Okinawa Hunter-Gatherers : The Examination of Hunter-Gatherer Mobility in an Island Context

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Okinawa Hunter-Gatherers: The Examination of Hunter-Gatherer Mobility in an Island Context

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The islands of Okinawa provide an ideal opportunity for the study of long term changes in hunter-gatherer settlement systems. Despite their small size, limited available resources, and relatively long distance from the nearest large landmass, these islands seem to have been occupied by hunter-gatherers from the late Pleistocene to the late first millennium A.D. Systematic investigation of the prehistory of this region can provide keys to answer various questions that are critical to our understanding of hunter-gatherer adaptive strategies. This paper focuses on the questions of 1) whether the initial successful colonizers of these islands were foragers or collectors [sensu Binford 1980], and 2) whether the settlement systems changed significantly through time after the initial colonization. Since islands are "natural laboratories," studies of prehistoric hunter-gatherers in Okinawa allow us to rigorously investigate the questions as noted above, which in turn will elucidate pros and cons of Binford's [1980] collector-forager model.

INTRODUCTION

Throughout most of the history of anthropological enquiry, a high degree of mobility, such as that displayed by the !Kung San, was considered one of the main defining characteristics of hunter-gatherers [KELLY 1992: 49] and that more sedentary hunter-gatherers could be considered "divergences" [LEE 1999: 828; see also PRICE and BROWN 1985]. However, recent archaeological, ethnohistorical, and ethnographic studies have provided considerable evidence for a wide range of mobility among hunter-gatherer groups in the distant and near past [BINFORD 1980; KELLY 1992; PRICE and BROWN 1985].

Why is there so much variation in the degree of mobility practiced by hunter-gatherers? It was once thought that since a reduction in mobility was advantageous for human populations, human groups would be expected to become more sedentary whenever appropriate opportunities arose [BEARDSLEY *et al.* 1956; BROWN 1985]. However, studies on hunter-gatherers conducted since the 1960s have revealed that more mobile lifeways are less stressful than more sedentary lifeways [BINFORD 1980; BROWN 1985; LEE 1968, 1999].

In his examination of the relationship between environment and mobility, Binford [1980] offers one possible explanation that might account for the observed variation in hunter-gatherer mobility. He suggests that more sedentary hunter-gatherers (whom he refers to as collectors) are found in environments in which natural resources are distributed heterogeneously

geographically and/or seasonally. On the other hand, more mobile hunter-gatherers (whom he refers to as foragers) are characteristic of environments where resources are distributed homogeneously geographically and seasonally [see also LIEBERMAN 1993]. However, can the degree of mobility observed among hunter-gatherers be explained merely by environmental differences?

This paper will examine the issue of hunter-gatherer mobility within a "small island" context. Specifically, it will examine the mobility strategies of the initial colonizers of the Central Ryukyu islands, the largest of which is Okinawa. The island of Okinawa provides an ideal locality in which to examine the nature of hunter-gatherer mobility, especially in regards to understanding the influence of the environment. If we follow Keegan and Diamond [1987], who consider small islands to be those less than 1780 square kilometers in area, the island of Okinawa, approximately 1200 square kilometers in area, is a small island. Following the initial colonization during the later part of the Middle Jomon to Late Jomon period, the Central Ryukyu islands' inhabitants engaged in hunting-gathering lifeways for at least 3,000 years. Thus, the islands may be unique in that they were successfully colonized by hunter-gatherers rather than by farmers [see e.g. CHERRY 1981].

In addition, this paper addresses the following questions: 1) Did the degree of mobility remain the same until food production was introduced into the islands or did it change through time? 2) What were the mechanisms or conditions that maintained or changed the degree of mobility relative to that adopted by the first occupants of the islands?

In the next section, I will briefly summarize the geography and culture history of the Central Ryukyu islands. The third section will present hypotheses on hunter-gatherer mobility for two prehistoric periods, the Late and Final Jomon. These hypotheses will then be tested in the fourth section. The final section will consider the mechanisms and/or conditions that may have influenced hunter-gatherer mobility strategies on these islands.

BACKGROUND

Numerous small islands are scattered between Kyushu, Japan and Taiwan, and are collectively referred to as the Ryukyu archipelago (Figure 8.1). The main island of Okinawa is located approximately 600km from the larger landmasses of Kyushu, Taiwan, and the east coast of China, although many of the islands can be considered "stepping stones" between Kyushu and Okinawa. The island chain is divided into three subregions: Northern, Central, and Southern Ryukyu [KIZAKI 1980]. These three geographical divisions correspond well with pre- and proto-historical cultural divisions of this region [KOKUBU 1972]. It is generally believed that Northern Ryukyu was continuously influenced by prehistoric cultures in Kyushu. Central Ryukyu was initially influenced by Kyushu cultures, but developed its unique cultural characteristics afterwards, although cultural interaction with Kyushu was maintained. The Southern Ryukyu culture, on the other hand, seems to have originated from cultures in regions further to the south, and appears to have remained isolated from Kyushu and Central Ryukyu prior to the Gusuku period (*circa* 12th to 15th Century A.D.; see next section for chronology). Indeed, it was only during the Gusuku period when the Central and Southern Ryukyus became essentially one common culture, due to the invasion by, and subsequent dominance of, Central Ryukyu over

Southern Ryukyu.

