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Maritime Adaptation of Prehistoric Hunter-Gatherers and Their Transition to Agriculture in Japan

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Maritime Adaptation of Prehistoric Hunter-Gatherers and Their Transition to Agriculture in Japan

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This study is concerned with the problems of how and why the prehistoric hunter-gatherers of Japan—the Jomon peoples—reacted to an agricultural way of life and accepted it. The study has four objectives. First, the analysis will examine a territorial model of a Jomon shell-midden site in order to reconstruct the prehistoric local marine environment of the site territory habitually exploited by the shell-midden people. Second, it will examine local adaptation in the collection of marine resources and the occupational specialization of the Jomon shell-midden people of eastern Japan. Third, it will examine the beginning and spread of rice cultivation in the Japanese archipelago. This part emphasizes that different groups of Jomon people followed divergent paths at variable speeds in the transition to a settled life of agriculture, further the difference in the assessment of the resource potentials in the Japanese archipelago might be related to cultural evolution leading to the beginning of rice cultivation. The concluding part examines the extent to which fishing societies played a cultural-historical role in mediating the transition to early agriculture. Here, the cultural dichotomy between eastern and western Japan during the Jomon period is studied: specialized fishing societies flourished in the east, whereas intensive plant collecting and/or incipient plant cultivating societies with less specialized fishing activities flourished in the west. These facts suggest that Japanese history was characterized by two different paths: agricultural innovation was resisted and/or accepted slowly by the eastern Jomon people, but it was accepted and developed smoothly by the western Jomon people. [Jomon, Yayoi, Site Territory, Marine Adaptation, Resource Potential, Incipient Cultivation]

INTRODUCTION

Since the discovery of the Japanese Palaeolithic at the Iwajuku site, in 1949, hundreds of subsequent investigations have vastly improved our understanding of Japanese prehistory. It is now well-known that Japanese culture originated during the Pleistocene epoch. But the question of when and from where these earliest Japanese immigrants came remains unanswered. There has been much debate about origins of the Japanese Palaeolithic despite 30 years of progress since the excavation at Iwajuku (Fig. 1). As stated by Ikawa-Smith [1980: 136], "Some archaeologists believe that human occupation of the Japanese archipelago began over 100,000 years

ago; others believe that it did not begin until about 30,000 years ago; and still others, including myself, feel that 50,000 is the reasonable figure”.

Japanese prehistory entered the chronological and cultural period known as Jomon around 10,000 years ago. Although the Jomon people developed sophisticat-

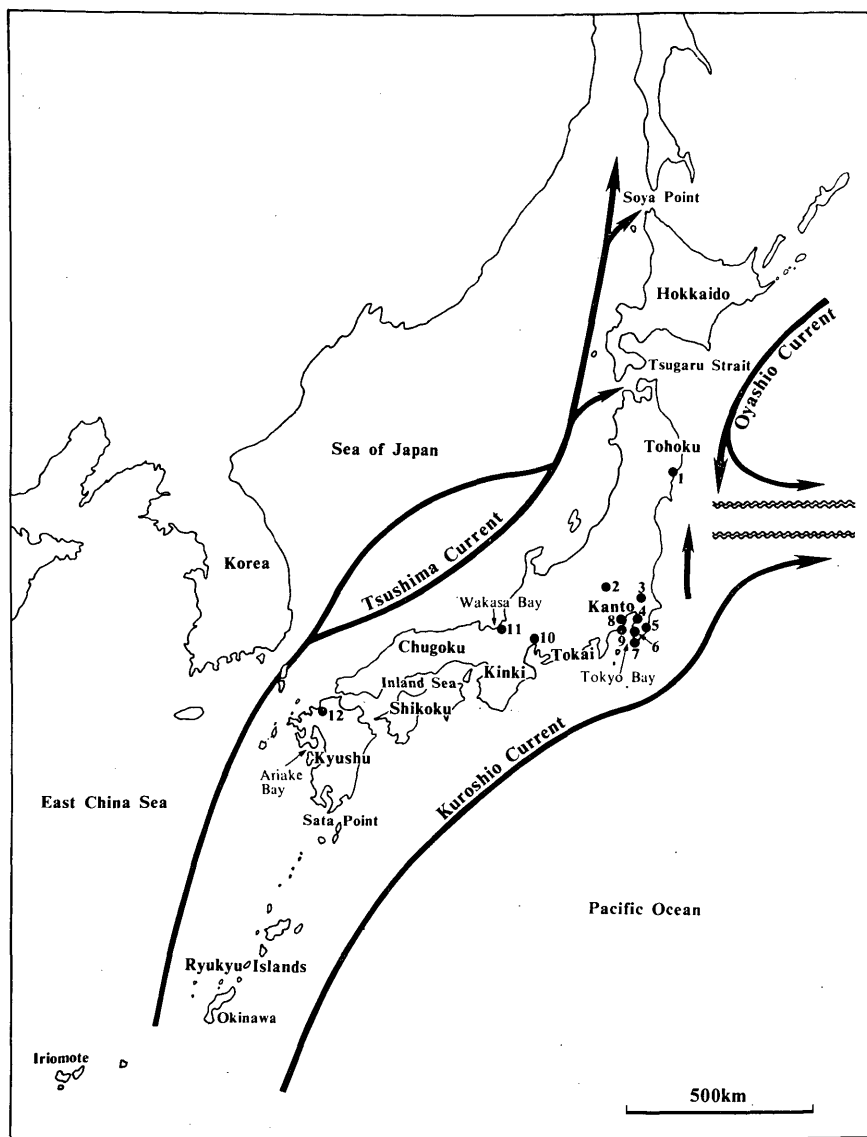


Fig. 1. Map of Japan. Archaeological sites discussed in the text are shown by keyed numbers.

1. Miyano, 2. Iwajuku, 3. Kamitakatsu, 4. Saihiro, 5. Nittano, 6. Fujimidai, 7. Natagiri, 8. Kikuna, 9. Shomyoji, 10. Nishishiga, 11. Torihama, 12. Itazuke.

ed pottery and various polished stone tools, their subsistence economy was characterized primarily by hunting, gathering, and fishing for about 8,000 years, lasting into the beginning of the Yayoi period, around 300 B.C. [SAHARA 1975: 127]. It is generally accepted that the Jomon culture flourished along the Pacific coast of eastern Japan, characterized by the extensive shell middens in the coastal regions [WATANABE 1966: 46]. The subsequent Yayoi period witnessed the appearance of a settled life of agriculture. The beginning of rice cultivation in the Japanese archipelago was first caused by diffusionary innovation and stimulus derived from the continent, around 3,000 B.P. [NAKAMURA 1979]. The adoption of rice cultivation ultimately affected the life-style of the former hunter-gatherer Jomon people.

Although this diffusion was certainly crucial in mediating the transition between subsistence technologies, the problems of how and why the former Jomon people accepted this new way of life remain unsolved. It has been said that "for hunters and gatherers to settle down to settled life of agriculture, a revolutionary readjustment of cultural habits is needed" [MURDOCK 1969: 144]. In the field of Japanese prehistory, there has been much debate about what kind of readjustment occurred in the Jomon hunting-gathering societies during the process of their transition to the agricultural economy of the Yayoi period.

The reactions to new food production techniques have been variable among hunter-gatherer groups:

The Natufians evolved an agriculture, the coastal Peruvians finally adopted agriculture about which they had known but which they had been avoiding for 1,000 years or longer, and the people of the northwest coast retained their traditional life (until it was destroyed by European invaders) without resource to agriculture [REED 1977: 943].

The fact that different groups of people living throughout the world followed divergent paths and at variable speed in the transition to a settled life of agriculture provides the basic framework in which to examine the beginning and spread of agriculture. The Japanese archipelago is a key location in which to review the cultural-historical role of agriculture in the process of cultural evolution.

This paper is concerned with the marine adaptation of the prehistoric Jomon hunter-gatherers and their transformation into rice farmers. The study first examines the exploitation territory of the Jomon shell-midden people, this part focusing mainly on a territorial model of the shell-midden people in order to assess the biophysical environment within the site catchment. The analysis also examines the habits of the shell-midden people when collecting marine resources. It is hoped that this section will result in a better organization of methods and will enable other prehistorians to draw more conclusions about local adaptation in the collection of marine resources and the resource specialization of the shell-midden people. The analysis also examines the problems of how and why the former Jomon inhabitants accepted or rejected the new agriculture. This section emphasizes divergent paths and variable

speeds followed by different groups of Jomon people in the transition to a settled life of agriculture. The relationships of these paths are shown to vary according to resource potentials within the Japanese archipelago during the Jomon period. The final part examines the role which fishing societies in general played in facilitating the transition to early agriculture.

TERRITORIAL MODEL OF A JOMON SHELL-MIDDEN SITE

The "exploitation territory" of a site has been defined as "the territory surrounding the site which is exploited *habitually* by the inhabitants of the site" [VITA-FINZI and HIGGS 1970: 7; emphasis mine]. The site territory is different from the *site catchment*, defined as the total area from which the contents of a site were derived [HIGGS 1975: IX]. The actual form and structure of these areas cannot be known in advance, usually making it necessary to use an initial estimate or approximation of the size, shape, and location, based on ethnographic analogy and some other comparative knowledge [ROPER 1979]. For instance, both methods of determining the site territory by means of "fixed radii" and "time contours", exemplified by Vita-Finzi and Higgs [1970] and others, were basically inferred from ethnographic analogy [ROPER 1979: 123]. Application of these concepts to the archaeological case is very useful, at least for behavioral studies such as the relationships of prehistoric man to his environment. But these concepts have been used only as analytic devices for examining the nature of sites, the people who lived there and their relationship to the environment [ROPER 1979]. By contrast, this paper uses the concept of exploitation territory to explain the relationship of the site to its local environment. The data used for this analysis come from the Jomon shell midden at Nittano with its associated molluscan and fish remains. The faunal remains found in shell middens are a major source of interpretations regarding the local prehistoric environment and collecting habits.

Nittano Site Excavations

Nittano site is located on the Boso Peninsula of Chiba Prefecture, in the Kanto district of eastern Japan. It is one of the few sites at which rigorous sampling techniques were used to recover materials from the excavated area, and where the identified species were described both qualitatively and quantitatively. The depositional and cultural contexts of the site are outlined below, following the excavation report [ARCHAEOLOGICAL SOCIETY OF RIKKYO UNIVERSITY 1975].

The deposit was divided into 10 geological layers numbered I through X (from top to bottom). Only six layers, III through VIII, produced enough material to compare qualitatively and quantitatively with Jomon assemblages elsewhere. The most important feature of the deposit was the distribution of molluscan remains, concentrated in layers III and V, and consisting of a number of dense deposits designated as Concentrations A, B, C, D, H, I, O and Q in layer III, and E, G, J, K, M and N in layer V. Although there were considerable differences in the volume of the

deposits, each concentration was formed independently in a similar depositional context.

These materials showed that the deposits at the Nittano site contained two distinct Jomon cultural assemblages. The older contained a large proportion of Early Jomon Hanazumi-type pottery (layers V through VIII). The younger assemblage had a large quantity of Middle Jomon Goryogadai-type pottery and was found in layers III and IV. No direct absolute dates are available for the Nittano site. However, at other sites in Kanto, Hanazumi-type pottery has an age of about 6,000 years (6,030 B.P. $\pm$ 135 years [N-287] and 5,790 B.P. $\pm$ 140 years [N-1156]) and Goryogadai-type pottery has an age of about 5,000 years (4,950 B.P. $\pm$ 180 years [O.B.-F.T.] and 4,850 B.P. $\pm$ 340 years [O.B.-F.T.]).

Nine species of gastropods and fourteen species of pelecypods were identified in the original excavation report [TOMURA 1975: 40]. Table 1 shows the relative frequencies of the species by period, together with the habitat of the living species. It is evident that the majority of the comparable living species inhabit tidal to sublittoral zones in bays. Only a few of the species live in riverine or open-sea environments, but the comparison of species according to their relative frequencies shows that one riverine mollusc, *Corbicula japonica*, was the most commonly exploited.

Pelecypods are the major constituents of the shell midden, the proportion of gastropods never exceeding 0.1 percent. In the Early Jomon deposits, *Cyclina sinensis* and *C. japonica* are the greatest in quantity; both species constitute about 90 percent of the total pelecypods in this period. In the deposit of the succeeding Middle Jomon period, the proportion of *C. sinensis* shows a marked decrease, while that of *C. japonica* shows a striking increase, making up over 99 percent of the total pelecypods.

Six species of fish and seven more genera and/or families were identified and described in the original report [OGAWA *et al.* 1975: 52]. Table 2 shows the relative frequencies of six of these species by layer. Although the total number of specimens is different in the Early and Middle Jomon assemblages (because the deposit volumes were different), the relative frequencies of the species show the same trend in both periods. The three species, *Mugil cephalus*, *Lateolabrax japonicus* and *Acanthopagrus schlegelii* are dominant in both periods. All these species are found in the brackish water of tidal and sublittoral zones in bays during their breeding seasons and/or feeding times. In particular, the two most abundant species, *L. japonicus* [KUWATANI 1962] and *M. cephalus* [MATSUBARA and OCHIAI 1965: 649-655], enter brackish water riverine zones for certain periods of feeding. In contrast to these, *Chrysophrys major* is exceedingly rare in the Nittano assemblages, inhabiting a distinctly different ecological zone from that of the major species of the site. It lives in littoral zones along the rocky shore facing the open sea, where the ocean water affects the environment directly [KAJIYAMA 1937; TANAKA 1958; TSUKAHARA 1968]. The marine species identified in Nittano site fall into three groups according to habitat:

- 1) those species that inhabit fresh- to brackish water environments in riverine and estuarine zones in bays,

Table 1. Comparison of the frequencies of the identified molluscan species from Nittano site by period, and the classification of these species according to habitat (F: freshwater, B: brackish water, S: sea water, T: tidal zone, U: upper sublittoral zone, L: lower sublittoral zone, R: river, e: estuary, E: embayment, O: open sea). The frequency was calculated from the data in Tomura [1975: Table 1].

