Palaeovegetation during the Jomonian Period around the Mawaki Archaeological Site, Noto Peninsula, Japan

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I Introduction

The Mawaki Archaeological Site is a Jomonian archaeological site which is located at a small alluvial plain facing on Toyama Bay of Japan Sea, Central Japan. The site was a small village during about 4,000 years from the Early Jomonian Period (about 6,000—4,500 years ago) to the Latest Jomonian Period (about 3,500—2,200 years ago), and covers an area of fourty -thousand square meters. The continually thick sedimentary deposits of this site had been investigated for about five years since 1982 from view points of archaeology, topography, geology, palaeobotany, palaeozoology, and chemistry etc.

Animal fossils such as many bones of delphins, fishes, deers and wild boars, and manufactured plants such as an oar, large pillars, sculptured pillar as a totem pole, knittings, ropes and wooden tray were found from the sediments for the Middle Neolithic Age from the Early Jomonian Period to the Middle Jomonian Period. And also, the Late Jomonian earthen masks and the Latest Jomonian large wooden pillars which are about 100 cm in the maximum diameter have been sought out from the Jomonian sediments. The Jomonian earthenwares which had been excavated from some Jomonian sites distributed in the Hokuriku region, Central Japan have been found stratigraphically from the Mawaki Site as a following description. Namely, the old Jomonian earthenwares and other remains have been found from the lower part of the sedimentary sequence in the Mawaki Site, and the other hand, the Jomonian earthenwares and other remains have been found from the upper part of the sedimentary sequence.

The Mawaki Site is recently designated one of the Cultural Assets of Japan by the Japanese Cultural Properties Protection Committee, the Ministry of Education, Japanese Government.

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In this paper, the present author states on palaeovegetation in and around the Mawaki Site on basis of pollen analyses and palaeobotanical investigation of manufactured woods, non-manufactured woods, seeds, leaves and cones etc. from the site, and additionally, on the sea-level change judged from fossil diatom- and granulometric analyses of the deposits from the site.

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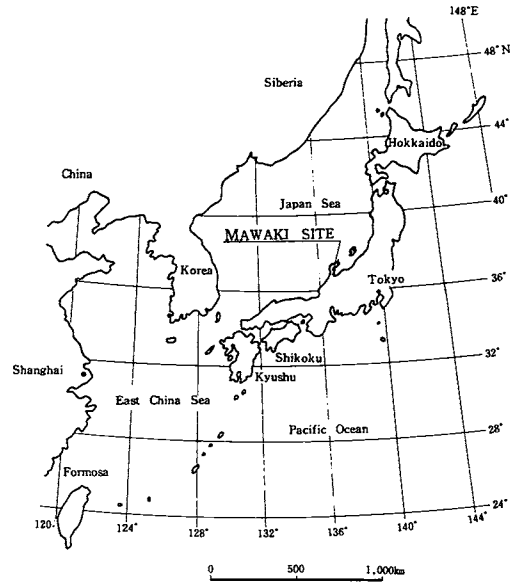

Fig. 1. Locality map showing the studied area.

II Summary of Archaeological Investigation

The Mawaki Site is one of complex sites which are composed of some archaeological ages from the view point of archaeological remains as earthenwares, stone implements and manufactured woods for the Middle Neolithic Age from the Early Jomonian Period to the Latest Jomonian Period, and these Jomonian remains are chronologically divided into some archaeological ages, and included stratigraphically in the deposit of each archaeological age. The sediments including archaeological remains reach about 5 m in thickness, and have been composed of soils, gravels and sands transported by Mawaki River which may have flowed down from hills and marine terraces surrownding the site to the alluvial lowland area. The sediments had been deposited perhaps in a small inlet near this site. The relationship between the sedimentary layers and archaeological periods is shown as Tabs. 1, 2 and 3.

Fossil animals such as dolphins, deers, fishes and wild boars, and fossil plants making of oar and pillars were sought out stratigraphically with various archaeological remains. Especially, many bones of dolphins identified *Lagenorhynchus obliquidens* Gill and *Delphinus delphis* Linné are found in the sediments from the Early Jomonian Period to the Middle Jomonian Period. It is estimated that the Jomonian peoples had used dolphins for food and fuel.

The manufactured plant remains as rope, knittings, wooden tray, oar, pices of pillars were excavated from the sediments during the Middle Neolithic Age from the Early Jomonian Period to the Latest Jomonian Period. Especially, the large pillars measured as about 50 to 100 cm in diameter were found from the late stage of the Latest Jomonian Period (about 3,000 to

2,500 year ago), and scientific name of all of the pillars is identified to be *Castanea crenata* Sieb. et Zucc.

Judging from the chronology of the archaeological earthenwares, stone implements and other remains, and also radiocarbon dating data of the pillars and carbonaceous soils including some archaeological remains, age of the site has been estimated to be the Middle Neolithic Age from the Early Jomonian Period (about 1,000—4,500 years ago) to the Latest Jomonian Period (about 3,500—2,200 years ago).