The present paper will focus specifically on the Central Ryukyu region and cultures. The largest island in the Central Ryukyu region, and indeed in the entire Ryukyu archipelago, is

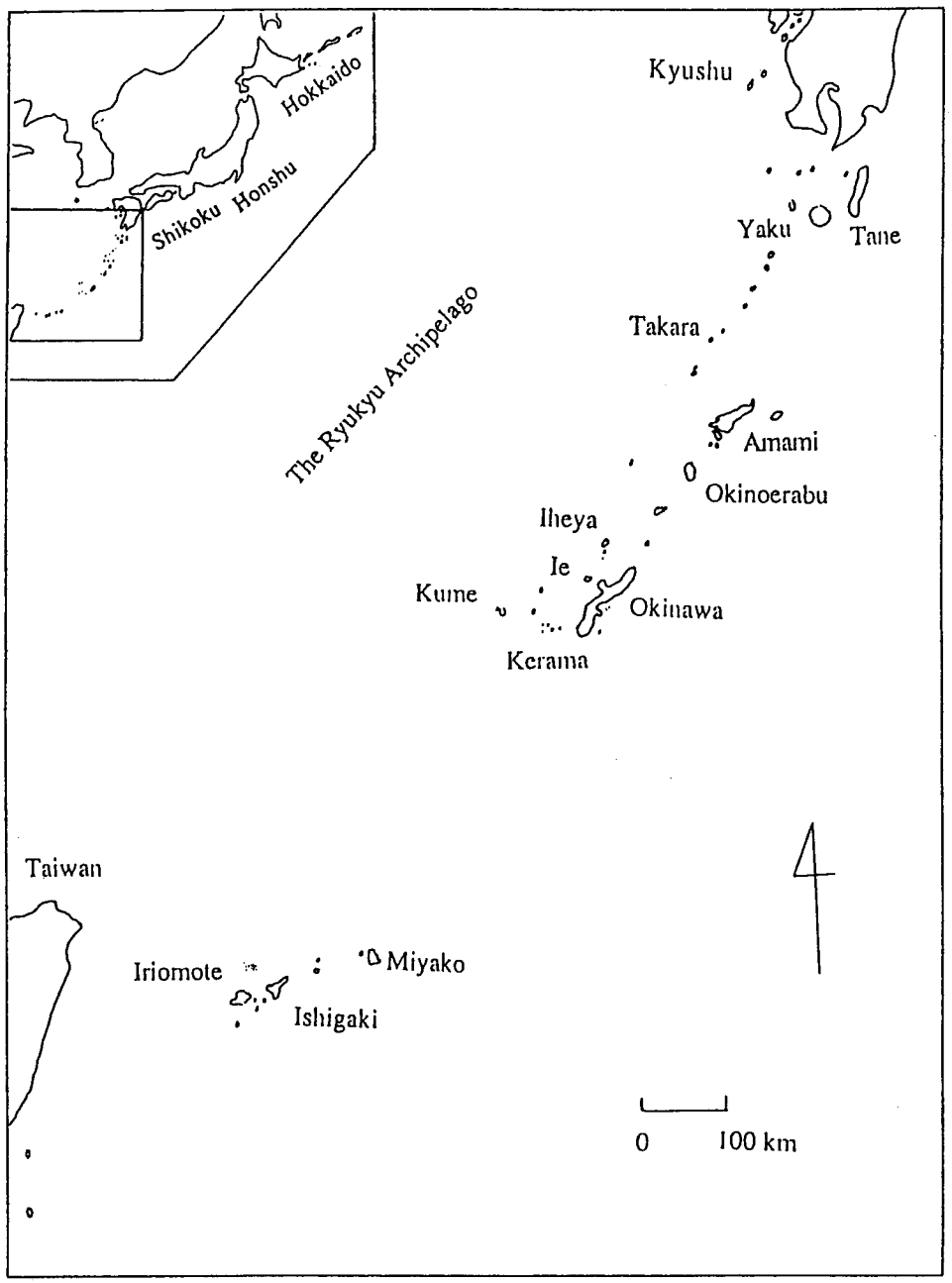

Figure 8.1 Map of the Ryukyu Archipelago.

Okinawa. It is surrounded by several smaller "satellite" islands, such as Ie, Kume, Tokashiki and Izena.

The environment of the Central Ryukyu region is classified as subtropical. The average annual temperature for the last 30 years has been about 20°C, with the warmest month, July, having an average temperature of 28.1°C and the coldest month, January, having an average temperature of 16°C. The average annual precipitation over the past 29 years has been 1894.4 mm. The precipitation is the highest in June (292.6 mm) and the lowest in December and February (117 mm) [YAMAZAKI *et al.* 1988].

The earliest evidence of human occupation dates to as early as 32,000 years ago, with eight Pleistocene sites having been recorded in this region. Extensive surveys and excavations have resulted in a considerable amount of data relating to the culture-history of Central Ryukyu. On the basis of this data, at least two chronological schemes have been proposed (Table 8.1). Scheme 1 emphasizes the relationships with mainland Japan, while Scheme 2, although recognizing the relationships with the Japanese mainland, stresses the unique cultural developments on Okinawa itself. Supporters of the latter scheme call the prehistoric period between the Paleolithic and the Gusuku "the Shellmidden period" (see Table 8.1). This paper follows Scheme 1, since most readers will be more familiar with terms such as Jomon and Yayoi rather than the Shellmidden period.