	Jomon period			Salinity	Habitat Bathymetric range	Geomor- phology
	Early (Layer V) N	%	Middle (Layer III) N			
Gastropoda						
<i>Umbonium (Suchium) costatum</i>	7	13.21	61	B-S	U	E
<i>Batillus cornutus</i>	15	28.30	30	S	U-L	O
<i>Monodonta labio</i>	0	0.00	2	B-S	T	E-O
<i>Cerithideopsilla djadjariensis</i>	4	7.55	53	B-S	T-U	E
<i>Batillaria multiformis</i>	8	15.09	25	B-S	T	E
<i>Neverita (Glossaulax) didyma</i>	7	13.21	0	B-S	T-U	E
<i>Rapana venosa</i>	6	11.32	0	B	T-U	E
<i>Thais clavigera</i>	6	11.32	0	B-S	T-U	E-O
<i>Babylonia japonica</i>	0	0.00	76	S	T-U	E-O
Total	53	100.00	247			
Pelecypoda						
<i>Tegillarca granosa</i>	114	0.91	3	B	T	E
<i>Crassostrea gigas</i>	855	6.82	32	B	T	E
<i>Ruditapes philippinarum</i>	150	1.20	1	B-S	T-U	E
<i>Cyclina sinensis</i>	5,773	46.03	448	B	T	E
<i>Meretrix lusoria</i>	127	1.01	115	B-S	T-U	E
<i>Mya (Arenomya) arenaria oonogai</i>	218	1.74	2	B-S	T-U	E
<i>Corbicula japonica</i>	5,303	42.30	122,177	F-B	R-T	R-e
Total	12,540	100.01	122,778			

Table 2. Comparison of the frequency of the identified fish bone fragments from Nittano site by layer. The frequency was calculated from the data in Ogawa *et al.* [1975: Table 4].

Jomon period	Layer	<i>Mugil cephalus</i>		<i>Lateolabrax japonicus</i>		<i>Acanthopagrus schlegelii</i>		<i>Chrysophrys major</i>		<i>Plectorhynchus cinctus</i>		<i>Platycephalus indicus</i>		Total		
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	
Middle	III	E. Max. N. I.*	21	30.43	30	43.48	11	15.94	1	1.45	2	2.90	4	5.80	69	100.00
		E. Min. N. I.**	13	34.21	13	34.21	6	15.79	1	2.63	2	5.26	3	7.89	38	99.99
Middle	IV	E. Max. N. I.	59	26.46	92	41.26	49	21.97	3	1.35	0	0.00	20	8.97	223	100.01
		E. Min. N. I.	30	33.71	33	37.08	17	19.10	1	1.12	0	0.00	8	8.99	89	100.00
Middle	Total	E. Max. N. I.	80	27.40	122	41.78	60	20.55	4	1.37	2	0.68	24	8.22	292	100.00
		E. Min. N. I.	43	33.86	46	36.22	23	18.11	2	1.57	2	1.57	11	8.66	127	99.99
Early	V	E. Max. N. I.	79	25.65	132	42.86	70	22.73	7	2.27	2	0.65	18	5.84	308	100.00
		E. Min. N. I.	44	29.53	61	40.94	28	18.79	4	2.68	2	1.34	10	6.71	149	99.99
Early	VI	E. Max. N. I.	34	24.46	63	45.32	30	21.58	1	0.72	1	0.72	10	7.19	139	99.99
		E. Min. N. I.	21	30.00	31	44.29	11	15.71	1	1.43	1	1.43	5	7.14	70	100.00
Early	VII	E. Max. N. I.	175	22.10	329	41.54	213	26.89	11	1.39	2	0.25	62	7.83	792	100.00
		E. Min. N. I.	94	33.81	95	34.17	63	22.66	4	1.44	1	0.36	21	7.55	278	99.99
Early	VIII	E. Max. N. I.	5	8.06	27	43.55	23	37.10	2	3.23	0	0.00	5	8.06	62	100.00
		E. Min. N. I.	5	17.24	11	37.93	9	31.03	2	6.90	0	0.00	2	6.90	29	100.00
Early	Total	E. Max. N. I.	293	22.52	551	42.35	336	25.83	21	1.61	5	0.38	95	7.30	1,301	99.99
		E. Min. N. I.	164	31.18	198	37.64	111	21.10	11	2.09	4	0.76	38	7.22	526	99.99

* total number of premaxillary and dentary bones, ** largest number of right or left premaxillary or right or left dentary bones

- 2) those that inhabit brackish water environments in tidal and sublittoral zones in bays; and
- 3) those that inhabit littoral zones facing the open sea.

The relative frequencies of both molluscan and fish remains are highest for those belonging to species inhabiting the first and second zones; the relative frequencies are almost negligible for those belonging to species that prefer the distant ecological zones of the open sea.

Although this pattern is similarly observed in both the Early and the Middle Jomon assemblages, there is significant change in the frequencies of two of the molluscan species. The frequency of *C. sinensis*, the dominant species in the Early Jomon period, drops to less than 1 percent of the total molluscs in the Middle Jomon period and is replaced by *C. japonica*. These two species have somewhat different habitats. The living species of *C. japonica* are found in fresh- to brackish water environments, such as the lower reaches of streams and estuaries, whereas *C. sinensis* is found in the muddy bottom of the tidal zones in bays [KIRA 1969].

Thus we see that the assemblages of the molluscan and fish remains have almost the same quantitative and qualitative features in both the Early and Middle deposits of the site, the only marked distinction being the change in the frequencies of two of the molluscan species, *C. sinensis* and *C. japonica*. The relative frequencies of molluscs and fish by species and habitat provide important data for comparison with the palaeogeographic reconstruction of the local prehistoric environment, and for defining the exploitation territory of the Nittano shell-midden people.

Prehistoric Environment of the Nittano Site

We can assume the prehistoric environment to some extent from the midden contents, but the primary data for reconstruction of the prehistoric environment must arise from geomorphological studies. The date 6,000 B.P. for the Early Jomon deposit at Nittano site coincides with the maximum stage of the early Holocene Jomon Transgression in Japan, as defined by many Japanese geomorphologists [e.g., ISEKI 1975, 1978; MAEDA 1976; OTA *et al.* 1978; OKADA 1978]. At that time, the sea had invaded deep into the coastal lowlands of the Japanese archipelago, and as the transgression spread, embayments were formed in many places along the coasts. About 6,000 B.P., lowlands of less than about 10 m above the present sea level were invaded and embayments were widely distributed throughout the Kanto district [TOKI 1926a, 1926b; ESAKA 1943, 1954, 1971; ENDO 1979].

Based on these data, it seems quite possible that an embayment around the Nittano site once existed along the coast between Capes Taito and Hachiman, extending inland along the lower reaches of the Isumi River (Fig. 2). The stippled portions in Figure 2 show the area less than 10 m above the present sea level and suggest the maximum extent of the Jomon Transgression along the Isumi River at about 6,000 B.P.—the time of the first evidence of human habitation at Nittano site.

The large circle in Fig. 2 encloses an area within a 10 km radius of the Nittano site, the area assumed to be the exploitation territory for the purposes of the present

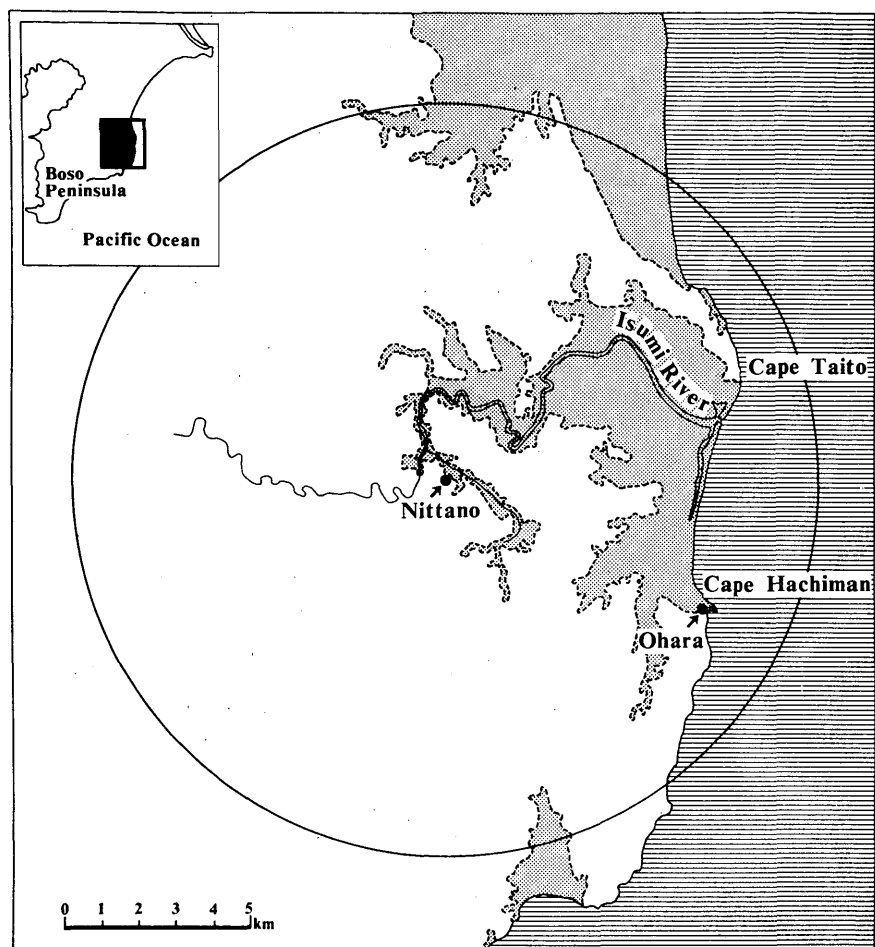


Fig. 2. Hypothetical exploitation territory of Nittano site, showing the Palaeo-Isumi Bay formed along the Isumi River by the maximum transgression in the early Holocene period around 6,000 B.P.

study. Note the marked difference in the proportion of marine territory 6,000 years ago and today (Table 3). As the encroaching sea spread into the lowlands, the marine environment covered more than twice the present area, occupying over 20 percent of the total territory, half of that being the Palaeo-Isumi Bay.

The present coast in this locality is generally characterized by rocky to sandy flats facing directly onto the open sea. These flats are strongly influenced by the Kuroshio current, which runs along the Pacific coast of Japan. On the other hand, the extensive embayments formed by the sea transgression probably went far inland from the present shoreline and were not influenced directly by the Kuroshio. Rivers such as the Isumi also flowed into the bays, probably creating brackish water environments of tidal and sublittoral zones with mud to sandy mud bottoms. The potential

Table 3. Comparison of the areas of the marine environments in the territory of Nittano site at present and at the maximum extent of the Palaeo-Isumi Bay. The percentage is the proportion of the total area of the site territory.

	Territory Total area (km ²)	Open sea		Palaeo-Isumi Bay		Embayment Other		Total		Total	
		Area	%	Area	%	Area	%	Area	%	Area	%
Present	314.16	30.41	9.68	0.00	0.00	0.00	0.00	0.00	0.00	30.41	9.68
Ca. 6,000 B.P.	314.16	30.41	9.68	34.38	10.94	12.59	4.01	46.97	14.95	77.38	24.63

prehistoric marine resources, therefore, were considerably different from those available under the present conditions. It is possible to examine further the formations of the Palaeo-Isumi Bay by considering the behavior of *L. japonicus*, the dominant species identified in both occupation phases of the site. *L. japonicus* is a representative coastal fish, widely distributed along the Pacific Ocean and the Sea of Japan coasts of the central and southern parts of the country [MATSUBARA and OCHIAI 1965: 683–687]. The most important fishing grounds of this species are inside the bays at Sendai, Tokyo, Ise, and so on [KUWATANI 1962: 28]. In most cases, the bays face the open sea, and brackish water conditions occur in the inner bay because of the inflow of fresh water from the rivers. Kuwatani [1962] has provided the data for a detailed examination of the relationship between the habitat of *L.*

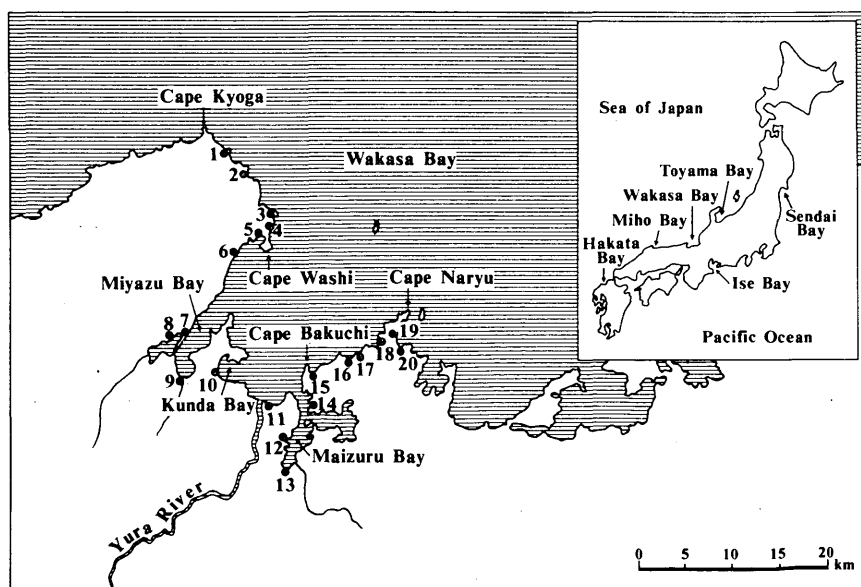


Fig. 3. General topography of the western part of Wakasa Bay, showing the distribution of today's fishing ports. The port numbers correspond to those in Figure 4. (Compiled from Kuwatani [1962: Figs. 1, 3, 17].)

japonicus and the topography at Wakasa Bay, the fishing grounds where this species is most abundant today (Fig. 3).