III The Present-day Vegetation

Vegetation at the Present-day in Noto Peninsula, Central Japan is grouped generally into four floras as follows:

Vegetation in *Camellietea japonicae* Region (lower than about 300m in altitudl in altitude)
Vegetation in *Querco-Fagetea* Region (about 300—about 1,700 m)
Vegetation in Vaccinic-Piceetea Region (about 1,700—2,400 m)
Vegetation in Alpine Zone (higher than about 2,400 m)

There is a narrow space of a national vegetation in the other three floras except for *Camellietea japonica* Region. As previous-mentioned, this site is located at about 6—9 m in altitude of a small lowland distributed alongshore the Mawaki Inlet. Therefore, although the modern vegetation around the Mawaki Site has been belonged to the wide secondary community, the natural vegetation during the Early Neolithic Age before the human's impact for the environment around the site must have been fundamentally *Camellitea japonica* Region. That is, *Polysticho-Machiletum thunbergii* association with *Cryptomium falcatum* subassociation in a lowland area, *Polysticho-Machiletum thunbergii* association with *Zelkova serrata* subassociation in a vally, and *Quercus salicina* forest with *Castanopsis cuspidata*, *Zelkova serrata* and *Abies firma* on hills, judging from some palaeontological evidences. However, this natural flora has been changed into secondary community represented by *Pinus densiflora* and deciduous *Quercus* group caused by the human's heavey impact since the middle stage of the Early Jomonian Period.

IV Summary of Plant Remains

The plant remains collected from the site are divided into tree stumps such as non-manufactured and manufactured woods, leaves, seeds, and pollen grains from the view point of a kind of plant organ.

(1) Non-manufactured Woods

Three hundred fourty-four specimens were identified as thirty-three taxa as shown in Tab. 1. These taxa are grouped into three life form types, i. e., conifer trees such as *Pinus densiflora,* deciduous broad-leaved trees such as *Castanea crenata,* and evergreen broad-leaved trees such as *Camellia japonica.* According to the previous investigation (Yoda and Suzuki, 1986), the conifer tree type is the most dominant with about 65% of the total specimens and the

deciduous broad-leaved trees occupy a quarter of the total, while the evergreen broad-leaved trees are less abundant with only about 12% of the total. Among the thirty-three taxa as

Tab. 1 Name of the Natural (non-manufactured) Woods and their specimen number, frequency and life form (YODA et al., 1986).

Botanic name	Specimen	number(%)	*Life form
Pinus densiflora	121	35.2	C
Thujopsis dolabrata	39	11.3	C
Torreya nucifera	22	6.4	C
Cephalotaxus harringtonia	17	4.9	C
Cryptomeria japonica	11	3.2	C
Abies	2	0.6	C
conifer trees	212	61.6	
Castanea crenata	18	5.1	D
Acer	11	3.2	D
Quercus (Prinus)	10	2.9	D
Juglans ailanthifolia	7	2.0	D
Fagus	7	2.0	D
Maackia amurensis	7	2.0	D
Zelkova serrata	5	1.5	D
Ostrya japonica	3	0.9	D
Cercidiphyllum japonicum	3	0.9	D
Fraxinus	3	0.9	D
Carpinus (Eucarpinus)	2	0.6	D
Morus bombycis	2	0.6	D
Prunus	2	0.6	D
Aesculus turbinata	2	0.6	D
Aralia elata	2	0.6	D
Callicarpa	2	0.6	D
Cornus	1	0.3	D
Rhus javanica	1	0.3	D
Acanthopanax sciadophylloides	1	0.3	D
deciduous broad-leaved trees	89	25.9	
Camellia japonica	10	2.9	E
Castanopsis	9	2.6	E
Eurya japonica	8	2.3	E
Quercus (Cyclobalanopsis)	6	1.7	E
Daphniphyllum	5	1.5	E
Cleyera japonica	2	0.6	E
evergreen broad-leaved trees	40	11.6	
Elaeagnus	2	0.6	?
woody vine	1	0.3	?
Total	344	100.0	

*Life form: C=conifer trees, D=deciduous broad-leaved trees, E=evergreen broad-leaved trees.

Tab. 2 Scientific Name of the Manufactured Woods and their Ages (SHIMAKURA & FUJI, 1988)

Horizon	Archaeological Age	Scientific Name	Number	Total
I		*Fraxinus mondshurica japonica*	2	5
		Camellia japonica	1	
		Castonea crenata	1	
		Zelkova serrata	1	
II	Late Jomon. ~ Latest Jomon.	*Chomaeccyparis obtusa*	3	34
		Castanea crenata	30	
		Zelkova serrata	1	
III	Early Late Jomonian Period	*Cryptomeria japonica*	1	1
IV		*Pinus densiflora*	1	4
		Abies firma	1	
		Pterocarya rhoifolia	1	
		undeterminable	1	
V−X	Late Jomon. ~Mid. Jomon.	*Cryptomeria japonica*	1	1
XI		*Pinus densiflora*	1	34
		Chamaecyparis obtusa	7	
		Cryptomeria japonica	2	
		Acer spp.	2	
		Aesculus turbinata	1	
		Fraxinus mandshurica japonica	2	
		Quercus serrata	3	
		Castanea crenata	6	
		Torreya nucifera	4	
		Juglans mandshurica var.	1	
		Carpinus sp.	1	
		Cercidiphyllum japonicun	1	
		Camellia japonica	1	
		Quercus (Cyclobalanopsis) sp.	1	
		undeterminable	1	
XII	Late Early Jomonian P.	*Fraxinus mandshurica japonica*	1	4
		Aesculus turbinata	1	
		Castanea crenata	1	
		Quercus (Cyclobalanopsis)	1	
unknown age & horizon		*Cryptomeria japonica*	1	3
		Torreya nucifera	1	
		undeterminable	1	
T O T A L			86	86

above-mentioned, *Pinus densiflora* is the most common, about 35% of the total, *Thujopsis dolabrata* is about 11% of the total, *Torreya nucifera* about 7%, *Castanea crenata* about 5%, *Cephalotaxus harringtonia* about 5%, *Cryptomeria japonica, Acer, Quercus, Camellia japonica* and *Castanopsis* about 3% severally, and *Eurya japonica, Juglans ailanthifolia, Fagus* and *Ostrya* about 2% respectively.