Table 8.1 Chronology of Central Okinawa.

Okinawa		Mainland Japan (except Hokkaido)
Scheme 1	Scheme 2	
Gusuku		Historical Period
Yayoi-Heian	Late Shellmidden	Yayoi to Nara-Heian Periods
Final Jomon	Middle Shellmidden	Final Jomon
Late Jomon	Early Shellmidden	Late Jomon
Middle Jomon	Initial Shellmidden	Middle Jomon
Early Jomon	Initial Shellmidden	Early Jomon
Initial Jomon	Initial Shellmidden	Initial Jomon
		Incipient Jomon
Paleolithic		

(Simplified from Hiroe TAKAMIYA 1992)

While many researchers believe Central Ryukyu has been occupied since the Pleistocene, it appears that the Pleistocene populations either left the islands or died out by the end of this epoch [TAKAMIYA 1996a, 1997a, 1998, n.d.]. The first successful island colonization appears to have taken place during the late Middle and Late Jomon periods (approximately 4000 B.P.). The following will briefly summarize the probable rationale and sequence of the colonization process.

Kirch [1984] and Mithen [1990] state that, ultimately, the degree of adaptedness should be measured by an increase, decrease, or stability of population in the past. Kirch [1984]

suggests four possible population models for human groups migrating to an island environment: the crash, oscillation, logistic, and step. The crash model describes a situation wherein a population suddenly decreases because it grows above the level of the carrying capacity. The oscillation model describes situations in which populations continually fluctuate above and below the carrying capacity. The logistic model describes populations that initially grow rapidly towards the carrying capacity, after which growth slows, and eventually stabilizes near the carrying capacity. Finally, the step model describes a situation in which the initial population grows as in the logistic model. If the carrying capacity increases due to an environmental or technological change, however, the population increases logistically again towards this new level of carrying capacity. According to Kirch [1984] and Keegan and Diamond [1987], the logistic or step models of population growth are expected for human populations that migrate, and adapt to, island environments.

While there are many methods that have been developed to infer prehistoric human population levels [e.g. HASSAN 1981], at present, a population estimate based on the number of sites is probably the most appropriate in the Okinawan case. The population reconstruction based on the number of sites [TAKAMIYA 1996a, 1997a, 1997b, 1998, n.d.] is shown in Figure 8.2. Since the length of each period differs and the number of C-14 dates is relatively small, population estimates have been normalized to 100 year occupation intervals. Both mainland Okinawa and its satellite islands show similar population trajectories. That is, population levels increased substantially during the Late Jomon period, increased only slightly during the Final Jomon, decreased slightly during the Yayoi-Heian, and then increased dramatically during the Gusuku. The overall trends follows the "step" pattern of population growth as described above, although specific details may be more complicated than described here [TAKAMIYA 1996a, 1997a, 1997b, 1998, n.d.]. On the basis of these patterns, Takamiya [1993, 1996a, 1997a, 1997b, 1998] has suggested that the first successful colonization by humans of the Central Ryukyu region took place during the late Middle Jomon and Late Jomon periods.

The initial colonizers of the Central Ryukyu islands were hunter-gatherers who relied on resources from the coral reef environment for protein, targeting primarily coral reef fish [TAKAMIYA 1997a]. No unequivocal remains of domesticated animals, except dogs, have been recovered from pre-Gusuku period sites. The earliest evidence of cultigens dates from between the 6th and 8th Century A.D. [TAKAMIYA 1999a] although food production *per se* began only between the 8th and 10th Century A.D. [TAKAMIYA 1996b, 1997a]. The Takachikuchibaru shellmidden (Figure 8.3; refer to Figure 8.3 for site locations mentioned in this paper), which dates to the early Yayoi-Heian period in Okinawa (roughly corresponding with the Yayoi period on mainland Japan), has yielded no cultigens, but instead only nuts and other wild species such as grapes [TAKAMIYA 1997a]. Several Final Jomon sites, such as Nubataki and Nigamashibaru, have yielded remains of nuts and some seeds of wild species in the course of regular excavations (i.e., without flotation or screening), but no cultigens have been recorded [BOARD OF EDUCATION OF GUSHIKAWA CITY 1977; WATANABE 1989]. Finally, the wet site of Mebaru, dated to the Late Jomon, has yielded large amounts of nuts and other wild species [OMATSU and TSUJI 1999; TAKAMIYA 1999b]. While additional analyses of macro-plant remains are required in order to arrive at a better understanding of the plant dietary component, at present, the available evidence suggests that the subsistence strategy from the Late Jomon to the early Yayoi-Heian was based

on hunting and gathering.