Wakasa Bay is a large embayment facing the Sea of Japan and surrounded on the west, south, and east by a rocky, ria shore. Inside the western part of the bay, between Capes Washi and Naryu, are three smaller embayments, called Miyazu, Kunda, and Maizuru. These bays are strongly influenced by rivers which cause large areas of brackish water environments with mud and sandy mud flats, although these bays, too, face the open sea [KUWATANI 1962: 10–12].

Many fishing ports known for large catches of *L. japonicus* are situated along the coasts of these embayments, as shown in Fig. 3. Each fishing port has a natural and/or artificial fishing bank close by [KUWATANI 1962: 12]. Figure 4 shows the monthly change in the catch of *L. japonicus*, by fishing port, based on the data presented by Kuwatani [1962: Fig. 22]. There is a close relationship between the quantity of the monthly catch and the location of the fishing grounds. In the fishing

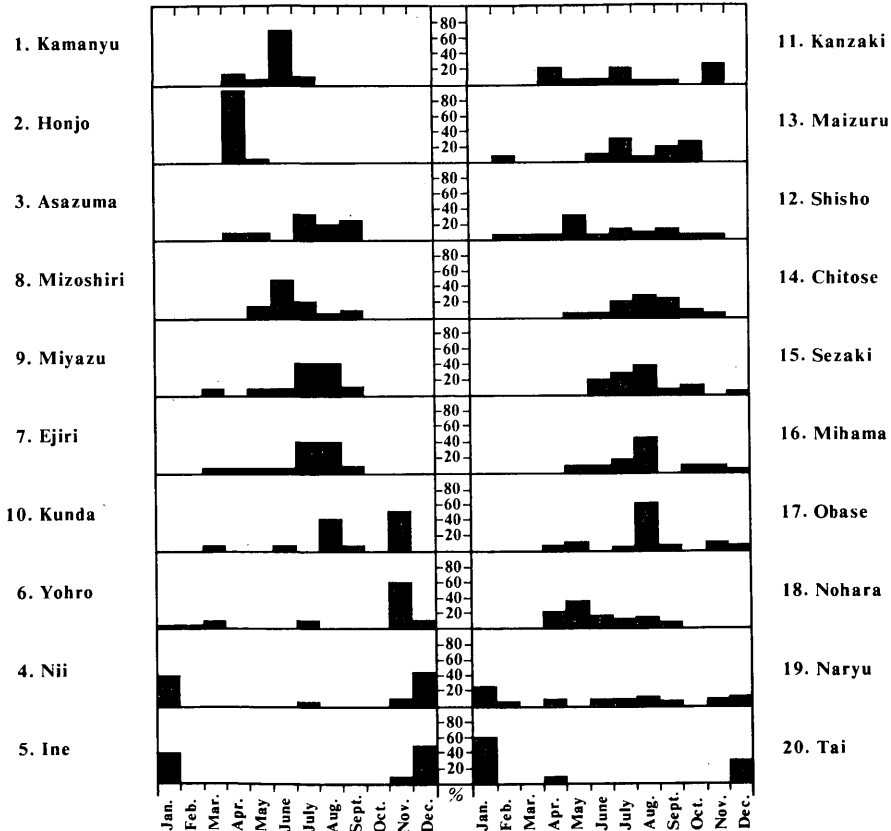


Fig. 4. Comparison of the monthly catch of *L. japonicus* among the fishing ports in Wakasa Bay. The port numbers are shown in Figure 3. (Modified from Kuwatani [1962: Fig. 22]).

grounds near the mouth of the bay the greatest catch can be expected during autumn and winter, whereas in those inside the bay, especially in the smaller bays within Wakasa Bay, the best catch is generally during the spring-summer and early autumn. According to Kuwatani [1962: 55-58], these spatial and seasonal variations in the catch of *L. japonicus* result from the seasonal migration of this species for breeding and feeding in Wakasa Bay (Fig. 5).

Figure 6 shows the body size composition of this species inside Wakasa Bay during the spring and early autumn of 1961 and 1962. It is apparent that the population includes both young and adult groups, represented by two size classes above and below 400 mm in fork length [KUWATANI 1962]. That is to say, the adults of this species enter the shallow water along the rocky shores near the mouth of the bay for

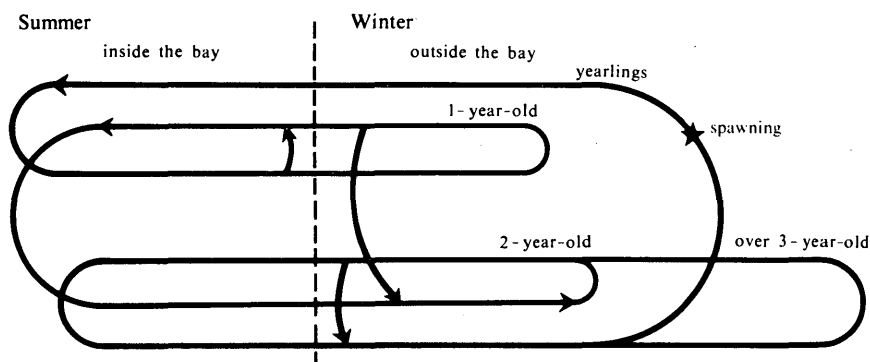


Fig. 5. Schematic representation of the seasonal and annual variations of the habitat of *L. japonicus* (Modified from Kuwatani [1962: Fig. 41]).

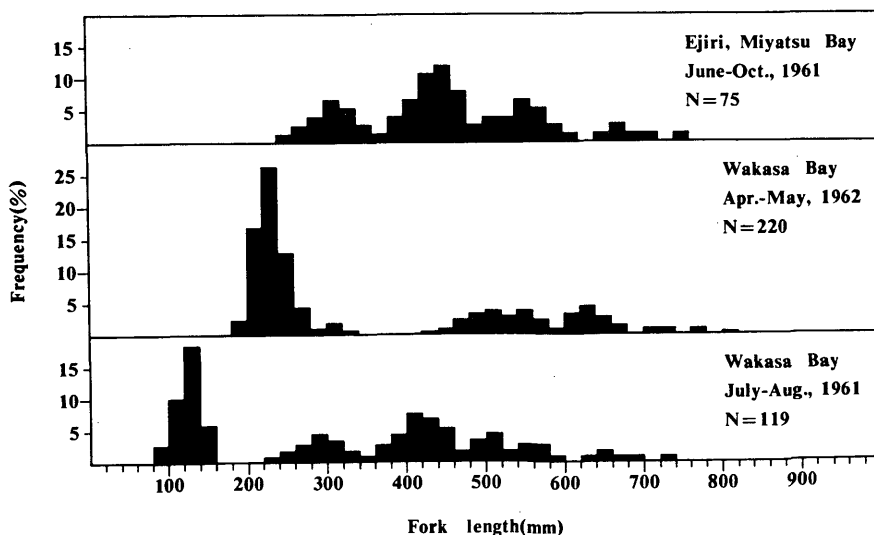


Fig. 6. Body size composition of *L. japonicus* inside Wakasa Bay during spring and autumn (Compiled from Kuwatani [1962: Figs. 32, 34]).

breeding purposes during late autumn, and then move offshore to deep waters for the winter. When the water temperature rises again in the spring, yearlings and other non-adults, as well as adults, migrate gradually into the bays and stay there for feeding during the spring and summer. With the drop in water temperature in the autumn, they leave the coastal waters of the inner bay and move to the mouth of the bay, and finally to the deep water in the open sea again for winter [KUWATANI 1962: 52-58; see also Fig. 5].

An examination of the body size frequencies of *L. japonicus* in the Nittano Jomon assemblages showed that many adults and non-adults had been caught. Figure 7 compares the size frequency distribution of this species by layer, based on the results of body size estimated from the bone fragments by means of the single regression method [AKAZAWA 1969; AKAZAWA and WATANABE 1968]. Comparing these results with the natural population inside Wakasa Bay, illustrated in Fig. 6, the overall pattern of the size frequency between both samples agrees well. It shows that non-adults were also caught together with adults at the Nittano site.

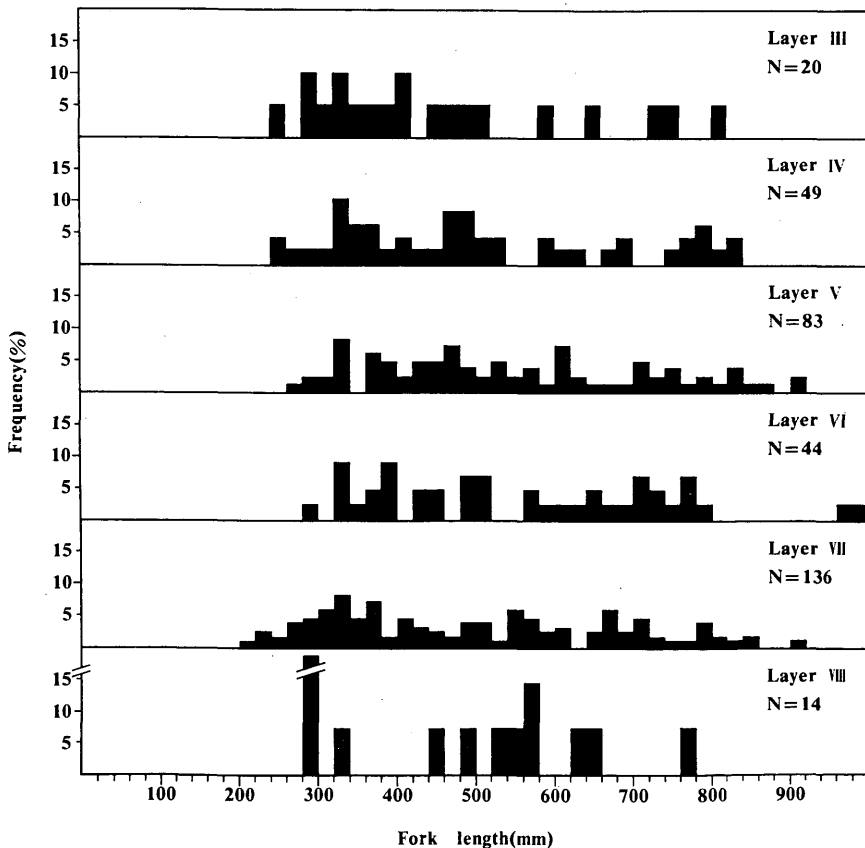


Fig. 7. Comparison of the body size frequencies of *L. japonicus* from Nittano site by layer.

The high frequency (30 to 50 percent of the total assemblage of each layer) of non-adults found in the Nittano Jomon assemblages supports the hypothesis that a Palaeo-Isumi Bay once existed in the territory of the site. This hypothesis is further supported by the extraordinary quantity of bone fragments of this species at the Nittano site; in fact, the bone density cannot be explained in any other way except that they might have been brought to the site from outside the territory by trading and the like. Moreover, the inferred existence of the Palaeo-Isumi Bay is consistent with the palaeo-topographical findings mentioned earlier.

Marine Territories of Jomon Sites

The relative quantity of the molluscan and fish remains at Nittano indicates a strong functional correlation between the type of marine environment in the site territory used by the shell-midden people and the degree of relative reliance placed on certain species as a food resource. At Nittano, the species found in the highest frequencies are those whose habitats are closest to the site; most of the species that were collected lived in the brackish water environment of the Palaeo-Isumi Bay and the lower reaches of streams of the Palaeo-Isumi River. By contrast, species that inhabit coastal areas facing the open sea were not included in the marine assemblage, with the rare exception of the *Batillus cornutus* and *C. major*.

We can now reconsider the area habitually exploited by the occupants of the Nittano site. At the beginning of this section, we assumed an exploitation territory of a 10 km radius as a working model for the present study; as a result, the territory of the Nittano site included a small amount of open sea. But, it is quite possible that the area exploited by the Nittano people did not extend that far. The rare presence of marine resources, as shown in the faunal data at the site, suggests that the open sea lay beyond a reasonable walking or canoeing distance. If the sea was within the area habitually exploited by the Nittano people, we would expect a higher frequency of oceanic species. Taking this into account, we can assume that the exploitation territory of the Nittano site was less than 10 km in radius.

A similar situation prevails at other Jomon shell-midden sites, such as Miyano, Shomyoji, and Kamitakatsu, on the Pacific coast dating to the Late Jomon period, around 4,000 to 3,000 B.P. These sites are some of the few at which systematic sampling techniques were used to recover all the materials from the excavated areas, and where the identified fish species were described both qualitatively and quantitatively.

