tools of the Incipient Jōmon phase underwent three major shifts from edge-ground adzes with large bifaces to tanged bifacial points to arrowheads, implying that there were continuous changes in hunting strategies over this period (Habu, 2014). Sedentism increased in the Early to Middle phases but the Late and Final Jōmon were marked by more decentralised settlement systems. Changes in agriculture are discussed below. The question of the inter-relationships between various Jōmon Neolithicities is one that needs further research.

Problems and solutions: initial observations on Upper Palaeolithic and Jōmon Japan

Perhaps the first point to make about sustainability in prehistoric Japan is that the human populations which occupied the archipelago already displayed many elements of high complexity from their initial appearance in the Islands. Japan certainly provides no support for the progressivist views of hunter-gatherer evolution which are common in the literature (cf. Rowley-Conwy, 2001). As discussed below, Upper Palaeolithic and earliest Jōmon groups employed a number of unusually complex adaptations but, in many cases, it is unclear *why* that complexity was required.

The first question is how to explain the late settlement of Japan. Early hominins appear to have reached China by 2.1 million years ago (Zhu et al., 2018). By one million years ago, humans had spread north to around 40^{o} in continental Asia, and in Europe the warming effects of the Gulf Stream probably enabled hominin expansion up to 53^{o} N (Dennell, 2017). However, humans did not reach Japan (located between 43^{o}-24^{o} N) until much later. From the 1970s, an amateur archaeologist in Japan successfully faked a number of

Lower and Middle Palaeolithic sites, convincing most scholars of an early hominin occupation of the archipelago until his forgeries were exposed in 2000 (Hudson, 2005). On present evidence, however, the earliest human settlement of Japan only occurred around 38,000 years ago (Izuho and Kaifu, 2015). Once humans did reach Japan, they seem to have spread quickly across the whole archipelago. While it was previously believed that Hokkaido was not settled until as late as 17,000 years ago (Reynolds and Barnes, 1984), new dates place the first occupation of that island at around 30,000 BP (Izuho and Kaifu, 2015). Sites in the Ryukyu Islands date back at least 36,000 years (Kaifu et al., 2015).

Why was Japan settled so late? In many respects, the archipelago would seem to have provided a favourable habitat for Late Pleistocene humans. Glaciers were small and only found in high mountains in Hokkaido and Honshu (Reynolds and Kaner, 1990, p. 299). Although small islands are generally difficult habitats for pre-agricultural populations (Takamiya et al., 2015), lower sea levels in the Pleistocene meant that the present islands of Kyushu, Shikoku and Honshu formed one large island known as 'Palaeo-Honshu'; the current islands of Sakhalin, Hokkaido and the southern Kurils formed a 'Palaeo-Sakhalin-Hokkaido-Kuril peninsula' (Iwase et al., 2015). Humans used boats when they eventually crossed into Japan, but a land bridge between Korea and Kyushu had existed in earlier periods and much of the Late Pleistocene fauna of Japan is thought to have crossed this land bridge during the Middle (ca. 300,000-400,000 BP) or Late (ca. 130,000 BP) Pleistocene (Takahashi and Izuho, 2012). The northern land bridge connecting Hokkaido, Sakhalin and the Amur may have been too cold to provide a viable route for much of the Pleistocene, but this route *was* used during the Late Glacial Maximum (LGM) when the harsh climate seems to have forced Siberian populations to move south (Izuho et al., 2012). Once in Japan, available food resources would have included a naïve fauna unused to human predation and Dennell (2017, p. 81) has

specifically argued that, 'In the case of Japan, the first colonists on Palaeo-Honshu, with its endemic island fauna, would have found hunting far easier than on the mainland.'

The Palaeolithic human occupation of Japan employed several complex technologies—such as microblades—which were found on the mainland (Bleed, 2002), but also utilised new adaptations such as distinctive stone tool types (trapezoids, knife-shaped tools and edge-ground adzes), boat-building and voyaging to offshore islands, long distance exchange networks for obsidian and other materials, and communal hunting suggested by pit traps (Ikawa-Smith, 1986; Kaifu et al., 2015; Ikeya, 2015; Sato, 2015; Nakazawa, 2017). Dennell (2017, p. 81) has argued that Japan was settled through a *networked dispersal* wherein 'each community forms part of an integrated network held together by shared traditions, exchange of valued materials, skills and information, and probably kinship.' Networks are an important adaptation for hunter-gatherers in difficult environments yet they involve high social costs and complexity (Fitzhugh et al., 2011, 2016; Hudson et al., 2012).