HYPOTHESIS

On the basis of hunter-gatherer mobility strategies, Binford [1980] suggests that higher residential mobility is a preferred strategy in an environment with homogeneously distributed resources, in which all critical resources can be obtained within a walking distance from a residential base. On the other hand, he suggests a strategy employing a greater degree of residential sedentism but higher degree of logistical mobility should be characteristic of hunter-gatherers in environments in which critical resources are not homogeneously distributed. In the case of prehistoric Okinawa, critical resources probably consisted of nuts and coral reef fish for the Late Jomon population [OMATSU and TSUJI 1999; TAKAMIYA 1997a, 1999b]. While stable carbon and nitrogen isotope analysis has not been conducted on Late Jomon human skeletal

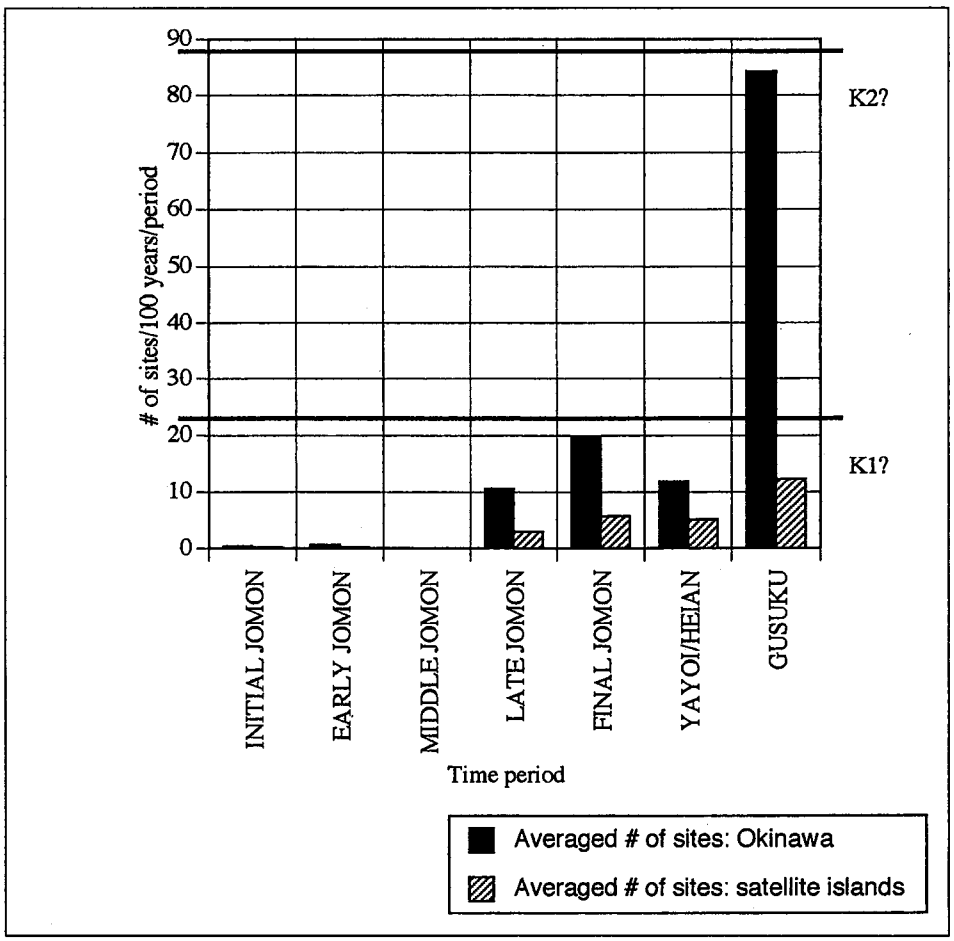

Figure 8.2 Paleodemography of the Okinawa Archipelago.

remains, the results of such analyses on Final Jomon skeletal remains suggest that they obtained protein in approximately equal proportions from both terrestrial and marine resources [TAKAMIYA *et al.* 1999]. Accordingly, it can be suggested that resources from both the terrestrial and marine environments were important to the Late Jomon population as well.

While these critical resources would have been obtained from two ecological zones,