There is a marked difference in the proportion and nature of marine territory among these sites (Figs. 8, 9). The marine territory of the Miyano site is characterized by rocky to sandy flats of ria type, directly facing the open sea. These flats are strongly influenced by the Kuroshio and Oyashio oceanic currents running along the Pacific coast; they are not influenced by fresh water. The Shomyoji site is located along the present coast facing Tokyo Bay, in localities with rocky shore zones and with no direct freshwater source. In contrast, the Kamitakatsu site is located inland about 50 km from the Pacific coast. Research on postglacial marine trans-

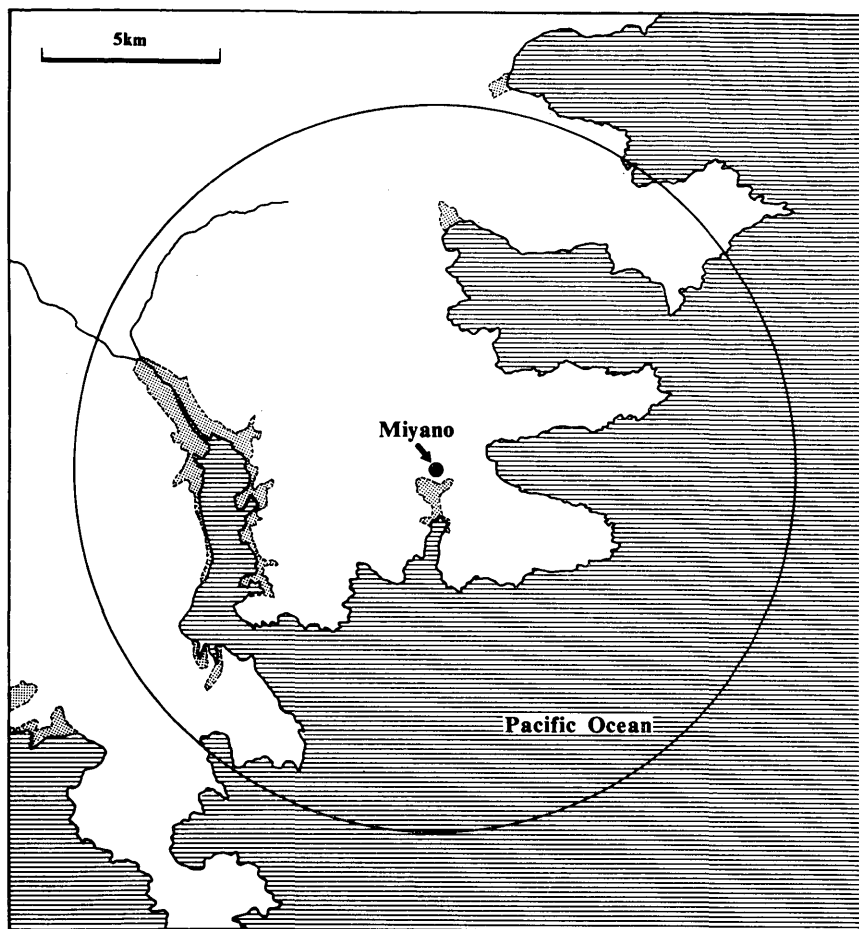


Fig. 8. Hypothetical exploitation territory of Miyano site, showing a marine territory surrounded by a rocky shore of ria type.

gressions shows that at the time this site was occupied the sea had invaded the nearby lowlands, and the territory of the site included shallow bays. The bay had a brackish-water tidal zone environment, which was affected by the rivers flowing into it, but not by the ocean.

Tables 4 and 5 show the relative frequencies of fish species found at these three sites. Two different methods were used to estimate these frequencies of fish species: one estimated the number of individuals from the number of jaw bones found in the entire excavation area, and the other used the total number of vertebrae sifted from a column sample by water sieving through a 1 mm mesh [SUZUKI 1977; KOMIYA 1980]. Although the relative quantities of specimens differ between the sites, the relative frequencies of the species identified indicate a functional correlation between the fish assemblages and the potentials of the marine territory in each site.

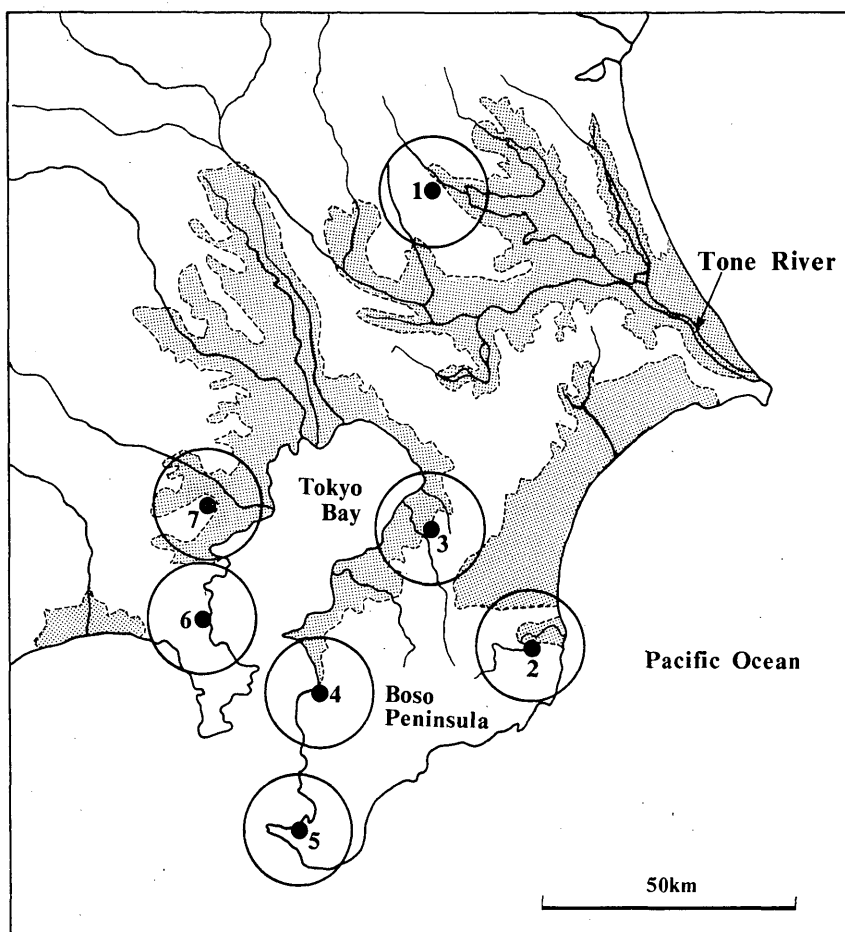


Fig. 9. Distribution of Jomon shell-midden sites in the Kanto district referred to in the text (1. Kamitakatsu, 2. Nittano, 3. Saihiro, 4. Fujimidai, 5. Natagiri, 6. Shomyoji, 7. Kikuna). The areas enclosed by circles show the maximum exploitation territory (10 km radius) assumed for each site as a working model. The stippled portions show the approximate expanse of the maximum sea transgression around 6,000 B.P.

The Miyano assemblage is characterized by high frequencies of rocky shore species, such as *C. major*, and by the families Scorpaenidae and Hexagrammidae. These species are equally common coastal fish which are widely distributed along the Pacific Ocean and which inhabit the rocky shore zones facing the open sea. They seldom enter fresh- and brackish water environments [MATSUBARA and OCHIAI 1965: 892-901, 903-910]. Another feature of the Miyano assemblage is the high proportion of some oceanic types, such as the family Scombridae, including the genera *Thunnus*,

Katsuwonus, and *Scomber*, species which migrate seasonally along the Pacific coast of Japan [MATSUBARA and OCHIAI 1965: 763–862].

The Shomyoji assemblage is also characterized by the presence of rocky shore species, such as *C. major*, and by the families Scorpaenidae and Hexagrammidae, but the proportion of the oceanic species is markedly decreased. On the other hand, *A. schlegeli* and the family Sphyrnidae increase. These fish prefer the rocky shore zones with somewhat brackish water environments of the littoral zones in bays [MATSUBARA and OCHIAI 1965: 702–720].

The Kamitakatsu assemblage is markedly different from the other two. The rocky shore and oceanic species characterizing the other two assemblages were found only in negligible proportion, or were absent entirely. The majority of identified species consist of fresh- and brackish water species from riverine and tidal to sublittoral zones in bays, such as the families Anguillina, Mugilidae, and Tetraodontidae, the genera *Carassius* and *Hemiramphus*, and *Engraulis japonica*, *Cyprinus carpio*, and *Acanthogobius flavimanus*.

Table 6 shows the relative frequencies of three species of fish, *L. japonicus*, *A. schlegeli*, and *C. major* found at five more shell middens. From these data, the sites can be separated into three groups according to the dominant species: 1) Nittano Early and Middle; 2) Saihiro and Kikuna; and 3) Fujimidai and Natagiri. *L. japonicus* characterizes the Nittano group, *A. schlegeli* the Saihiro-Kikuna group, and *C. major* the Fujimidai-Natagiri group. These three species are equally common coastal fish in Japan, but their habitats differ, as described above.

Table 4. Comparison of the frequency of the identified fish bone fragments at three shell middens ^a.

	Miyano	Shomyoji	Kamitakatsu		
			ST-III	ST-II	ST-I
<i>Engraulis japonica</i>	0	0	27	17	5
<i>Scomber</i>	1	2	0	0	0
<i>Seriola</i>	2	0	0	0	0
<i>Oplegnathus punctatus</i>	0	4	0	0	0
<i>Lateolabrax</i>	12	16	4	12	9
<i>Acanthopagrus</i>	0	30	7	14	0
<i>Chrysophrys major</i>	31	77	1	0	0
<i>Plectorhynchus</i>	0	2	0	0	0
<i>Acanthogobius flavimanus</i>	0	0	54	125	76
Tetraodontidae	0	0	4	2	1
<i>Platycephalus indicus</i>	0	3	0	0	1
Unidentifiable	10	23	?	?	?
Total	56	157	97	170	92

^a Frequencies for Miyano and Shomyoji sites were calculated from premaxillary and dentary bones recovered in the total excavation area by dry sieving with 5 mm mesh (from Suzuki [1977: Fig. 2]). Frequencies for Kamitakatsu site were calculated from all jaw bones recovered from three column samples by water sieving with 1 mm mesh (from Komiya [1980: Table 2]).

Table 5. Comparison of the frequency of the identified fish species at three different sites, based upon the number of vertebrae recovered from column samples by water sieving with 1 mm mesh ^a.

	Miyano	Shomyoji	ST-III	Kamitakatsu ST-II	ST-I
Chondrichthyes	13	7	54	38	6
Clupeina	106	143	21	157	13
<i>Engraulis japonica</i>	33	10	21	346	38
<i>Carassius</i>	0	0	2*	4*	2*
Cyprinina	0	0	2*	0	0
Anguillina	24	0	593	695	390
<i>Hemiramphus</i>	0	0	46	204	23
Mugilidae	0	0	3**	0	1**
Sphyraenidae	0	15	0	0	0
<i>Thunnus</i>	13	0	0	0	0
<i>Katsuwonus</i>	27	0	0	0	0
<i>Thunnus/Katsuwonus</i>	35	0	0	0	0
<i>Anxis</i>	2	1	0	0	0
<i>Scomber</i>	41	9	0	1	0
Carangidae	2	25	27***	36***	8***
<i>Lateolabrax</i>	5	5	4****	12****	9****
Sparidae	15	7	8****	14****	0
<i>Acanthogobius flavimanus</i>	0	0	54****	125****	76****
Balistina	1	9	0	0	0
Tetraodontidae	0	0	4****	2****	1****
Scorpaenidae	50	18	0	0	0
Hexagrammidae	39	8	0	0	0
<i>Platycephalus indicus</i>	0	0	0	0	1****
Unidentifiable	220	600	1,009	2,310	1,073

* pharynx, ** opercular, *** scale, **** jaw bones

^a Frequencies for Miyano and Shomyoji sites used here were calculated back from the histograms made by Suzuki [1977: Figs. 3-5]. Frequencies for the Kamitakatsu site were from Komiya [1980: Table 2].

Figure 9 shows the geographical distribution of these shell middens. Each site is enclosed by a circle with a 10 km radius, assumed to be the maximum subsistence activity field. The sites characterized by *C. major* are distributed along the present coast facing the open sea, in locations with rocky shore zones and no direct influence from fresh water. A marine territory of this kind is highly productive of *C. major*.

In contrast, the three sites in the other two groups are located inland along an extinct bay shoreline, about 10 km from the present coastline. Moreover, the sites of Saihiro and Kikuna are situated within the Tokyo Bay area. The bays, which existed during postglacial marine transgressions when these sites were occupied, had the brackish water environments of tidal and littoral zones, influenced by the rivers flowing into them but not directly influenced by the ocean. These environments

Table 6. Comparison of the frequency distributions of *L. japonicus* (1), *A. schlegeli* (2) and *C. major* (3) at different shell middens in the Kanto district. The locations of these shell middens are shown in Fig. 9.

Shell midden	Jomon period	1		2		3		Total		Reference
		N	%	N	%	N	%	N	%	
Nittano	Middle	122	65.59	60	32.26	4	2.15	186	100.00	Ogawa <i>et al.</i> [1975]
		46	64.29	23	32.86	2	2.86	70	100.01	
Nittano	Early	551	60.68	336	37.00	21	2.31	908	99.99	Ogawa <i>et al.</i> [1975]
		198	62.94	111	33.55	11	3.51	313	100.00	
Saihiro	Late to Final	17	6.54	240	92.31	3	1.15	260	100.00	Kaneko <i>et al.</i> [1977]
		12	12.12	85	85.86	2	2.02	99	100.00	
Kikuna	Early	10	34.48	17	58.62	2	6.90	29	100.00	Komiya [1976]
		7	36.84	11	57.89	1	5.26	19	99.99	
Fujimidai	Late	15	7.89	16	8.42	159	83.68	190	99.99	Kaneko [1964]
		9	7.14	10	7.94	107	84.92	126	100.00	
Natagiri	Late	2	0.50	13	3.24	386	96.26	401	100.00	Kaneko [1958]
		2	1.56	5	3.91	121	94.53	128	100.00	

would provide agreeable surroundings for the feeding and breeding of *A. schlegeli* and *L. japonicus*. Accordingly, it is not surprising that these sites are characterized by a high frequency of these two species. In other words, the relative frequencies of the three species depend mostly on the potential of the marine territory of the site in which they are found.

The relative quantities of the fish remains in these shell-middens thus show a strong functional correlation between the type of marine environment in the site territory used by the shell-midden people and the degree of relative reliance placed on a species as a food resource. The territory of the Miyano and Natagiri sites possessed a subsistence system oriented toward the open sea (at least for the marine territory of the site), and the inhabitants collected their marine food resources from the rocky shore environment of the open sea. The Shomyoji and Fujimidai people adapted to the rocky shore environments with somewhat brackish water conditions in bays, and practiced an embayment-oriented subsistence system. The kinds and relative quantities of marine species found at Kamitakatsu, Saihiro and Nittano provide evidence that a large embayment was formed in the territory of the site during the Jomon period. The majority of marine fish remains were identified as species inhabiting fresh- to brackish-water environments of tidal to sublittoral zones in bays. These data, taken together, suggest that the shell-midden people were well-adapted to their local environment.

MARINE EXPLOITATION PATTERNS OF JOMON SHELL-MIDDEN PEOPLE

In addition to an examination of the exploitation territory of the shell-midden site, some other questions, particularly those concerning the collecting habits of the shell-midden people, can be raised. This section discusses two specific questions of marine exploitation: namely seasonality of fishing and differentiation of activities by sex and/or age. The answers will provide the basic data for clarifying the local adaptation in the collection of marine resources and the occupational specialization of the shell-midden people.