Japan's Neolithic: costly simplification

The appearance of pottery in the Japanese Islands around 14,500 BC marks the beginning of the Neolithic Jōmon period which continued until the arrival of a full-scale agricultural economy with rice, millet, wheat and barley in the Bronze/Iron Age Yayoi period (900 BC – AD 250). Despite a growing literature on Jōmon subsistence adaptations, it is by no means easy to perform the type of cost analysis of the Jōmon economy required by Tainter. From the currently available evidence, however, it seems that the Jōmon people possessed a rather different balance sheet of the costs of complexity *versus* simplification than that predicted by Tainter (2006). Here I want to briefly consider two examples: (1) ceramic production and use as evidence of high initial complexity; and (2) Late-Final Jōmon trends away from increased agricultural intensification.

(1) Fish and pots: Pleistocene megafauna in Japan, including Naumann's elephant (*Palaeoloxodon naumanni*), Yabe's giant deer (*Sinomegaceros yabei*), woolly mammoth (*Mammuthus primigenius*) and bison (*Bison priscus*), became extinct either during the LGM or shortly thereafter (Norton et al., 2010; Iwase et al., 2015). Debate continues over the possible role of humans in these extinctions, but the disappearance of these animals has often been proposed as an explanation for the appearance of pottery and other new technologies in Japan (e.g., Kidder, 1993; cf. Kaner, 2009). Recent organic residue analyses of Jōmon pottery have found that a strong association with processing aquatic resources straddles the Pleistocene-Holocene transition (Lucquin et al., 2018). Residue analyses show a broader array of aquatic resources by the Initial Jōmon (Lucquin et al., 2018) but it is unclear how or why aquatic resources were processed in pots. Salmonid species lend themselves to mass-harvesting and storage, but they can be preserved by drying or smoking without the use of ceramics. In fact, the use of salmon has long been controversial in Jōmon archaeology: while in theory a nutritionally valuable and widely available resource, salmon remains are relatively rare in Jōmon sites (Matsui, 1996). The fabrication and use of ceramic vessels to process 'front-loaded' (Tushingham and Bettinger, 2013) aquatic foods would appear to represent a clear example of high complexity *sensu* Tainter from the very beginning of the Jōmon period. Processing fish using ceramics must have involved long and complex *chaînes opératoires*, including the fabrication of pots, catching, processing and storing the fish, and then the redistribution and consumption of the final product.

It is unclear to what extent ceramics continued to be used to process marine resources throughout the Jōmon. There was an increased diversity in vessel shapes over the course of the period and it seems likely that new forms such as shallow dishes and spouted and pedestalled vessels came to be used for feasting and other social activities (Kawashima,

2010). From the Late Jōmon (ca. 2500 – 1200 BC), there was an overall increase in the use of marine resources (Hudson, 2019; Sakaguchi, 2007). At the Inariyama site (Aichi), nitrogen isotope analyses suggest a substantial increase in marine food dependence at the very end of the Final Jōmon followed by a decrease in the Middle Yayoi (Kusaka et al., 2018).

(2) Beans and nuts in the Late-Final Jōmon: The use of wild soybean (*Glycine soja*) is reported from Kyushu as early as 13,000 years ago but size increases consistent with a process of domestication first appear in central Honshu in the Early and Middle Jōmon (Obata, 2016, p. 23). The cultivation of both soybeans (*Glycine max*) and adzuki beans (*Vigna angularis* var. *angularis*) was associated with the population increase and cultural fluorescence of Middle Jōmon central Honshu (Nakayama, 2010; Obata, 2016). At the end of the Middle phase, however, this culture underwent a crash and reorganization into more dispersed settlement strategies (Kidder, 1993; Imamura, 1996; Twiss, 2001; Kawashima, 2013). As noted above, a precipitous drop in the number of pit houses at this time is thought to represent a major population decline. Climate change has long been cited as a major factor behind this change: the social framework achieved in the Middle Jōmon became difficult to maintain, it is argued, in the face of climate cooling (Ishikawa, 2010, p. 46). The role of ecological overshoot or environmental degradation around sites has also been suggested by Uchiyama (2006, 2008). Uchiyama describes two contrasting settlement patterns, which he terms ‘clumped’ and ‘dispersed’, with the caveat that the dispersed pattern does not necessarily reflect an overall population decrease. In eastern Japan, large monuments such as stone circles are more common in the dispersed pattern stage of the Late-Final Jōmon. Very broad exchange networks in the Late and Final phases (Bausch, 2017) may suggest lower self-sufficiency, yet such networks require complexity in the sense used by Tainter because of the social costs needed to maintain them.