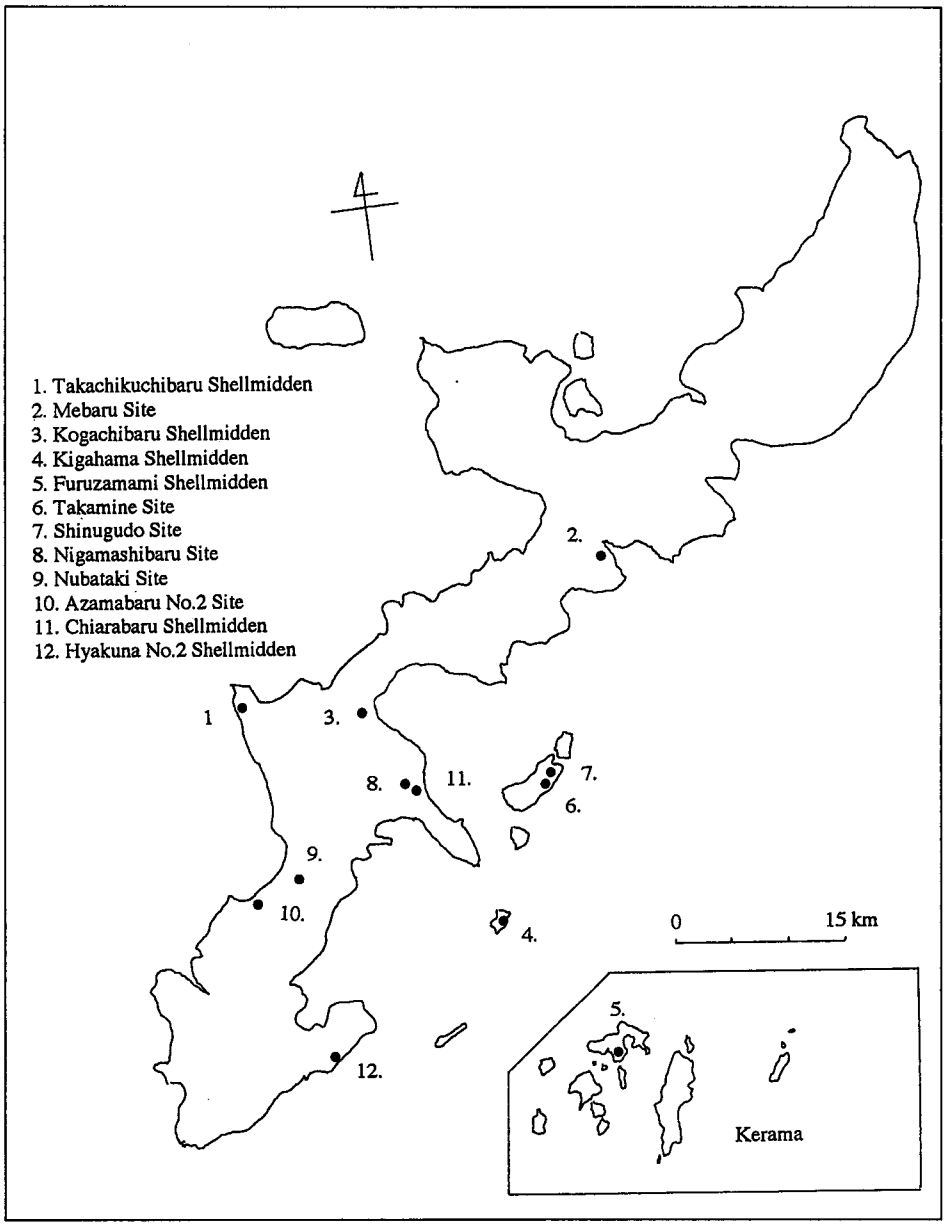

Figure 8.3 Locations of sites mentioned in the text.

terrestrial and marine, Okinawa and its satellite islands are small. Given the geographical homogeneity of both marine and terrestrial resources, it can be hypothesized that the initial successful colonizers of the islands would have followed a foraging system strategy employing high residential mobility. Most resources were probably procured within a day's walk: approximately a 10 kilometer radius [see BINFORD 1980]. For example, from the Kogachibaru shellmidden, one of the earliest Late Jomon sites on the island of Okinawa, the Pacific Ocean is less than one kilometer away, and the East China Sea less than five kilometers. Between these oceans is land where plant foods would have been available.

If the environment or distribution of critical resources alone influence the mobility of hunter-gatherers, it can be further hypothesized that prehistoric populations of this region may have remained as mobile hunter-gatherers until food production was introduced to the island. Recent studies into the development of increased sedentism among hunter-gatherers, however, suggest several other factors must be considered in attempting to understand decrease in mobility. For example, Brown [1985; see also KELLY 1992] summarizes three basic models in order to explain decreases in mobility. Brown terms the first two of these "pull" and "push". The "pull" model suggests that abundant natural resources provide an opportunity for mobile hunter-gatherers to develop sedentary settlements. On the other hand, the "push" model suggests that subsistence stress encourages a decrease in the mobility of hunter-gatherers. The third model, originally proposed by Bender [1978], suggests that social relations of production are the cause of the decrease in mobility. Examining these models in the context of data from the U.S. Midwest, Brown [1985: 224] rejects all prime-mover models and concludes that "decision making in risk management" was the primary factor in the decrease in mobility in this region.

While many authors in Price and Brown [1985] consider prime-mover arguments to be simplistic, at the same time, many other authors, including Price and Brown [1985] themselves, appear to agree that the three models discussed above provide at least minimal conditions for a decrease in hunter-gatherer mobility. As will be discussed in more detail below, two of the prime-movers, environmental deterioration and population pressure, likely emerged after the successful colonization of the islands during the Late Jomon period. This implies that there was a gradual shift from relatively high settlement mobility during the Late Jomon period to substantially reduced settlement mobility during the Final Jomon period. Hunter-gatherer mobility in the Central Ryukyu region will be examined in the next section, with a focus primarily on dwelling structure.

HUNTER-GATHERER MOBILITY IN CENTRAL RYUKYU

Semi-subterranean dwellings have been recorded at three sites dating to the Late Jomon. These sites are the Kigahama (early Late Jomon) [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1978], Kogachibaru (early Late Jomon) [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1987], and Furuzamami (late Late Jomon) [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1982] shellmiddens. They all contain one or two dwelling structures. Dwelling structure dimensions are given in Table 8.2.

Table 8.2 Dimensions of Late Jomon dwelling structures.