Seasonality

With regard to the seasonality of shell-fishing, Koike [1979] concluded from her extensive study of some species of bivalves collected from the shell middens in the Kanto district that:

Each assemblage usually contained shells collected through the year, suggesting that these sites were used for full one-year cycles as permanent settlements. The general pattern of the seasonal assemblages of shell collecting activity examined in shell-midden layers shows about 70% of the total shells dated to spring and autumn, then this percentage decreasing gradually in late summer and autumn, reaching almost zero in winter [KOIKE 1979: 267].

Fish, another important source of marine food found in shell middens, cannot be

dated seasonally by direct methods, like counting the daily growth lines of molluscan species. Although there is a method of estimating seasonality from otolith ring measurement, few otoliths have so far been found in Japanese middens. Contemporary migratory patterns of fish must therefore be used to estimate the season in which they were collected.

The oceanic species, such as the family Scombridae, a very common species in Jomon shell middens of the Tohoku district [KANEKO 1965], are large-scale migrants. Figure 10 shows the seasonal migration of *Thunnus thynnus*, a common fish in the Miyano shell-middens. From these data it might be possible to state that species of this kind were caught at Miyano when they migrated along the rocky-shore zones during the summer season. Surveys made in Hokkaido indicate that the salmon fisheries were restricted to summer and autumn seasons (Fig. 11). Since bone remains of this species have been found in the middens only in negligible proportions, it remains controversial whether or not the eastern Jomon people caught salmon.

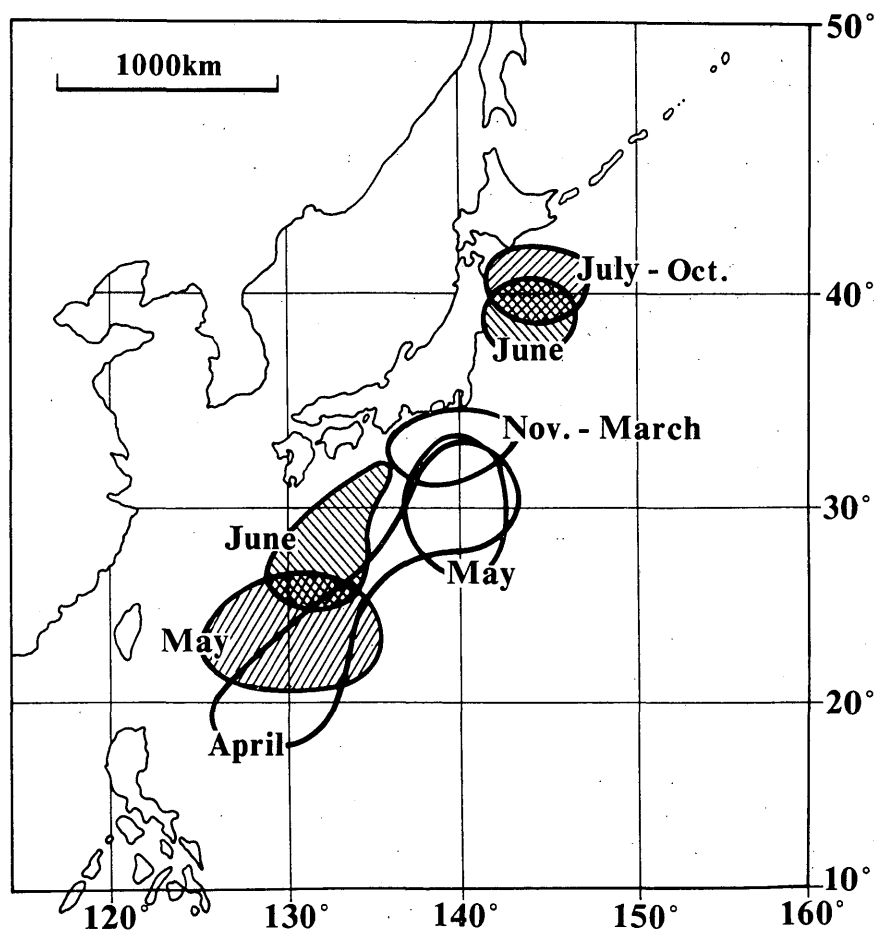


Fig. 10. Seasonal migration of *Thunnus thynnus* [YAMANAKA 1959].

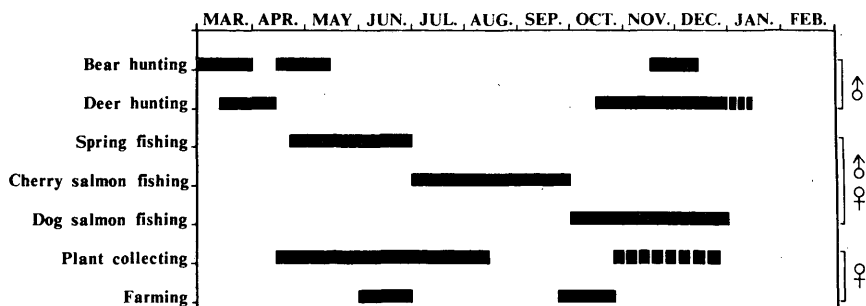


Fig. 11. Seasonal cycles of gathering activities and sex division of labor among the Ainu [WATANABE 1977: Fig. 6].

L. japonicus and *C. major* were the most common species in the prehistoric occupation periods at the sites considered in this paper. Neither are large-scale migrants, like *T. thynnus*, but they do move onshore and offshore to some extent. *L. japonicus* has a distinctive life history of repetitive seasonal migrations for breeding and feeding, as shown by observations of the living species made by Kuwatani [1962: 34–58]. After breeding along the rocky shore of the open sea in late autumn to winter, they spend the winter offshore in deep water. They enter bays in the spring and stay there for feeding until the lowering of the water temperature again, at the beginning of autumn (see Fig. 5).

The frequency distribution of the estimated sizes of this species at Nittano shows that fishing may have been restricted to the bay, as discussed earlier (see Fig. 7). If fishing for this species had been conducted around their spawning grounds, which are used during late autumn and winter, the size frequency of the catches would be skewed toward adults. But the actual size distribution includes a large number of small-sized non-adults together with the adults. As seen in Kuwatani's study of Wakasa Bay, these smaller-sized individuals inhabit bays for feeding during periods of warm water temperature. In other words, the size distribution of this species from Nittano is satisfactorily explained by fishing activities only inside the Palaeo-Isumi Bay in a season other than late autumn or winter.

C. major was also a very common species in the shell-middens referred to in this paper, moving onshore and offshore to some extent. With the rising of the water temperature in spring, *C. major* move shoreward to breed and feed along the coast and/or in bays; but with the lowering of the water temperature in fall, they migrate to the open sea or to deeper water in the bays for the winter [KAJIYAMA 1937; TANAKA 1958; MATSUBARA and OCHIAI 1965: 707–708]. An important characteristic of this species is that the routes and degree of its migrations alter according to the growth of the individual members. Hayashi [1968: 25] has provided the data for a detailed examination of the relationship between the growth and habitat of this species. Yearlings, which are spawned in the *Zostera* areas during spring, stay in rocky shore zones of bays and then migrate to the rocky shore zones along the open sea (Fig. 12).

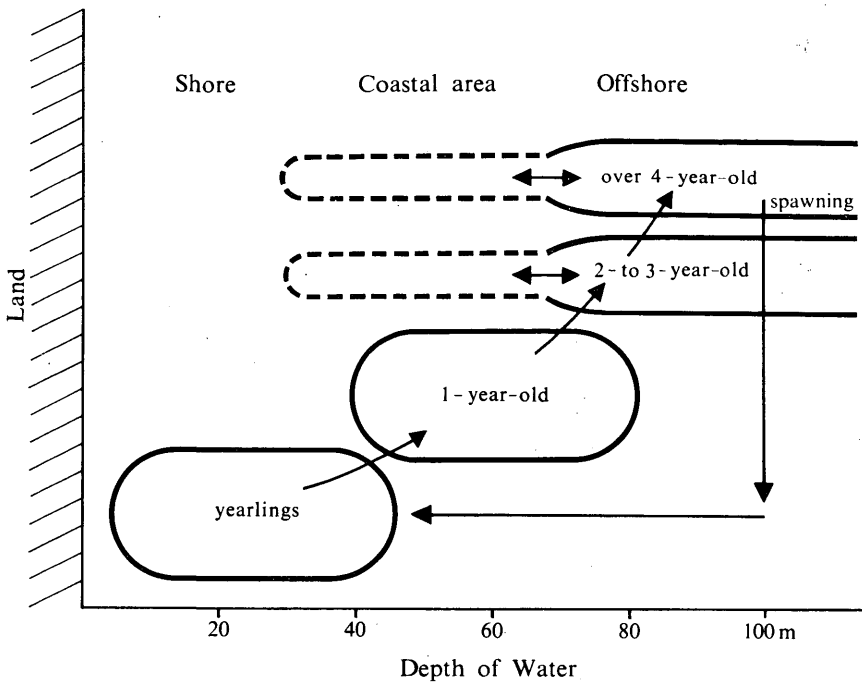


Fig. 12. Schematic representation of the annual variations of the habitat of *C. major* (Modified from Tsukahara [1968: Fig. 2]).

In other words, the non-adults of this species (10–15 cm in body length) are found in the shallow water along the rocky shores of bays and open sea. But the adults of this species move offshore during winter to depths of 90–100 m in the open sea, and then migrate and stay in the rocky shore zones for breeding during spring, when the water temperature rises.

These data suggest that the pursuit of the species *C. major* was seasonally fixed. Figure 13 compares the size frequency distribution of *C. major*, based on the results of body size estimated from the premaxillary and dentary bone fragments collected from the two shell middens of Miyano and Shomyoji. It is apparent that their respective size populations differed; the Miyano sample includes only adult groups, and the Shomyoji sample includes both young and adult groups, as seen in two size classes above and below about 300 mm in body length [KAJIYAMA 1937; TANAKA 1958; MATSUBARA and OCHIAI 1965: 706–707]. Discrepancies in the size distributions of these two shell-middens may indicate seasonal differences in the natural population of this species.

These results can obviously be criticized because they rely on indirect evidence, particularly assumptions based on the ecological habits of living species. There is no direct evidence that the shell-midden people did not go fishing for *L. japonicus* and *C. major* during winter or early autumn, or that the fish could not have been brought to

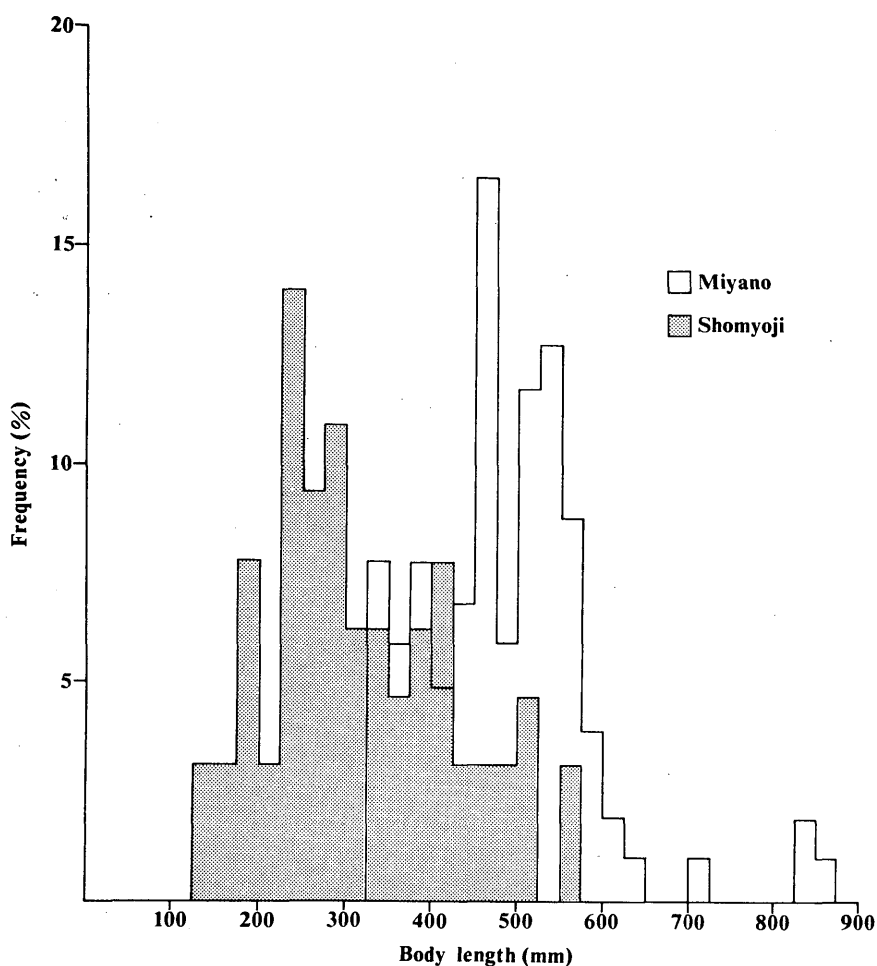


Fig. 13. Comparison of the body size frequencies of *C. major* from between Miyano (N=102), and Shomyoji (N=64).

the site in other ways. Nevertheless, the hypothesis that the majority of major fish species from the shell middens were probably caught during spring, summer, and autumn, (and not in winter), explains the data reasonably well. But a large number of faunal remains were excluded from the present study and it is unsafe to argue that the Jomon shell-midden site was occupied only during particular seasons and not all-year-round. It is still difficult to say whether the Jomon shell-midden site was a temporary camp site or a permanent base settlement. But the evidence presented above, which represents the majority of the marine species collected from the site, gives some support for the possibility of more than one season of occupation and so suggests that the site was a permanent base settlement.