Tab. 3 Name of the Macroplant Remains except for Woods and their Ages

Horizon	Archaeological Age	*Scientific Name*	Number
II	Late Jomon-Latest Jomon.	*Cryptomeria japonica*	many leaves
		Alnus japonica	8 seeds
		Lepidobalanus spp.	8 seeds
		Cyclobalanopsis spp.	7 seeds
		Salix spp.	leaves
		Zelkova serrata	leaves
		Aesculus turbinata	seeds
		Pinus thunbergii	leaves
III	Early Late Jomonian Period	*Aesculus turbinata*	11 seeds
		Lepidobalanus spp.	leaves
		Juglans mandshurica	seeds
IV		*Lepidobalanus* spp.	6 seeds
		Machilus thunbergii	5 leaves
		Aesculus turbinata	seeds
		Cyclobalanopsis spp.	leaves
VII	Mid. Middle Jomonian	*Pinus densiflora*	22 leaves
		Fagus cf. *crenata*	seeds
		Lepidobalanus spp.	leaves
		Pinus thunbergii	cones
VIII	Mid. Middle Jomonian	*Aesculus turbinata*	19 seeds
		Lepidobalanus spp.	18 leaves
		Salix spp.	12 leaves
		Machilus thunbergii	11 leaves
		Pinus densiflora	cones
X	Early Middle Jomonian	*Juglans mandshurica*	17 seeds
		Pinus densiflora	cones
		Aesculus turbinata	seeds
XII	Late Early Jomonian Period	*Pinus densiflora*	22 leaves
		Machilus thunbergii	13 leaves
		Fagus cf. *japonica*	leaves
		Lepidobalanus spp.	leaves

(2) Manufactured Woods

Eighty-three specimens of the manufactured woods excepting three unknown specimens, have been identified as sixteen taxa. Among the sixteen taxa, *Castanea crenata* is the most common species, showing about 44% of the total, and nextly *Chamaecyparis obtusa* is common, ten specimens (about 12% of the total specimens). While *Torreya micifera,*