Site Name	Length (m)	Width (m)
Kigahama	2.8	2.5
Kogachibaru	2.95	2.7
Furuzamami	2.5	2.0
	2.5	2.0
Average	2.7	2.3

Three observations can be offered regarding these structures. First, semi-subterranean dwellings were constructed from the beginning of the first successful colonization of the island. Second, these dwelling structures are all about the same size and are relatively small for such features. Third, these structures were probably used ephemerally by small groups, given that only one or two occur at each site.

This settlement system did not persist into the Final Jomon period. Several sites have yielded dwelling structures that date to this period. Examples include the Takamine (middle Final Jomon) [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1989], Shinugudo (middle Final Jomon) [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1985], Nigamashibaru (late Final Jomon) [BOARD OF EDUCATION OF GUSHIKAWA CITY 1977], and Nubataki (late Final Jomon) [BOARD OF EDUCATION OF GINOWAN CITY 1991] sites. The Nigamashibaru site has yielded only one dwelling structure similar in size to those of the Late Jomon. However, a single small dwelling at the Nigamashibaru site is associated with storage pits [BOARD OF EDUCATION OF GUSHIKAWA CITY 1977].

Significant changes in dwelling number and size are seen at a number of other sites. The Takamine site on Miyagi Island has yielded at least 20 dwelling structures. It is believed that the complete excavation of the site would yield more than 50 dwelling structures [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1989]. The Shinugudo site, also located on Miyagi Island, contains 43 dwelling structures [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1985]. At least 16 dwelling structures occur at the Nubataki site [BOARD OF EDUCATION OF GINOWAN CITY 1991].

Moreover, the average dwelling dimensions increased from 2.7 m x 2.3 m during the Late Jomon to 3.3 m x 2.6 m during the Final Jomon (Figure 8.4). Furthermore, while the Late Jomon dwellings tend to be similar in size, Final Jomon dwellings show considerable variability in size. Dimensions of the dwellings at the Shinugudo, Takamine, and Nubataki sites are shown in Figure 8.3. Four dwellings at the Shinugudo site are slightly larger, and one dwelling at the Nubataki site is much larger than the other Final Jomon dwellings. The differences in dwelling size might indicate increasing social complexity during this period. In addition to increases in average dwelling size and dwelling size variability, many dwellings at the Shinugudo and Takamine sites were not only simply excavated into the ground, but were supported with stone walls. This suggests that the Final Jomon population invested more time and labor in dwelling construction than did the Late Jomon population. At the Takamine site, an outer stone wall was recorded, implying a concept of "private property" or territoriality.

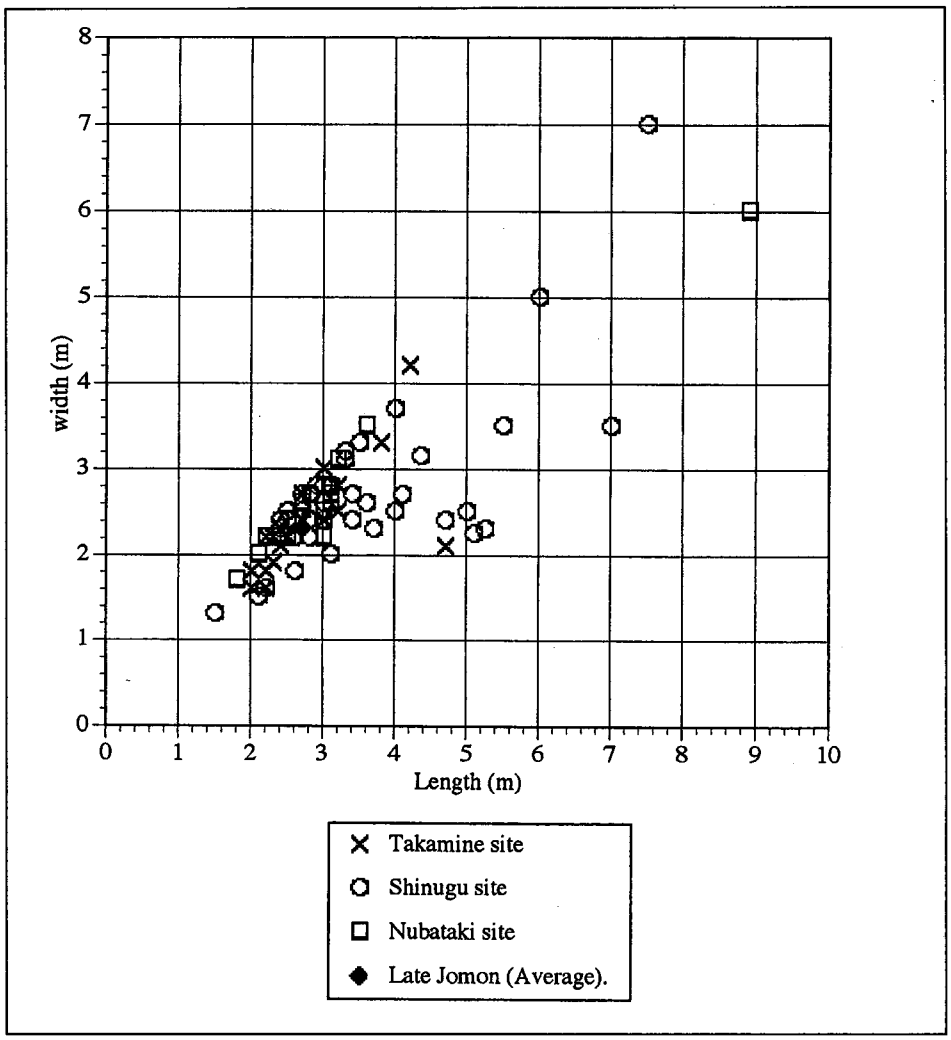

Figure 8.4 Size of the Final Jomon dwelling structures.