Division of Labor

Watanabe's examination of ethnographic data shows a tendency among hunter-gatherers for a division of labor by sex and/or age (Fig. 11), although it is not certain to what extent this division is fixed [H. WATANABE 1968: 77]. For men, the division of labor depends on a differentiation of activity areas, with the younger men exploiting more distant locations and the older men exploiting locations in or near the base camp. The following analysis will examine some problems of prehistoric division of labor which have been often overlooked from an archaeological viewpoint.

As discussed earlier, there were significant changes in the relative quantities of some of the molluscan species from Early to Middle Jomon at the Nittano site (Table 1). Specifically, the quantity of *C. sinensis* showed a marked decrease in Middle Jomon, while that of *C. japonica* increased to over 99 percent of the total of the identified molluscan specimens in that same period. The relative quantities of fish species remained almost the same in the two periods.

The gap of some 1,000 years between the deposits of Early and Middle Jomon, based on radiocarbon dates from related sites, was the period of the post-maximum sea regression. The ocean probably receded during this interval from the Palaeo-Isumi Bay, gradually reducing its size from the maximum reached during the Early Jomon Transgression. The coast of the Palaeo-Isumi had receded toward the present seacoast by Middle Jomon. As a result, the embayments which had yielded the major part of the marine resources used by the Early Jomon people at Nittano were reduced in area and were also further away from the site. In turn, the riverine environments were enlarged around the site.

These palaeo-environmental changes quite possibly brought about changes in the potential marine resources that could be exploited by the shell-midden people within the territory of the site. The marine molluscs were certainly influenced directly by these environmental changes, and this ought to be reflected in changes in the frequencies of the molluscan species in the two periods. In particular, we expect an increase in riverine species, such as *C. japonica*, in the Middle Jomon period. *C. japonica* is indeed extremely abundant in Middle Jomon, and this increase in riverine species can be explained by the palaeo-environmental changes that occurred in the territory of the site.

In contrast to the changes in the molluscan species, the relative frequencies of the fish species remained the same in both periods (see Table 2). The majority of the Early and the Middle Jomon fish species were the same, all inhabiting the mud flats in the brackish water environments of tidal and sublittoral zones in bays. The size frequency distribution of *L. japonicus* showed the same tendency in the two Early and Middle Jomon periods, as shown in Fig. 7.

In other words, the Nittano people changed their habits in collecting molluscs during Middle Jomon from a bay-oriented system to a river-oriented system, but they still fished in the Palaeo-Isumi Bay. These differences in the locations of collecting activities certainly were caused by environmental change in the territory of the site.

But why did the people going on fishing excursions to the seacoast not continue

to collect brackish water molluscs, such as *C. sinensis*, that were so common in Early Jomon? A change of taste might be one possible explanation, but this differentiation of activity area might also result from a division of labor by sex and/or age, a possibility which should not be overlooked.

The coastline moved away from the Nittano site with the regression of the sea in the Middle Jomon period, although it is not certain how far. In order to adapt to these new circumstances, the Middle Jomon Nittano people divided their marine territory into two activity areas, one along the somewhat distant Palaeo-Isumi Bay for catching the brackish water fish, and the other along the lower stream and the mouth of the Palaeo-Isumi River, nearer to the site for collecting molluscs. These two activity areas were probably exploited by different age and/or sex groups within the society. That is to say, the younger men went to the more distant bay shore, but the older men, children and women exploited the locations along the Palaeo-Isumi River near Nittano. Such a division of labor and the separation of activity areas that it allows would explain why the proportion of molluscs and fish did not change in the same way through time.

In examining the relative frequencies of marine species at relevant shell-middens of the Jomon period, the same general pattern as seen at Nittano can be observed frequently at inland sites [KANEKO and USHIZAWA 1977; MATSUSHIMA 1979]. These data suggest that shellfishing activities by the shell-midden people could certainly have been directly influenced by the environmental changes occurring within the marine territory of the site. That the proportions of molluscs and fish did not change in the same way through time further suggests the possibility that both activities were pursued by different groups of the society.

Most hunter-gatherers practiced a number of different subsistence activities for acquiring staple food. Together with fishing and shellfishing, the shell-midden people might also have collected seeds, nuts, fruits, and roots, and hunted and trapped game. This regular behavior was grounded in a detailed knowledge of the natural resources for the pursuit of economic efficiency. The most important adaptation for the shell-midden people depended on the regularity of the ecological habits of the basic species of available fish. Consequently, these situations enabled their way of life to become differentiated and socioculturally fixed.

It is obvious that these systems promoted the technological and sociocultural specializations of the shell-midden people. Not only was there craft specialization in fishing equipment but there was the concentration of population, increased settlement size, and permanence of settlement in the fishing societies [MURDOCK 1969]. These same circumstances obtained along the Pacific coast of eastern Japan, as can be inferred from a greater emphasis on fishing [M. WATANABE 1966, 1973]. In association with these technological developments, the sociocultural systems were transformed to specific specializations. We will examine in the next section how these shell-midden people reacted to a new, settled life of agriculture.

RICE CULTIVATION IN JAPAN

Beginnings and Diffusion Patterns of Rice Cultivation

The earliest evidence of rice cultivation is found in northern Kyushu, at Itazuke, the type site for the Itazuke pottery, which marks the earliest phase of the Yayoi period in this region. Recent evidence from this site implies that rice cultivation was initiated in northern Kyushu around the final stage of the Jomon period [SHIMOJO 1979]. Evidence of radical technological innovations caused by rice cultivation was found at this site, together with carbonized grains of rice during the Yusu-type pottery stage of the Final Jomon period in this region. There can be no doubt, based on the palaeobotanical studies of the sediment at this and other relevant sites in northern Kyushu [NAKAMURA 1979; FUJIWARA 1979], that the occupants cultivated rice during the final stage of the Jomon period, around 3,000 B.P.

After rice cultivation first appeared in northern Kyushu, the Itazuke-type pottery stage—whose beginning is dated at 2,560 B.P. ± 100 years (Gak-2360), and 2,400 B.P. ± 90 years (Gak-2390)—commenced. A new cultural complex spread eastward during this stage, as far as the Tokai district of central Japan [cf. KONDO 1962; KANASEKI and SAHARA 1978] (Fig. 14). It is assumed that this first expansion of rice technology occurred quite rapidly, because the cultural complex of the Early Yayoi period is quite homogeneous in the area from Kyushu to the Tokai district [KANASEKI and SAHARA 1978: 20]. This assumption may be supported by the radiocarbon determinations of the early stage of the Yayoi period at the Nishishiga site in the Tokai district. The Yayoi deposit at this site, associated with the earliest Yayoi type pottery of this region, is dated at 2,520 B.P. ± 140 years (N-120), 2,220 B.P. ± 120 years (N-161-1), and 2,440 B.P. ± 130 years (N-161-2). These dates indicate that this site was occupied during the first stage of rice expansion, around the same time as the formation of Itazuke site in Kyushu.

According to KOMURA [1980], however, the various groups of Final Jomon people in the Tokai district followed divergent paths and variable speeds in the transition to rice cultivation.

The western Tokai Jomon people reacted quickly to rice cultivation and produced the earliest Yayoi pottery, which is generally known as the Ongagawa type, its uniformity being based on the similar technological and morphological features. But the eastern Tokai Jomon people retained their traditional ceramic technologies and did not produce Ongagawa-type pottery. The sites in the eastern Tokai area were concentrated in the coastal regions and along rivers, often characterized by extensive shell-middens [KOMURA 1980].

Prehistoric sites of the Jomon period in the coastal regions of Japan are often characterized by shell-middens and, although these shell-middens were not deposited entirely during Jomon times, the largest and densest deposits were made in the Late Jomon period [KANEKO 1965, 1980]. Furthermore, the most conspicuous features

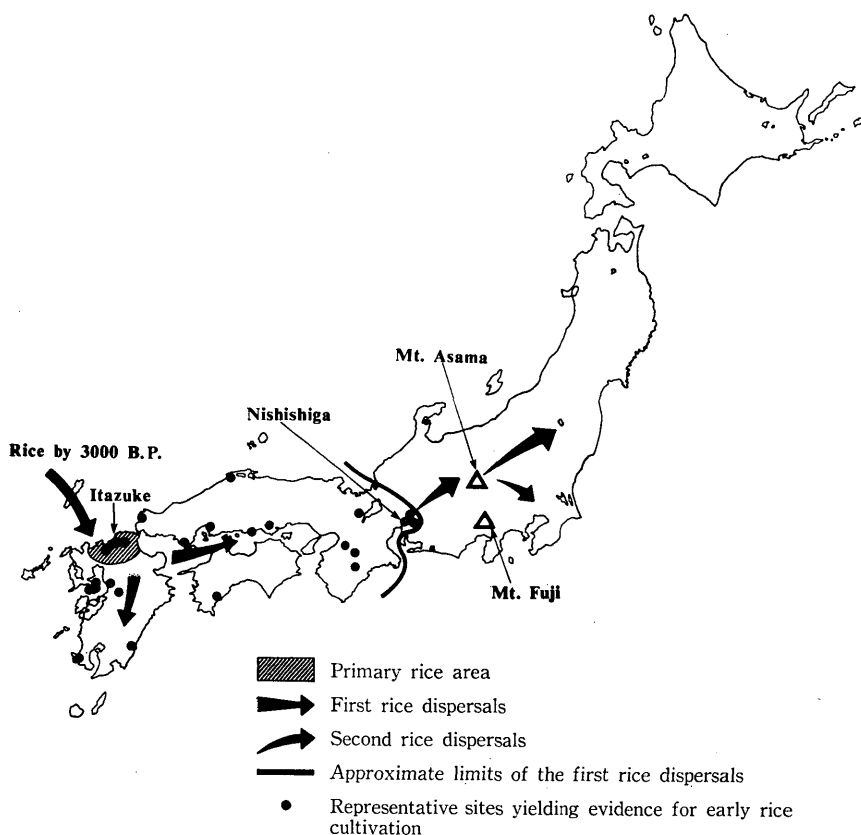


Fig. 14. Map illustrating the probable route over which rice was diffused eastward from northern Kyushu to the Tokai district (First expansion), and its subsequent dispersal to the Kanto district (Second expansion). Approximate limits of the first rice dispersals used here were from Sugihara and Otsuka (eds.) [1964: Fig. 2].

are concentrated along the Pacific coast of eastern Japan, that is, from the Tokai to the Tohoku districts [KANEKO 1965: 386–388].

Figure 15 shows the distribution of Jomon sites which have produced fish-hooks, an important indicator of fishing activities, and also indicates frequency distribution by region of these fish-hooks. Based on these data, Watanabe stated that:

The sites containing the fish-hooks are concentrated along the Pacific coast of central and northeast Honshu, and are very rare in the prefectures bordering the Japan Sea and in southern Honshu and Hokkaido. It is noteworthy that the areas of heaviest concentration of the sites from which the fish-hooks have been recovered correspond to the areas where the Jomon culture most flourished [1966: 46].

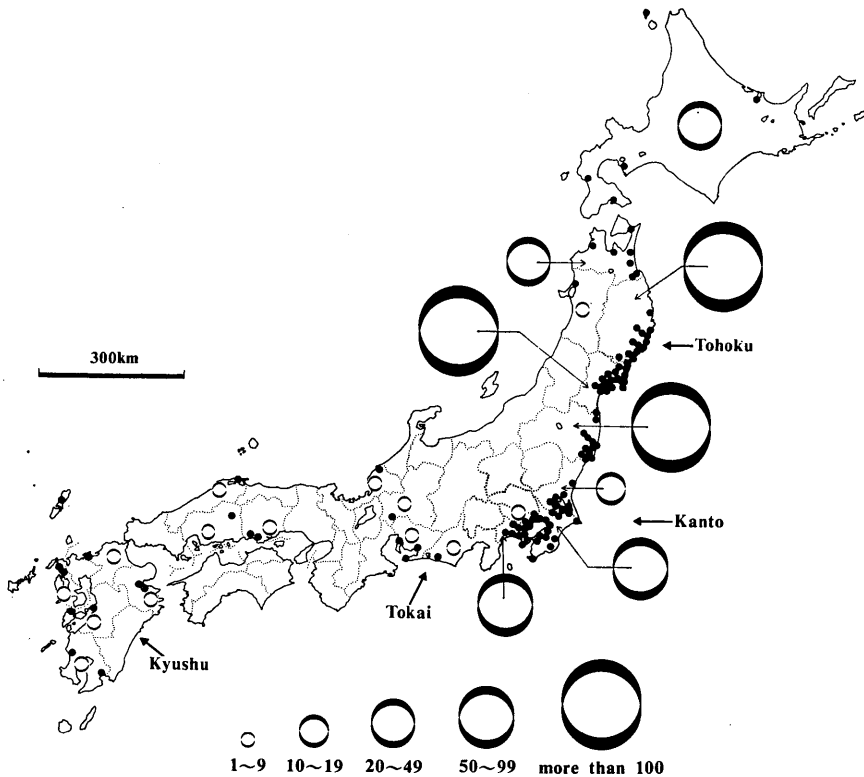


Fig. 15. Map illustrating the geographical distribution of Jomon sites yielding fish-hooks, and the relative frequencies of the fish-hooks by area (Compiled from Watanabe [1973: Figs. 38, 39, 41, 42, 45, 47, 49, 52, 56, 61]).

These data suggest that the Jomon people of eastern Tokai, who resisted the initial spread of agricultural technology, had developed an exceptionally efficient subsistence economy based on marine fishing and gathering activities, a view perhaps supported by the diffusion route of the second rice dispersals eastward.

The second stage of rice expansion occurred during the Middle Yayoi period (ca. 100 B.C.–A.D. 100). But this second route was quite different from the first. The diffusion of rice traveled initially through the lowlands along the Inland Sea coast to the lower reaches of rivers and estuaries in western Japan. The second diffusion traveled inland—through the basins of Yamanashi and Nagano Prefectures, along the base of Mt. Asama to northern Kanto and on to Fukushima Prefecture in northern Japan, but it never reached the large southern Kanto Plain [KANASEKI and SAHARA 1978: 21] (see also Fig. 14).