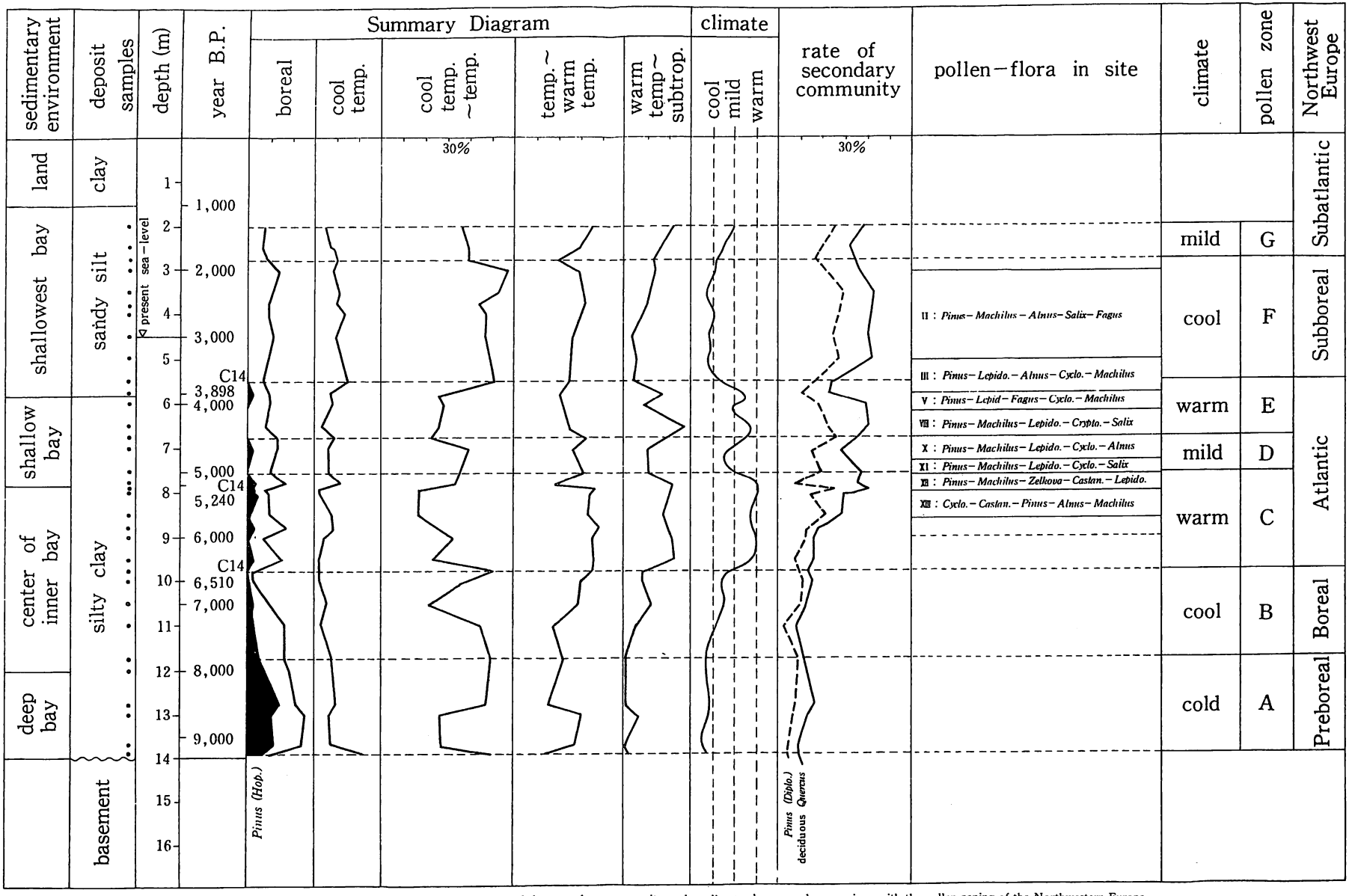

Fig. 2. Diagram showing the summary of pollen analyses, rate of the secondary community, palaeoclimate change, and comparison with the pollen zoning of the Northwestern Europe.

Cryptomeria japonica and *Fraxinus* are respectively about 5% of the total as shown in Tab. 2.

(3) Leaves, Seeds and Cones

Leaves, seeds and cones found from the deposits of the site are rare as shown in Tab. 3 in a comparison with the other archaeological sites. A reason of the rearness is caused by a narrow back-area and a short and steep rivers around this site. Relationship between the macroplant remains excepting stump remains and their horizons in the deposits is shown as Tab. 3 and a following description.

The middle Early Jomonian Period (XII-Horizon, about 5,000 years ago): *Pinus densiflora* (22 leaves), *Machilus thunbergii* (13 leaves), *Fagus* cf. *japonica* (11 seeds), and deciduous *Quercus* etc.

The early Middle Jomonian Period (X-Horizon, about 4,500 years ago): *Juglans mandshurica* (17 seeds), *Pinus densiflora, Aesculus turbinata* etc.

The middle stage of the Middle Jomonian Period (VIII-Horizon, about 4,200 years ago): *Aesculus turbinata* (19 seeds), deciduous *Quercus* (18 seeds), *Salix* spp. (12 leaves), *Machilus thunbergii* (10 leaves), *Machilus* spp. (1 leave), *Pinus densiflora* etc.

The middle stage of the Middle Jomonian Period (VII-Horizon, about 4,200 years ago): *Pinus densiflora* (22 leaves and 1 cone), *Fagus* cf. *crenata* (11 seeds), deciduous *Quercus, Pinus thunbergii* etc.

The early Late Jomonian Period (IV-Horizon, about 3,600 years ago): deciduous *Quercus* (6 seeds), *Machilus thunbergii* (5 leaves), *Aesculus turbinata,* evergreen *Quercus* (leaves) etc.

The early stage of the Late Jomonian Period (III-Horizon, about 3,500 years ago): *Aesculus turbinata* (11 seeds), deciduous *Quercus, Juglans mandshurica* etc.

The middle to late stages of the Late Jomonian Period (II-Horizon, about 3,200 to 3,500 years ago): *Cryptomeria japonica* (many leaves), *Alnus japonica* (8 seeds), deciduous *Quercus* (8 seeds), evergreen *Quercus* (7 seeds), *Cryptomeria japonica* (6 cones), *Salix* spp., *Zelkova serrata, Aesculus turbinata,* deciduous *Quercus, Pinus thunbergii* etc.

As shown in Tab.3, *Cryptomeria japonica, Aesculus turbinata, Pinus densiflora, Lepidobalanus* spp., *Salix* spp., *Juglans mandshurica* and *Machilus thunbergii* are the most common species. Among them, *Aesculus turbinata* and *Juglans mandshurica* had been used evidently as food at these periods.

(4) Pollen Analyses

(a) Samples from the Archaeological Site:

According to the result of the pollen analyses of twenty-seven samples from the Mawaki Site, the pollen community at the each period can be summarized as follows:

The early stage of the Early Jomonian Period (XIII-Horizon, about 5,000—5,500 years ago): *Cyclobalanopsis* (evergreen *Quercus*)—*Castanopsis*—*Pinus diploxylon* type—*Alnus*—*Salix* pollen community.

The middle stage of the Early Jomonian Period (XII-Horizon, about 5,000 years ago):

Pinus diploxylon type—*Machilus*—*Zelkova*—*Castanopsis*—*Lepidobalanus* (deciduous *Quercus*)—*Salix* pollen community.

The late stage of the Early Jomonian Period (XI-Horizon, about 4,500 to 4,700 years ago): *Pinus diploxylon* type—*Machilus*—*Lepidobalanus*—*Cyclobalanopsis*—*Salix*—*Alnus*—*Castanopsis* pollen community.

The early stage of the Middle Jomonian Period (X-Horizon, about 4,500 years ago): *Pinus diploxylon* type—*Machilus*—*Lepidobalanus*—*Cyclobalanopsis*—*Alnus*—*Salix* pollen community.

The middle stage of the Middle Jomonian Period (Ⅷ-Horizon, about 4,200 years ago): *Pinus diploxylon* type—*Machilus*—*Lepidobalanus*—*Cryptomeria*—*Salix*—*Alnus*—*Fagus crenata* type—Compositae pollen community.

The early stage of the Late Jomonian Period (V-Horizon, about 3,500 years ago): *Pinus diploxylon* type—*Lepidobalanus*—*Fagus crenata*—*Salix*—*Alnus*—*Machilus* pollen community.