Finally, at the Azamabaru No.2 site, located in Ginowan City, several dwellings with an associated cemetery have been recorded [BOARD OF EDUCATION OF GINOWAN CITY 1989]. While it is difficult to estimate the number of dwellings occupied simultaneously, at least 90 such structures were identified at the site. Unfortunately, the dimensions of the dwelling features at this site are not available at the present time. Furthermore, a cemetery containing at least 60 burial pits has been identified at the Azamabaru No.2 site. Several types of burial pits were recorded. Some were simply excavated into the ground, others were lined with stone walls, and still others were lined with stone walls and sealed with stone covers. These differences in burial structures may also indicate increasing social complexity during the Final Jomon period.

Taken together, the data presented above strongly suggest that the Final Jomon populations were less mobile than the Late Jomon populations.

DISCUSSION

Binford [1980] suggests that collectors (less residentially mobile hunter-gatherers) were more common in northern latitudes where availability of critical resources tends to be restricted geographically and seasonally. Based on Binford's [1980] model, it can be predicted that the first successful colonizers of the islands were more mobile hunter-gatherers, having adapted to the subtropical environment of this region [also AMES 1985], wherein critical resources would have been located within immediate foraging zones. Also, if the environment alone is considered as the key factor influencing hunter-gatherer mobility, it is expected that these hunter-gatherers would have remained highly mobile until food production was introduced into the Central Ryukyu region. The data presented above suggest that the Late Jomon people are likely to have been mobile hunter-gatherers. While we do not have enough data to determine whether or not the Final Jomon hunter-gatherers were collectors, it can be suggested that their mobility was certainly restricted during this period compared with the previous period. Thus the first of the two predictions has been supported by the data, while the second has not. The data have shown that the initial successful colonizers of the island (i.e. the Late Jomon population) were more mobile than their descendants during the Final Jomon.

Why were Late Jomon hunter-gatherers more mobile? Binford [1980] has argued that high hunter-gatherer residential mobility is adaptive in southern latitudes because critical resources are more uniformly distributed geographically and seasonally. For the Late Jomon population, one critical resource would have been fish which were available in the coral reef environment. More than 80% of animal bones (based on NISP) are of coral reef fish species [TAKAMIYA 1997a]. The coral reef environment surrounding the islands in Central Ryukyu is more or less homogeneous in the distribution of associated resources. At the same time, the other possible critical resource, nuts, is homogeneous in distribution on the small islands of Okinawa. This suggests that the Late Jomon population was not faced with spatial variability in resource distribution. Thus, foraging mobility must have been cost-effective in this environment during the Late Jomon period.

On the other hand, archaeological data suggest a decrease in mobility during the Final Jomon. Several factors can be suggested to explain this reduction, as outlined by Price and Brown [1985; see above]. The relationship between an increase in social complexity and the degree of sedentism is difficult to determine in the present context. On the other hand, climatic change does not seem to have been a critical factor in this case. While we do not have direct evidence of climatic change from this region, the data from mainland Japan and elsewhere indicate that there was significant climatic change during the Late Jomon, with an overall warming trend during the Final Jomon, followed by climate deterioration during the subsequent Yayoi period [e.g. TSUJI 1989; YASUDA 1983]. If this climatic trend can be applied to the Central Ryukyu, it is likely that a more restricted level of mobility was practiced when the climate was the most optimal between ca. 3000 and 2500 years ago. If this interpretation is correct, it would support the "pull" model of mobility reduction. However, the "pull" model seems to be the least likely explanation or condition for the beginning of a more sedentary way of life.

In the case of Okinawa, population pressure and environmental deterioration seem to account for, or at least provide, conditions for the restriction in mobility during the Final Jomon

period. As human populations adapted to the island environment during the late Middle and Late Jomon periods, their size increased rapidly (Figure 8.2). Since the population seems to have decreased during the Yayoi period, it can be suggested that the population reached near or above the carrying capacity during the Final Jomon period (Figure 8.2) [TAKAMIYA 1997a]. Furthermore, since the Late Jomon people were more mobile than the Final Jomon people, it is likely that the differences in population size between these two periods was greater than that indicated by pure site numbers alone (Figure 8.2).

At the same time, it should be kept in mind that the island environment is extremely fragile, especially after successful human colonization. For example, Kirch [1984, 1994] has summarized how the island environments of Polynesia deteriorated following colonization. It seems to be the norm that when successful colonization of islands by humans takes place, it triggers environmental deterioration [KIRCH 1984; KEEGAN and DIAMOND 1987]. In the case of Okinawa, several attempts have been made to reconstruct palaeoenvironments, such as those based on pollen and phytolith analyses [e.g. BOARD OF EDUCATION OF GINOZA VILLAGE 1998]. Unfortunately, the results have been very limited to date, primarily because of poor preservation conditions.