By about A.D. 300, the beginning of the next cultural period, known as Kofun, the Yayoi culture had spread throughout almost all the Japanese islands, except the Ryukyus and Hokkaido [KANASEKI and SAHARA 1978: 16]. Moreover, a number of

significant differences can be observed between the Yayoi period cultures of western and eastern Japan. The outstanding difference between them is in pottery-making. All the sites of the Early Yayoi period throughout the area of the first stage of rice expansion yield the Ongagawa-type pottery mentioned earlier [KANASEKI and SAHARA 1978: 20]. By contrast, the Yayoi pottery complex of eastern Japan was characterized by strong influences from the local preceding Jomon traditions [KONDO 1962: 141-142]. That is, the Yayoi culture of eastern Japan is characterized by a strong tendency toward cultural regionalism.

Furthermore, as illustrated by Kenmochi [1972] and Kanzawa [1979], a number of cave sites along the Pacific coast in the Kanto district were characterized by shell-midden deposits together with a large quantity of fishing equipment, such as fish-hooks, harpoons, and net sinkers. This evidence also shows that the Yayoi people of this region retained their traditional life based on fishing activities, although it is not certain whether or not these sites were permanently occupied. The reasons for the difference of diffusion patterns between western and eastern Japan remains a subject of discussion among Japanese prehistorians.

Differences in Receptivity to Agricultural Adaptation

Haury has summarized the primary conditions for the diffusion of maize from Mesoamerica to the North American Southwest as follows:

First was propinquity, the geographical closeness to the avenue through which elements were passing from nuclear Mesoamerica northward. ...second, the biogeographical setting needed to be similar in kind to that of the donor area, and, third, an optimum cultural environment was needed, a willingness to accept, to modify, and to build [HAURY 1962: 116].

It is by no means impossible that these three conditions also applied to the transition to rice cultivation in Japan: The three conditions were present in western Japan, whereas some were lacking in eastern Japan.

As for geographical closeness to the donor area, it is hardly necessary to point out that western Japan was situated nearer to the avenue through which rice cultivation passed from the continent. Prior to the first appearance of rice cultivation there might have occurred a readjustment of sociocultural habits which had been under constant stimulus from the continent [KONDO 1962: 144-146, 152-155]. It is highly probable, in such a situation, that western Japan could easily accept new immigrants, although it is not certain how many arrived. Nevertheless, the evidence that the first expansion of rice technology was due to the conquest by large immigrant groups from the continent has not yet been obtained in the fields of archaeology and physical anthropology [e.g., KANASEKI 1962; KONDO 1962; KANASEKI and SAHARA 1978].

It is also generally accepted that the amount of sunshine is slightly less in the east than in the west of Japan [KONDO 1962: 62]. Kanaseki and Sahara [1978: 20] described the situation as follows: "The relatively small amount of sunshine in eastern

Japan made rice cultivation difficult. Therefore, the Yayoi people could not settle in the area until suitable types of rice had evolved". Nevertheless, the climatic setting is almost the same throughout the Japanese islands, since they lie within the monsoon climatic zone. Temperature and humidity for rice cultivation do not differ much from area to area, except for northern Tohoku and Hokkaido. Moreover, lowlands had formed along the seacoasts and the lower reaches of rivers and estuaries with the regression of the sea during the Late Jomon period. These lowlands could have easily been used as paddy fields by early farmers, and it was quite possible to cultivate rice on a simple level without special water-control devices [KANASEKI and SAHARA 1978: 22].

All these situations were similar between western and eastern Japan, the amount of sunshine differing only slightly between the two. As a consequence, it is unreasonable to believe that the second stage of rice expansion could not have begun before new species of rice evolved. That is to say, the condition mentioned above cannot explain the cultural dichotomy between the area where rice spread rapidly and the area where it was resisted.

We will also examine the conditions described as the "biogeographical setting" and "optimum cultural environment" suggested by Haury. To do so, we begin by centering on Kondo's paper [1962], which has been widely discussed from an archaeological viewpoint.

Kondo's interpretation relies heavily on the fact that Jomon sites are concentrated in eastern Japan, whereas such sites are scarce in western Japan. Thus, Kondo [1962: 149–150] has proposed that the difference in population density had already appeared during the Jomon period, especially during its Final stage. This density could, in turn, be attributed to the differences in the amount and nature of available foods. The abundant food resources of eastern Japan enabled the Jomon people to specialize in the food-getting activities of hunting, gathering, and fishing, resulting in a higher population density. In such a situation, the society could not readily react to a new way of life, and even after shifting to it, the regional tradition of the Jomon period survived in the Yayoi culture as it had before.

In contrast, western Japan during the Jomon period was sparsely populated, due to the paucity of natural resources [KONDO 1962: 150–152]. There appeared, as a result, a relatively simple mode of subsistence, and the people did not develop a specialized hunting-gathering society. A revolutionary readjustment of sociocultural habits was not demanded for the western hunter-gatherers to settle down to a new way of life. The transition for them was easier.

Challenging the ideas summarized above—which are widely accepted by Japanese archaeologists—is another view based on botanical evidence emphasizing that the two major areas are characterized by different forest zones [e.g., HONDA 1912; KIRA 1949; YAMANAKA 1979]. Western Japan is situated at the northern end of the laurel forest zones that characterize southeast Asia (Fig. 16), and Ueyama *et al.* [1969, 1976], Nakao [1966], and Sasaki [1971] suggest that prior to the first rice cultivation, a certain degree of plant manipulation and/or swidden-type agriculture had been pursued

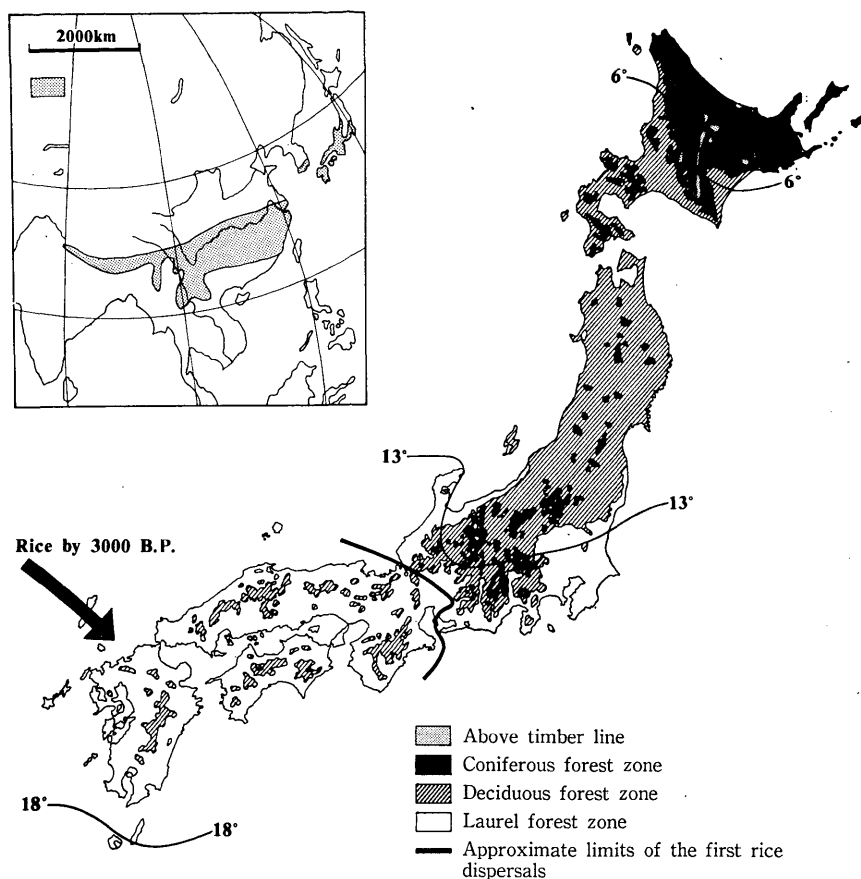


Fig. 16. Map illustrating the major classification of natural forest zones and their relationship to rice dispersal in Japan (Compiled from Honda [1912]; Sasaki [1971: Fig. 1]).

in western Japan. They proposed that a subsistence economy of this kind occupied an intermediate position between hunting-gathering and agriculture as follows:

1. a swidden type of agriculture in which some cereals and potatoes are cultivated is distributed in the laurel forest zones of southeastern Asia;
2. the same type of agriculture could have been pursued by later Jomon people living in the same laurel forest zones in Japan;
3. the distribution of the laurel forest zones in Japan generally overlaps the areas occupied by the first stage of rice expansion; and
4. swidden-type agriculture possibly played a crucial role in mediating the transition to rice cultivation.

It is quite apparent that these functional interpretations have succeeded in increasing

our understanding of the transition to agriculture in Japan, although these suggestions have not been proved archaeologically.

Some problems remain to be solved in order to support this hypothetical view. The most complex aspect is that swidden agriculture differs from rice cultivation in field preparation and related technologies. From the beginning, Japanese rice cultivation utilized a type of prepared paddy field [SATO 1971]. Thus, whether the transition to rice agriculture was vastly easier for swidden farmers than for hunter-gatherers or others is questionable, since both lacked experience with the proper technologies. Furthermore, this hypothetical approach cannot explain why the eastern Tokai and Kanto districts showed resistance even in the first stage of rice expansion through these regions; although these districts are in eastern Japan, they are included in the same forest zones as western Japan (Fig. 16). They could have offered similar conditions for rice expansion as in western Japan.

The resistance to rice cultivation, which can be traced along the Pacific coast in eastern Japan, seems best explained by the circumstances which supported existing flourishing fishing societies. This region was not an "optimum cultural environment" for the acceptance of rice, and the shell-midden people living there were unwilling to accept rice cultivation. Because the second stage of rice expansion also met with resistance from the shell-midden people along the Pacific coast of eastern Japan, it did not follow the coastal route of the first expansion, but spread first to inland regions.

Whenever an outside stimulus is present, a cultural and ecological relationship is established between donor and recipient. We now must examine the conditions in the western Jomon area where, rice cultivation was rapidly received.

Western Jomon Receptivity to Agriculture

There are regional differences between eastern and western Japan in the quantity of archaeological evidence available for the evaluation of the Jomon exploitation patterns. Information is more scarce for western Japan than for eastern Japan since the shell-middens are less dense in the west, and this presents an obstacle to a comprehensive understanding of the western Jomon culture and its transition to the Yayoi culture. Nevertheless, some important archaeological data are available for the examination of the subsistence economy and settlement pattern of the western Jomon people. Most noteworthy is the data presented by Makabe [1979] concerning storage pits associated with western Jomon settlement sites.

It is well-documented that a variety of pits are frequently associated with Jomon settlement sites, but there has been much debate about the use and function of these structures, since archaeological remains have rarely been found in them. Makabe [1979: 238] recently reported that "the western Jomon settlement sites are frequently associated with a number of storage pits containing plant remains such as various acorns and nuts. In particular, during the Late Jomon period of this region, the number of pits increased drastically". The recently excavated western Jomon

site at Torihama has been analyzed intensively with regard to the prehistoric economy, and is relevant to the views of Makabe.

The Torihama site is situated inland, about 5 km from the present coastline of Wakasa Bay (Fig. 17). The site has been extensively excavated several times since 1962, and completely analyzed by the Torihama Site Archaeology Expedition [1979]. From the excavations during the four seasons of 1962, 1963, 1972, and 1975, it was found that the site had a thick deposit of over 2 m, divided into 19 geologically defined layers [MORIKAWA 1979]. The analysis of associated pottery assemblages showed that the deposits of the site contained two major cultural horizons: an Initial Jomon deposit, ca. 10,000 B.P., overlain by an Early Jomon deposit, ca. 6,000 B.P.

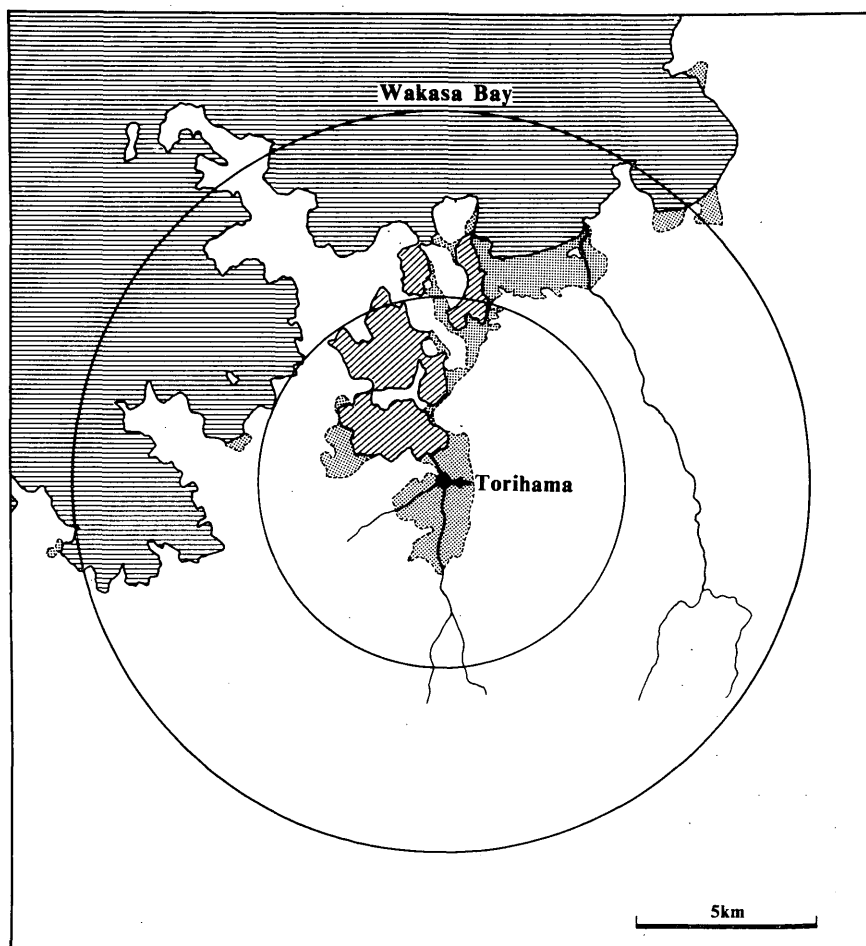


Fig. 17. Hypothetical exploitation territory of Torihama site, showing enlarged lakes and riverine environments. The stippled areas show the extent within the site territory of the maximum sea transgression in the early Holocene period, around 6,000 B.P.