The early stage of the Late Jomonian Period (III-Horizon, about 3,500 years ago): *Pinus diploxylon* type—*Lepidobalanus*—*Alnus*—*Cyclobalanopsis*—Gramineae—*Salix*—*Machilus* pollen community.

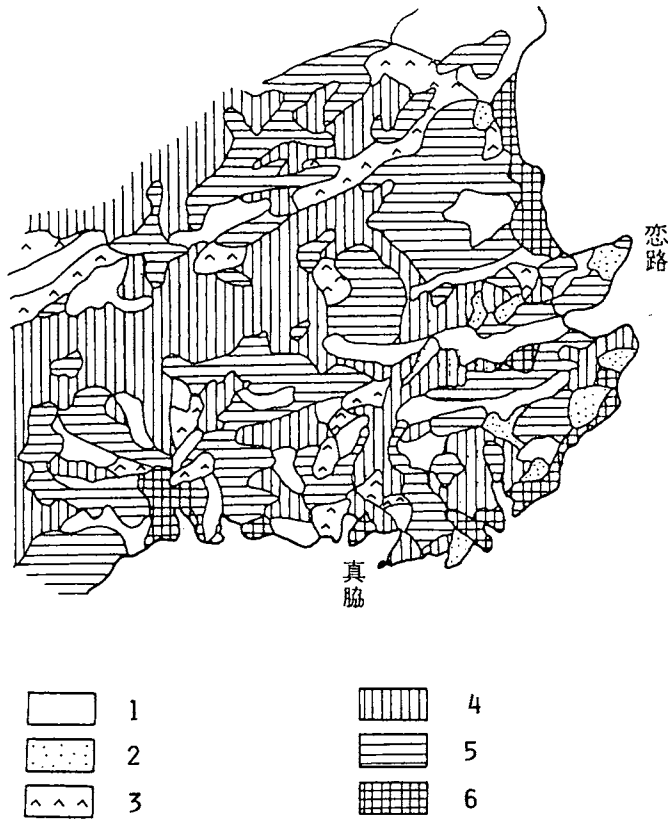

Fig. 3. Modern vegetation in the northeastern part of Noto Peninsula. 1: paddy field, 2: field, 3: *Cryptomeria japonica* plantation, 4: *Quercus serrata* forest, 5: *Pinus densiflora* forest, 6: residential area.

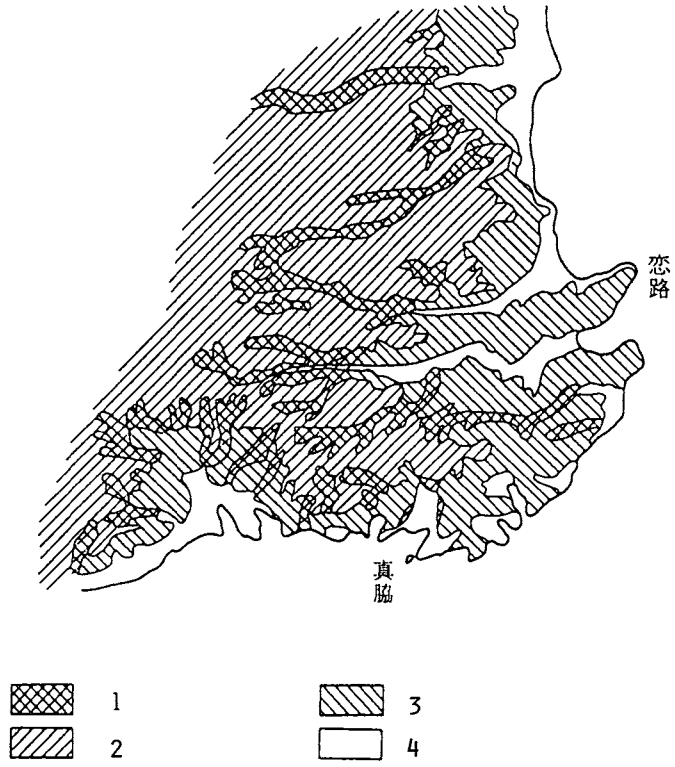

Fig. 4. Palaeovegetation during the early stage of the Early Jomonian Period in the northeastern part of Noto Peninsula. 1: *Polysticho-Machiletum thunbergii* subassociation with *Zelkova serrata*, 2: *Quercus salicina* forest with *Zelkova serrata*, 3: *Castanopsis cuspidata* forest (*Ardisio-Castanopsietum sieboldii* subassociation), 4: *Machilus thunbergii* forest (*Polysticho-Machiletum thunbergii* subassociation).

The early stage of the Late Jomonian Period (II-Horizon, about 3,500 years ago): *Pinus diploxylon* type—*Machilus*—*Salix*—*Alnus*—*Cryptomeria*—*Fagus crenata* type—*Castanopsis*—*Lepidobalanus*—*Aesculus*—Gramineae—*Cyclobalanopsis* pollen community.

(b) Samples from the Boring-core near the Mawaki Site

A boring-well for the research of palaeovegetation in and around the Mawaki Site was drilled at the Mawaki alluvial lowland area, being about 17m in length, and also covers the Holocene Epoch. Judging from the palynological research throughout the boring-core, the change of pollen community during the Holocene Epoch around the site is concluded as shown in Fig. 2.