However, a study on land snails recovered from the Takamine site, which was conducted by Kurozumi [1989], sheds new light on the past environment. He analyzed more than 6000 individual land snails and found that one species, *Cyclophorus turgidus turgidus*, comprises over 70% of the materal. Other Final Jomon sites he analyzed, including the Chibazukabaru and Uzahama B sites, showed similar frequencies of this species among the land snail assemblages. One interpretation of these high frequencies of a single species is that the Final Jomon people specifically selected it as a food resource. Kurozumi [1989] on the other hand disagrees, and suggests that the high frequencies of *Cyclophorus turgidus turgidus* directly reflects the palaeoenvironment rather than palaeosubsistence.

According to Kurozumi [1989], *Cyclophorus turgidus turgidus* may have been naturally incorporated in the Final Jomon middens, given that *Cyclophorus turgidus turgidus* prefers such habitats. In addition, the large number of *Cyclophorus turgidus turgidus* recovered from these sites suggests that the local site environments were predominantly secondary forests, since they are found in such habitats naturally. If his argument is correct, it implies that the environment surrounding the sites was modified by humans. Furthermore, this interpretation is applicable not only for the Final Jomon, but also for the Late Jomon, since *Cyclophorus turgidus turgidus* has also been identified at other Late Jomon sites, such as the Chiarabaru shellmidden [BOARD OF EDUCATION OF GUSHIKAWA CITY 1986] and the Hyakuna No.2 shellmidden [BOARD OF EDUCATION OF OKINAWA PREFECTURE 1981].

Sudden population increase and environmental deterioration would very likely have led to a population-resource imbalance. Indeed, in terms of faunal exploitation, the Late Jomon people established the most cost-effective system. As mentioned above, they centered their animal procurement system on coral reef fish. On the other hand, this system seems to have collapsed in the Final Jomon period. Not only does the average percentage of coral reef fish remains among faunal assemblage decrease from 80% during the Late Jomon to 70% during the Final Jomon, the faunal remains analyzed from this period indicate that people were exploiting more risky resources, such as wild boar.

At the same time, the population-resource imbalance likely increased tension among human groups living on the island during the Final Jomon period. For example, Lieberman [1993: 613] states that

> ... radiating (logistic) mobility may be energetically less efficient than circulating (foraging) mobility with low population densities but necessary in conditions of high intergroup competition.

While we do not have evidence of weapons or violence from the Final Jomon sites, an increase in population in the deteriorating environment would have in turn increased competition among hunter-gatherer groups on the island. This kind of process has been recognized in other island cases [see e.g. KIRCH 1984; see also GUMERMAN 1986]. This resulted in the decrease in residential mobility seen in the Final Jomon sites in Okinawa. The beginning of an increasing sedentary lifeways in Central Ryukyu was likely due to, or at least conditioned by, the population-resource imbalance that occurred during the Final Jomon.

CONCLUSION

This paper has examined hunter-gatherer mobility in an island context, using data from the subtropical Central Ryukyu Islands, the largest of which is Okinawa. The initial successful colonization took place during the late Middle to Late Jomon periods by hunter-gatherers. Unlike the situation in northern latitudes or large landmasses, critical resources are not as restricted in the subtropical environment of Okinawa. Thus, at least initially, a high level of mobility would have been the most cost-effective means of acquiring subsistence resources in this situation. Indeed, this is supported by the archaeological evidence. However, during the following Final Jomon period, the population became increasingly more sedentary, as evidenced by the construction of more substantial, and thus more permanent, dwellings. In addition, a large cemetery has been recorded at the Final Jomon Azamabaru No.2 site, while at the Final Jomon Takamine site a line of stones, possibly indicating boundary and the emergence of the concept of "private property", has been recorded.

Paleodemographical and faunal data suggest that the increase in the degree of sedentism during the Final Jomon of the Central Ryukyu islands likely resulted from a population-resource imbalance. Once the islands were successfully colonized, the population increased rapidly, which at the same time led to the modification of the surrounding environment. At present, the best indicator of the environmental modifications comes from the analysis of land snails conducted by Kurozumi [1989], who has suggested that the environment in the immediate vicinity of the Final Jomon sites consisted primarily of secondary forests. There is a proverb in Okinawa that states that "*Yama hagin, umin hagin* (when a mountain is deteriorated, then the ocean will be deteriorated, too)". Thus, while Kurozumi's [1989] study is admittedly the only one at present that attempts a reconstruction of local paleoenvironments, it is likely that the natural resource base decreased during the Final Jomon period. Faunal remains recovered from Jomon sites in Okinawa support this conclusion. Many scholars have suggested that the prime-mover models offer only simplistic explanations [PRICE and BROWN 1985]. It is not yet clear

how a population/natural resource imbalance contributed to a reduction in mobility. Did it affect hunter-gatherer mobility directly or indirectly? While this is a question for further study, it can at least be concluded for now that, during the Final Jomon period, there existed the necessary conditions whereby a more sedentary way of life was required.

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