[YAMADA and HAMADA 1979]. The most important feature of the site is the thick distribution of peat and midden deposits producing a large quantity of faunal and floral remains. All remains were carefully examined *in situ*, and their provenance was recorded on a grid system. Some column samples were processed systematically through a 1 mm mesh sieve. For the present study only the column samples from the Early Jomon deposits have been selected for analysis.

Table 7 shows the relative frequencies of constituents by weight, found at two column samples of the site. Table 8 shows the caloric levels in the main food resources of the Torihama people, calculated from the same data given in Table 7. From these data it is evident that the Torihama people obtained a high proportion of their calories from plants and aquatic animals.

The original Torihama site report identified and described 26 species of plants plus 11 genera and/or families [NISHIDA 1979]. Among them, various acorns and nuts, such as *Juglans mandshurica*, *Castanea crenata*, and the genus *Trapa*, accounted for a major portion of plant remains identified from the column sample [NISHIDA 1979, 1980]. Another important fact to be noticed here is that some cultivated plant species of *Phaseolus radiatus* and *Lagenaria leucontha* were identified, and although the frequency is very low it is not negligible [NISHIDA 1979; MATSUMOTO 1979].

Identified molluscan and fish remains belong to a large number of species. The relative frequencies are greatest for molluscs and fish species living in fresh- to brackish water environments with riverine to lake conditions. For instance, the living species of *C. japonica*, the dominant species of molluscan remains identified, lives in fresh- to brackish water environments, such as the lower reaches of streams and estuaries, as described in the Nittano samples. The next common molluscs identified are also fresh- to brackish water species, including *Lanceolaria cuspidata*, *Unio douglasiae nipponensis*, and *Inversidens japonensis* [FUJII and TAKAYAMA 1979: 167]. The dominant fish identified are also fresh- to brackish water species of the genera *Carassius* and *Cyprinus*. That is, the high caloric values of molluscan and fish species shown in Table 8 are obtained from these fresh- to brackish-water species.

Molluscan and fish species such as *C. sinensis*, *L. japonicus*, *A. schlegeli*, and *C. major*, which are common in the eastern Jomon shell-middens, show very low frequencies in the Torihama assemblages [NISHIDA 1980]. Furthermore, the molluscs of oceanic and rocky species, such as *Turbo stenogyrys* and *Thais bronni*, and the oceanic fish species of the family Scombridae, have also very low frequencies, and some species occur in almost negligible proportions.

Thus the fresh- to brackish-water environments with riverine to lake conditions yielded the major part of the food resources used by the Early Jomon people at Torihama. This means that the highest caloric values of molluscan and fish species were obtained from the potential aquatic resources of these prehistoric environmental conditions. In order to understand the meaning of the characteristics of these faunal assemblages from the Torihama site, it is necessary to examine further the territory of the site relative to the prehistoric geomorphology.

The stippled portions in Fig. 17 represent the area less than 10 m above the

Table 7. Density estimates for major constituents of the deposits at Torihama site. All values were expressed as weight of residual sum of remains per volume of sediment (in gram/1,000 cm³) (after Nishida [1980: Table 1]).

Sample No	Shells		Mammal bones		Fish bones		Seeds		Charcoal		Pots/herds		Wooden pieces	
	IE	IM	IE	IM	IE	IM	IE	IM	IE	IM	IE	IM	IE	IM
1	2.1	346.7	5.9	0.0	4.1	3.3	0.1	1.0	1.3	0.5	17.0	2.8	0.0	0.0
2	4.8	373.3	0.0	2.3	6.9	3.0	0.1	0.3	1.6	1.4	13.8	6.7	0.0	0.0
3	20.9	216.7	1.1	0.0	4.2	8.3	0.2	0.0	2.2	0.0	12.3	3.3	0.0	0.0
4	40.6	183.3	0.6	0.0	4.9	0.8	0.3	0.0	3.2	0.9	6.2	0.3	0.0	0.0
5	75.4	283.3	1.3	0.0	6.5	3.4	4.2	4.0	9.9	0.3	15.5	6.7	2.8	4.0
6	79.9	166.7	0.8	1.6	1.8	2.7	7.6	4.7	4.5	1.0	15.1	5.0	8.1	1.3
7	93.1	0.0	0.6	0.0	1.1	0.8	9.5	33.8	1.8	7.0	7.2	0.0	13.3	0.0
8	58.1	0.0	0.0	1.2	1.0	0.0	26.4	34.3	2.2	10.2	10.0	41.7	19.8	11.7
9	42.5	0.0	0.0	0.0	1.0	0.0	11.0	43.0	3.6	0.5	7.9	0.0	15.8	35.0
10	134.4	0.0	3.0	1.5	1.3	2.0	29.4	36.7	17.7	6.3	3.8	2.3	9.9	25.0
11	34.2	0.8	29.3	3.7	0.9	2.0	29.7	0.3	4.5	13.3	9.6	40.0	25.9	1.7
12	31.9	0.0	2.2	0.0	1.5	1.3	30.6	42.0	2.8	10.3	5.1	0.5	27.9	23.3
13	4.2	0.0	0.3	1.4	1.2	+	13.1	6.7	2.2	2.3	0.0	3.7	4.2	6.7
14	0.0	—	0.0	—	2.0	—	10.9	—	1.6	—	0.0	—	34.0	—
15	0.2	—	0.0	—	0.3	—	3.4	—	8.4	—	1.8	—	5.9	—
Total	622.3	1,570.8	45.1	11.7	38.7	27.6	149.5	206.8	67.5	54.0	125.3	113.0	167.6	108.7

+ present, — no sample

Table 8. Percentage comparison of the proportion of the caloric contribution of the major food residues at Torihama site, calculated on the basis of the same data as Table 7 (after Nishida [1980: Table 11]).

	Shells		Fish		Mammals		Walnuts		Water chestnuts		Chestnuts		Acorns		Total	
	IE	IM	IE	IM	IE	IM	IE	IM	IE	IM	IE	IM	IE	IM	IE	IM
Whole residue	70.6	89.7	4.4	1.6	5.1	0.6	12.6	7.7	3.7	0.3	1.2	+	3.6	1.7	100.1	100.1
Edible portion	12.7	36.7	47.4	39.0	18.2	5.5	4.6	7.0	3.8	0.9	3.4	+	10.0	10.8	100.1	100.1
Caloric contribution	8.5	24.8	31.9	26.3	17.5	5.3	16.1	24.8	4.4	1.1	5.5	+	16.0	17.7	99.9	100.0

+ unprocessed

present sea level, and this suggests the maximum extent of the Jomon Transgression around the Torihama site at about 6,000 B.P. [OKADA 1978]. This dating agrees well with the evidence of the Early Jomon habitation at this site. The circles in Fig. 17 enclose an area within 10 km and 5 km radii of the site—the area assumed to be the exploitation territory for the purpose of the present studies.

The larger circle includes a large amount of open sea environment, characterized by rocky to sandy flats directly facing the open sea. These flats are influenced by an oceanic current running along the coast of the Sea of Japan. The potential prehistoric marine resources in the flats were most likely characterized by oceanic species. But, as described earlier, the relative frequencies of these rocky to sandy flats species in the open sea are almost negligible at Torihama. The dominant species of fish and molluscs are found in fresh- to brackish-water environments, such as the lower reaches of streams and estuaries. Thus, the species found in the highest frequencies are those whose habitats were closest to the site and those which lived in the enlarged lake and riverine environment formed by the Early Jomon transgression. An exploitation territory enclosed by a circle of 10 km radius is thus too large for this site, at least for the marine exploitation activities; the area habitually exploited by the Torihama people were the lakes and rivers within the 5 km radius.

Why did the Torihama people not go on fishing excursions to the seacoast to collect oceanic and sea water species that were so common in Jomon shell-middens of eastern Japan? The important evidence is the significance of plant remains in the total food resources exploited in the Torihama site territory. It can be concluded from the caloric proportions estimated by Nishida that the exploitation patterns of the Torihama people were characterized basically by inland-oriented systems in riverine and lake environment, not by sea-oriented systems like those of the eastern Jomon shell-midden people. This view generally coincides with the study presented by M. Watanabe [1968: 16–18]. He concluded from comparative studies of the relationship between western Jomon sites and the associated faunal remains that the distribution of western Jomon sites is concentrated along rivers and lakes, not along the seacoast, and their exploitation pattern was lake- and river-oriented for the pursuit of the fresh water species.

The comparison between the marine adaptation of the Jomon people in western and eastern Japan reveals a significant difference. Although the evidence is still insufficient, it appears that the hypothesis that western Jomon people were engaged in intensive plant collecting and/or in incipient plant cultivation of native species in the hinterland zones, rather than fishing, explains the available data reasonably well. Accordingly, it is easy to argue that western people of the Japanese archipelago gained a greater degree of botanical experience and innovation during the Jomon period than did the eastern Jomon people. In addition, these innovations may have been reinforced because western Japan was closer to the continent and in the same biophysical environment as the areas providing the stimulus to rice cultivation, described earlier. The resistance to rice cultivation, which is traced in eastern Japan along the Pacific coast, is adequately explained by the circumstances which supported existing flourish-

FINAL CONSIDERATIONS

After reviewing the papers presented at the symposium on *Origins of Agriculture*, Reed [1977: 943] concluded that "the shift to agriculture by original innovators was not sudden, it depended in large part upon the possession of preadaptive cultural artifacts and the practices of particular hunters/gatherers". This statement is true for the explanation of the receptivity process to an agricultural way of life, which has been discussed in the present paper. It is generally accepted that this kind of preadaptation occurred among sedentary hunter-gatherers:

A high degree of sedentary existence would (also) be a condition to the cultural contexts for the first domestication. Another special condition is the apparent propensity of wild plants to develop special characteristics as a result of interaction with man [CALDWELL 1977: 81-82; parenthesis mine].

The general view of this kind had been suggested earlier by scholars such as Sauer [1952], Haury [1962] and others, who commonly took the position that a sedentary population rather than a nonsedentary population could readily be induced to agricultural experimentation.

On the basis of a world-wide comparative study of aboriginal cultures, Murdock argued the problem of fishing societies and their relationship to early agriculture in the process of cultural evolution:

Fishing (including shellfishing and the pursuit of aquatic animals) is the only relatively simple mode of subsistence that appears conducive to a settled way of life, and it is highly probable that prior to the first appearance of agriculture about 10,000 years ago, the only sedentary populations for many millennia were groups of fishermen. For hunters and gatherers to settle down to a settled life of agriculture, a revolutionary readjustment of cultural habits is needed, but for fishermen, the transition is vastly easier, and *it is by no means improbable that fishing may have played a very important cultural-historical role in mediating the transition to early agriculture* [1969: 144; emphasis mine].

These statements suggest that fishing societies occupied a kind of transitional stage from hunting-gathering to agriculture. But, as far as Japan is concerned, we can propose another interpretation, since for fishermen the transition to a new way of rice cultivation was not necessarily easy. These fishermen were well-adapted to a small geographical area and became sedentary with increased population, as is commonly recognized in other fishing societies. These conditions would have predisposed shell-midden people to accept rice agriculture, if the formula mentioned above is correct. But taking into account the entire process of rice cultivation in Japan, I think that Murdock's last sentence places too much emphasis on fishing for the explanation of cultural change to agriculture in human history. We cannot overlook specific aspects of fishing societies, which are quite different from those of

plant collectors and hunters, and even farmers. That is to say, their subsistence economy is principally based upon sea-oriented exploitation systems: The development and elaboration of technology and collecting habits derived mainly from increased efficiency in the performance of intensive activities within a marine territory. If a society had developed its fishing efficiency to the level maintained by the Jomon shell-midden people of eastern Japan, then agricultural innovation would have been resisted and/or accepted slowly.

“A high degree of sedentary existence” leading to the beginning of and receptivity to agriculture has to originate in a subsistence economy specifically relevant to native plants, as concluded by Caldwell. A subsistence economy of the western Jomon hunter-gatherers, like the Torihama people, showed great dependence on foods derived from native plants. They tended to develop “an appropriate cultural milieu” as one general condition for the receptivity of innovation [CALDWELL 1977: 80]. In particular, a strong concern for plants would provide particular kinds of activities and social systems entailing a smooth acceptance of innovation.

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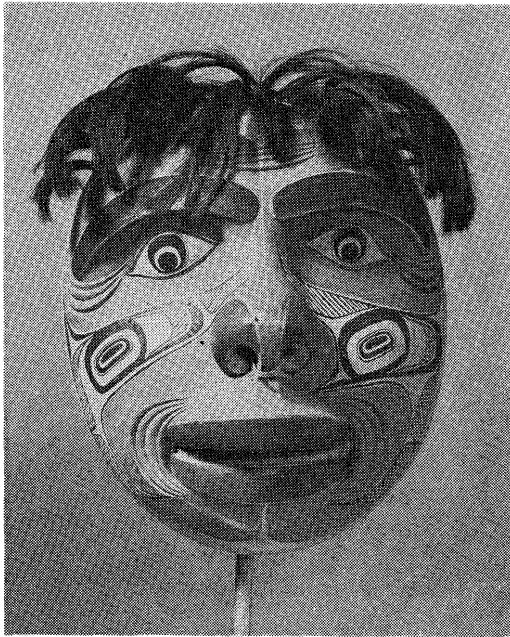
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Part IV

Comparisons between Foragers of the Pacific Coasts East and West



Northwest Coast Indian Mask
(Courtesy of American Museum of Natural
History)



Jomon Clay Mask
(Courtesy of University Museum,
University of Tokyo)