According to the consideration based upon many informations of the manufactured and non-manufactured woods, leaves, seeds, cones, and pollen analyses as above-mentioned, the palaeovegetation and palaeoclimate changes, and a rate of secondary community around the site during the Holocene Epoch are summarized as Fig. 2. Stating from the present data, the most dominant taxa were *Pinus densiflora* and deciduous *Quercus* around the site since the

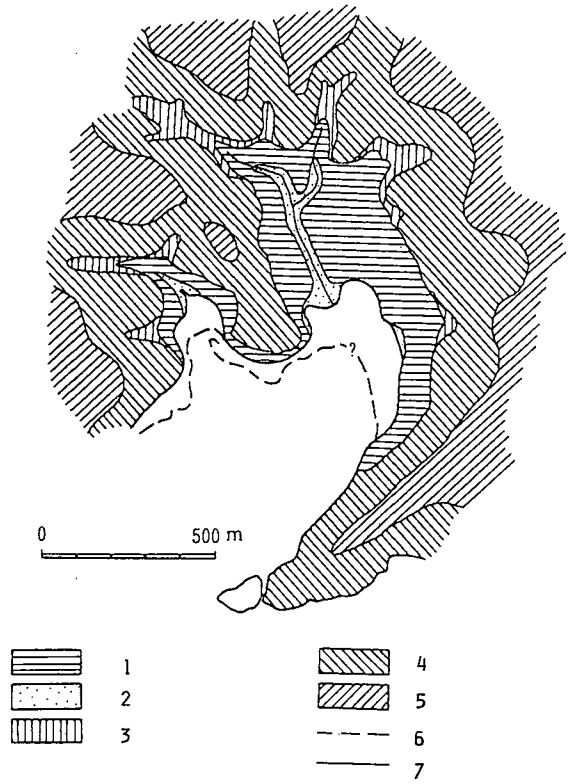

Fig. 5. Palaeovegetation before the early stage of the Early Jomonian Period around the Mawaki Site. 1: *Polysticho-Machiletus thunbergii* subassociation, 2: *Phragmites communis* community, 3: *Polysticho-Machiletum thunbergii* subassociation with *Zelkova serrata*, 4: *Ardisio-Castanopsietum sieboldii* community, 5: *Aucubo-Quercetum salicinae* subassociation, 6: strand-line at the present-day, 7: strand-line at the early stage of the Early Jomonian Period.

Middle Neolithic Age, especially after the middle stage of the Early Jomonian Period. However, according to the many palynological researches, it is generally considered that the evergreen laurel and tall forests were predominantly spread in the coastal regions of Central Japan. Namely, the natural vegetation for the Early and Middle Neolithic Ages, during the ca. 7,500 years from about 10,000 to 2,500 years ago, was fundamentally *Polysticho-Machiletum thunbergii* association with *Cyrtomium falcatum* subassociation in the lowland areas, *Polysticho-Machiletum thunbergii* with *Zelkova serrata* subassociation in the small valleys, and *Quercus salicina* forest with *Castanopsis cuspidata, Zelkova serrata* and *Abies firma* in the hills around the site. However, slightly different from the general consideration, it may be said that the pine and oak forests had been spread widely around the site as above-mentioned. Dominant occurrence of the pine and oke is commonly observed in the forests of the secondary community. Therefore, it seems to be inferred that the natural vegetation above-mentioned has been changed into the secondary community composed mainly of *Pinus densiflora* and deciduous *Quercus* by the ancient human's heavy impact since the early stage of the Middle Neolithic Age.

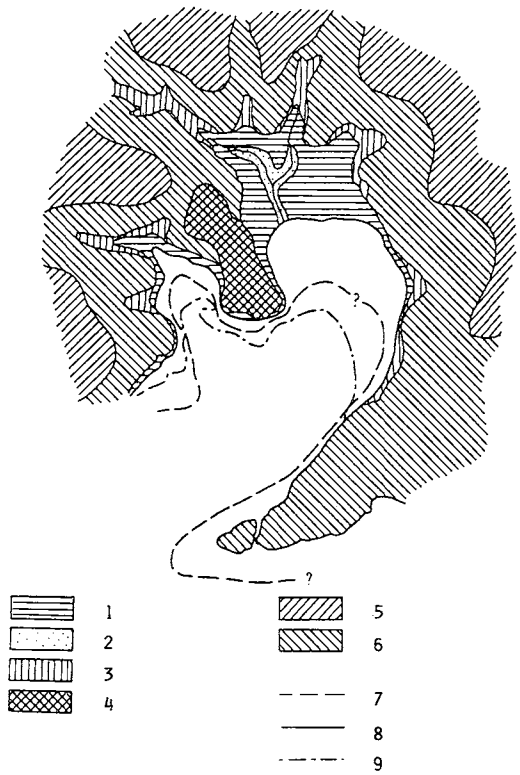

Fig. 6. Palaeovegetation during the Latest Jomonian Period around the Mawaki Site. 1: *Polysticho-Machiletus thunbergii* subassociation, 2: *Phragrites communis* community, 3: *Polysticho-Machiletum thunbergii* subassociation with *Zelkova serrata*, 4: *Ardisio-Castanopsietum sieboldii* community, 5: *Quercus salicina* forest with *Quercus serrata* and *Pinus*, 6: *Ardisio-Castanopsietum sieboldii* community with *Pinus densiflora*, 7: strand-line at the Latest Jomonian Period, 8: strand-line at the late stage of the Early Jomonian Period, 9: strand-line at the present-day.