In the Late and Final Jōmon, adzuki and soybean cultivation expanded into western Japan (Obata, 2016), but in the eastern regions of the archipelago the growing complexity of legume farming was apparently reduced in favour of a broader spectrum of resources. Increased consumption of horse chestnuts (*Aesculus turbinata*) was associated with a new type of processing facility termed 'water reservoirs'. These wooden tanks are assumed to have been used for the time-consuming leaching of toxic aloin and saponin from horse chestnuts (Kawashima, 2016). By contrast, in western Japan this period was associated with wet type storage pits for deciduous acorns which require less leaching (Kawashima, 2016; Hosoya, 2011).

These changes in Late-Final Jōmon subsistence contradict many of the foraging theory predictions made by Tushingham and Bettinger (2019). A shift to a greater emphasis on back-loaded nuts was associated in the Late-Final Jōmon with several traits of what Tushingham and Bettinger term 'expansive territorialism'—territorial expansion, larger social networks, and a probable greater emphasis on controlling access to kin groups as evidenced by the new custom of tooth ablation. On one level, some of these changes may represent a type of simplification *sensu* Tainter, but that simplification was not instituted across the board and is perhaps best characterized as a *different type of complexity*. My argument here is that these changes must be seen against the background of a reluctance to follow the Neolithic pattern of complexity into full-scale agriculture. By the Middle Jōmon, both foxtail (*Setaria italica*) and broomcorn (*Panicum miliaceum*) millet had spread from northeast China to Korea and the Russian Far East (Lee, 2017; Kuzmin, 2013b; Miyamoto, 2016; Robbeets, 2017; Li et al., in press). Clear archaeological evidence for contact between southern Korea and western Japan (Bausch, 2017) shows that the expansion of this Northeast Asian Neolithic was already impacting Late and Final Jōmon cultures, inspiring a diverse suite of responses as Jōmon society continued to resist full Neolithicization.

Bioarchaeology

Since the seminal work of Cohen and Armelagos (1984), numerous studies have demonstrated a decline in human health in the Neolithic. Widely confirmed palaeopathological conditions associated with the Neolithic include increases in dental caries, ante-mortem tooth loss and dental enamel hypoplasias; increases in infection resulting in osteoperiostitis; reduced stature due to growth disruption; and increased levels of trauma from warfare and other violence (Cohen and Crane-Kramer, 2007; Larsen, 2014; Schulting and Fibiger, 2012). There is a long history of research on some of these categories within Japanese anthropology. Numerous studies have shown that dental caries was common in Jōmon populations as compared to other prehistoric hunter-gatherers (Turner, 1979; Fujita, 1995). Although this may reflect the higher number of skeletal remains from those phases, the frequency of caries appears to be greatest in the Middle, Late and Final Jōmon (Fujita, 1995; Temple, 2019). The high overall rate of Jōmon caries is sometimes interpreted as support for agriculture (Turner, 1979). Temple (2019) suggests that increased processing and consumption of nuts from the Late Jōmon may have impacted carious tooth frequencies, but he does not discuss the role of legume cultivation in the same period. In the Yayoi period, caries frequencies are higher than those known from the Jōmon at some sites but are unchanged in other populations (Temple and Larsen, 2007). These findings support the conclusion that, from the perspective of dental caries, the Jōmon can be understood as a Neolithic society.

A number of studies have examined markers of systemic stress in the Jōmon with results often suggesting higher rates of such stress as compared to the Yayoi and later periods (Yamamoto, 1988; Koga, 2003; Sawada, 2008; Temple, 2010). Such results are often explained by the assumption that rice farming provided a more secure resource base than

hunter-gathering (Temple, 2010), but that assumption remains untested. Many bioarchaeological studies of Neolithic Japan have adopted an adaptationist perspective, exploring how Jōmon groups adapted to climate change in the latter half of the period (e.g., Kusaka et al., 2018; Temple, 2007, 2019; Watanabe et al., 2019). However, the impact of expanding Late Neolithic / Bronze Age socio-economic systems from Eurasia also needs to be considered. Kidder (1995) suggested that the late Middle Jōmon decline discussed above may have been caused by an epidemic disease spreading from the continent. The dominant model of the epidemiological history of premodern Japan has proposed that insularity prevented diseases such as smallpox and measles becoming endemic until the late medieval era (McNeill, 1977; Farris, 1985). Given this model, we would expect the Japanese Islands to be highly susceptible to epidemics such as plague if they reached the archipelago. The recent discovery of *Yersinia pestis* from Sweden in an individual dated to 4900 years ago suggests a Late Neolithic plague pandemic which may have spread primarily through trade (Rascovan et al., 2019). The possibility that *Y. pestis* reached northern China during the Late Neolithic or Bronze Age has been discussed by Hosner et al. (2016) and further research including biomolecular analyses is warranted for Neolithic Northeast Asia including Jōmon Japan.