In conclusion, it may be summarized from the present data as above-mentioned that the forests around the site have been constructed by the mixture of plants of the Cool Temperate and Warm Temperate forests since the Early Jomonian Period.

At the early stage of the Early Jomonian Period (about 5,500 years ago) just before the human's heavy impact to the natural environment in and around the site and at the Latest Jomonian Period (about 3,000 years ago) after the human's impact to the environment, the palaeovegetation around the site is shown in Fig. 5 and Fig. 6 respectively.

V Confirmation of the Sea-level during the Middle Neolithic Age

Confirmation of the sea-level during the Middle Neolithic Age at the Mawaki lowland area has been studied on the basis of granulometric research of twelve sand samples from the site and fossil diatom-analyses of about 20 fine-grained samples from the site and the boring core. It is inferred that the sea-level at the early stage of the Early Jomonian Period, about 5,500 years ago, had been at 6.3m above the present sea-level on the basis of the detailed data

Tab. 4　Granulometric analyses of sand samples from the Mawaki Site.

Sample nos.	Sample name	Estimated age	Altitude im meter	granulometric analyses							Sedimentary environmefit
				ϕ 16	ϕ 50	ϕ 84	Mdϕ	Mϕ	$\sigma\phi$	$\alpha\phi$	
1	I-D·W·Asahi	Early Jomon Shijimimori	+6.50	0.13	0.95	1.86	0.95	0.995	0.865	0.026	near the mouth of Mawaki R.
2	I-D·W·Shi-l.	Early Jomon Shijimimori	+6.30	0.72	1.56	2.24	1.56	1.51	0.785	0.064	near the mouth of Mawaki R.
3	I-D·W·Shi-up.	Early Jomon Shijimimori	+6.10	0.25	0.96	1.00	0.96	0.625	0.375	0.893	strand
4	I-D·W·cent	Early Jomon Shijimimori	+6.40	0.74	1.62	2.51	1.62	1.63	0.885	0.006	near the mouth of Mawaki R.
5	I-E·Asahi	Early Jomon Shijimimori	+6.30	0.13	0.95	1.86	0.95	0.99	0.80	0.026	strand
6	IV-Y·-75		+5.08	1.43	2.32	3.05	2.32	2.24	0.81	-0.09	near the mouth of Mawaki R.
7	IV-Y·-87		+4.96	0.12	0.74	2.69	0.74	1.28	1.41	0.39	near the mouth of Mawaki R.
8	IV-Y·-100		+4.83	0.05	0.62	1.86	0.62	0.96	0.90	0.37	strand
9	V-3	Before 1820±boy.B.P.	+5.60	0.31	1.23	2.15	1.23	1.24	0.92	0.	near the mouth of Mawaki R.
10	V-2	Before 1820±boy.B.P.	+5.70	0.46	1.41	2.11	1.42	1.28	0.83	-0.15	near the mouth of Mawaki R.
11	VI-s		+5.10	1.27	2.00	2.41	2.00	1.85	0.56	-0.26	the mouth of Mawaki R. near dune
12	VI-u		+5.20	0.30	1.22	2.23	1.23	1.27	0.96	0.04	near the mouth of Mawaki R.

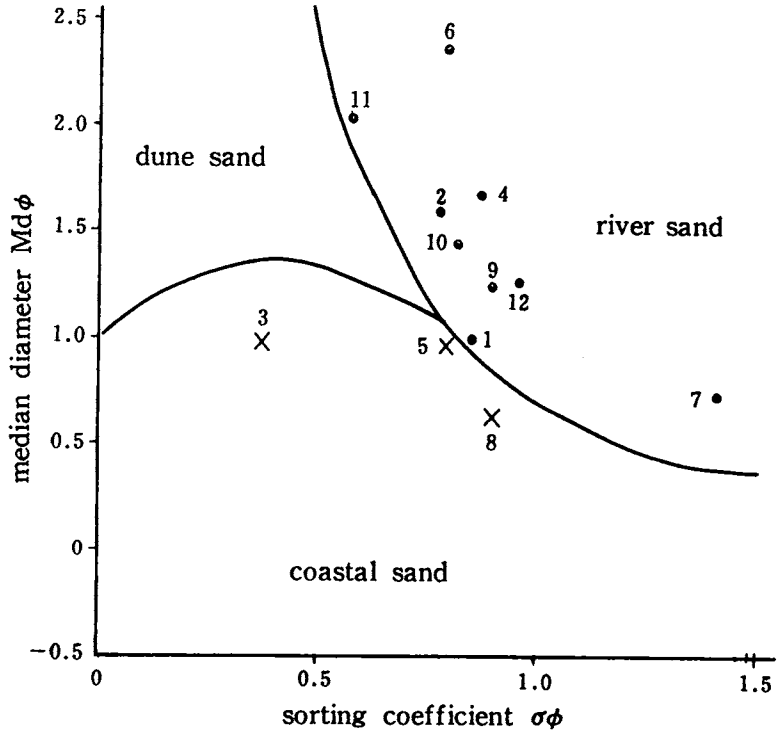

Fig. 7.　Diagram showing the result of granulometric analyses of samples from the Mawaki Site. Numbers are refer to Tab. 4.

of the granulometric analyses as shown in Tab. 4. This estimation is similar to the conclusion judged by the occurrence of fossil marine and brackish diatom assemblages found from silt and clay samples obtained from the site and the boring-core. The height of the sea-level during the Early Jomonian Period around the Mawaki Site has been backed up by the evidence concerning the sea-level change obtained from some localities throughout the Japanese Islands. The relative change of the sea-level during the Neolithic Age, the last 10,000 years, is shown in Fig. 8.