Discussion and Conclusions

Although post war Japanese archaeology has ostensibly shied away from environmental interpretations in favour of more humanistic concerns (Hudson, 2017), since the 1980s environmental variation has been increasingly invoked to explain observed diversity within Jōmon cultures and their following transition to agriculture (e.g., Akazawa, 1986; Kusaka et al., 2018; Temple, 2019). This environmental diversity paradigm focused on complex hunter-gatherers has replaced earlier views of the Jōmon as a Neolithic society, a point made explicitly by Akazawa (1999). Here, I have suggested that the term

'Neolithicities' (Fuller and Carretero, 2018) be used to overcome the sometimes-fraught debates over the status of hunter-gathering versus agriculture in Japanese prehistory. This is not to say that regional variation in resources and diet was not important to Jōmon lifeways—it clearly was and impacted both cultural and biological traits (see e.g., Hoover and Williams, 2016). Robb (2013) sees the Neolithic as a funnel sucking Mesolithic peoples away from their forager worlds. The concept of Neolithicities suggests a need to examine how transitional communities not only resisted this process but employed aspects of the Neolithic menu to build their own lifeworlds. From this perspective, affluent hunter-gatherers like the Jōmon are best understood as part of the Neolithicization process.

Of all the regions of Jōmon Japan, it can be argued that Hokkaido resisted Neolithicization and its unintended consequences for the longest time. Crawford (2008) is right that archaeologists whose research focuses on western Japan have tended to down-play the archaeobotanical evidence for plant cultivation in Hokkaido. At the same time, it is clear that around the coasts and offshore islands of Hokkaido, marine resources remained more central to Jōmon subsistence than in other parts of Japan. Hokkaido Jōmon populations even had a lower frequency of dental caries (2.18 % overall) than elsewhere in the archipelago, probably due to their higher dependence on marine resources (Ōshima, 1996). Cereal agriculture was not, however, fundamentally incompatible with the marine adaptations found in prehistoric Hokkaido. Finds of barley and millets from sites of the Okhotsk culture (ca. AD 500-1200) in northern Hokkaido are interpreted as evidence for a separate introduction of agriculture from the Russian Far East not directly related to the Yayoi farming transition in western Japan (Leipe et al., 2019). Still poorly understood, this Hokkaido farming dispersal shows that we still have much to learn about Neolithicization in the Japanese archipelago.

This chapter has examined long-term trends in socio-ecological sustainability in the Japanese Islands, analysing sustainability as a means of problem solving rather than as a

default result of environmental abundance. Three main outcomes of long-term problem solving have been proposed by Tainter (2006): complexity, collapse, and resilience through simplification. Although Japanese history provides many examples of sudden social and political change, few if any of those changes can be termed a 'collapse' in the sense used by Tainter. Premodern Japanese history displays examples of simplification, resulting in part from the ecological limits of isolation. For the Neolithic Jōmon period, however, it has been argued that Tainter's dichotomy of complexity *versus* simplicity is too coarse-grained to model sustainability. It is not my intention to suggest that the type of economic modelling employed by Tainter can never be used for hunter-gatherer or early Neolithic societies. My argument is rather that for the Jōmon the economic and social costs of complexity were plastic and involved intricate combinations of factors including time, labour, food processing and storage, the costs of territorialism and defence, natural hazards, and climate change. Hunter-gatherer complexity also needs to be approached in terms of the social and ideological costs of Neolithicization, costs that are hard to model using foraging or economic theory.

For over 11,000 years, Jōmon societies had engaged closely with numerous elements of the Neolithic 'problem package', adopting ceramics, sedentism and plant cultivation to varying degrees. With the exception of pottery, these engagements were always marked by a certain caution: the Jōmon people avoided falling completely down Robb's (2013) Neolithic funnel. A full-scale Neolithic eventually reached western Japan with the immigration of farmers growing rice, millets, barley and wheat in the Bronze Age after 900 BC (Hudson, 1999, 2019; Lee, 2017; Robbeets, 2017; Stevens and Fuller, 2017). In closing, however, we can note that Jōmon resistance to the Neolithic began to develop a fatal ambiguity in the Late and Final phases as a growing fascination with external sources of power began to transform Jōmon society. Increased participation in very long-distance exchange networks and a new interest in the outside have surprising parallels with the contemporaneous transition from the

Neolithic to the Bronze Age in Europe as discussed by Kristiansen (2015), Vandkilde (2016) and others, and this changing historical context provides another potential factor in understanding long-term sustainability in early Japan.

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