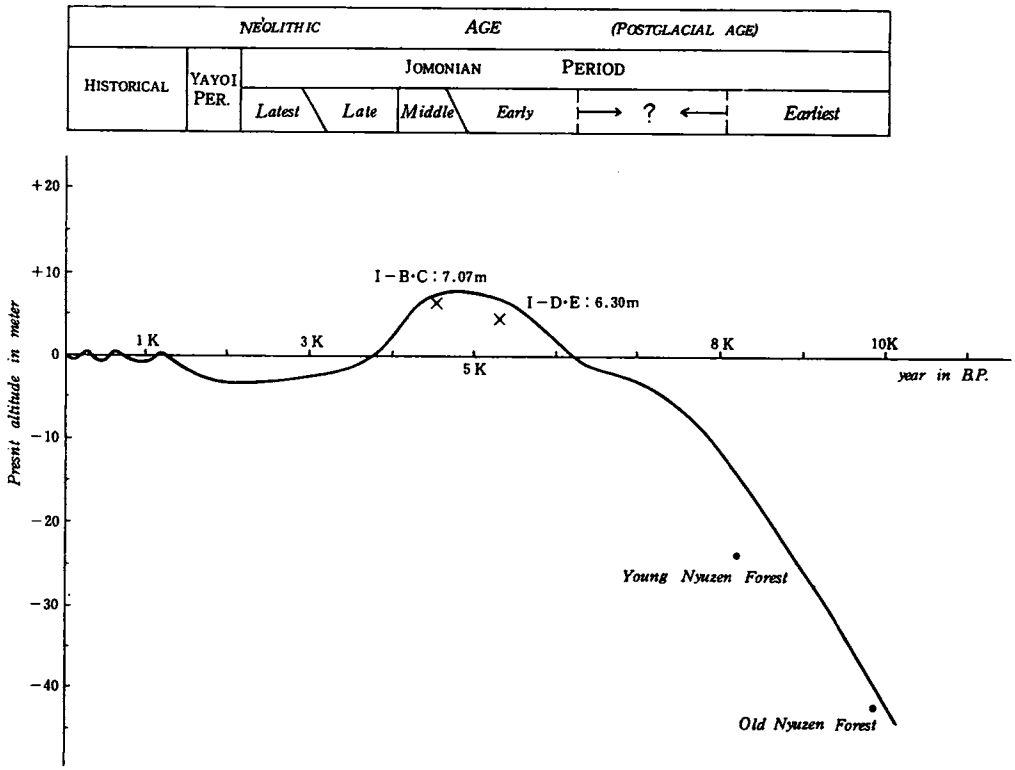

Fig. 8. Change of the relative sea-level during the Holocene Epoch in the Japanese Islands.

VI Conclusion

The Mawaki Archaeological Site is located at a small alluvial plain facing on Toyama Bay of Japan Sea, Central Japan. Fossil animals such as dolphins and fishes, and plants making an oar and pillars were excavated stratigrafically with various archaeological remains from the alluvial deposits which are about 5 meters in thickness.

Judging from the archaeological remains and ^{14}C dating data, age of the site may be inferred archaeochronologically to be the Middle Neolithic Age from the Early Jomonian to the Latest Jomonian Period, ca. 6,000 to 3,000 years ago.

The manufactured plant remains such as rope, knittings, wooden tray, oar, pices of pillars and a big pillar as totem pole were excavated from the deposits during the Jomonian Period. Judging from the result of palynological research, the palaeovegetation around this site had been affected by human's impact during the Middle Neolithic Age, and the secondary community of vegetation such as *Pinus diploxylon*-type, *Lepidobalanus* and *Plantago* had distributed widely at lowland and hills around this site. On the other hand, the changes of sea-level and shore line near the site during the Middle Neolithic Age are confirmed on the basis of results of diatom and granulometric analyses. Namely, the natural vegetation in the Early Jomonian to Middle Jomonian Periods was fundamentally *Polysticho-Machiletum thunbergii* association with *Cyrtomium falcatum* subassociation in the lowland areas, *Polysticho-Machiletum thunbergii* with *Zelkova serrata* subassociation in the small valleys, and *Quercus salicina* forest with *Castanopsis cuspidata, Zelkova serrata* and *Abies firma* in the hills. However, since the end of the Early Jomonian Period, the natural vegetation above-mentioned had been changed into the secondary community composed mainly of *Pinus densiflora, P. thunbergii,* and deciduous *Quercus* by the ancient human's impact. The sea-level during the Early Jomonian Period had been perhaps at about 6.30m above the present sea-level, and the shore line at that time may have been near this site.

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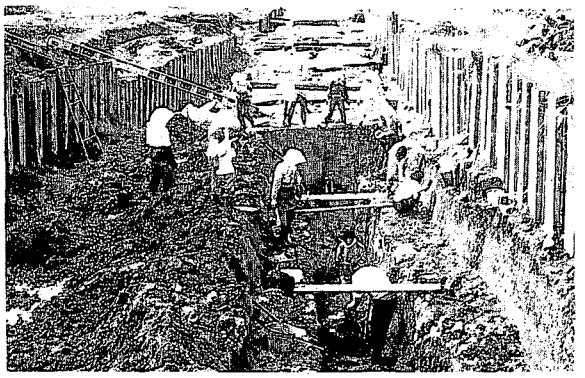
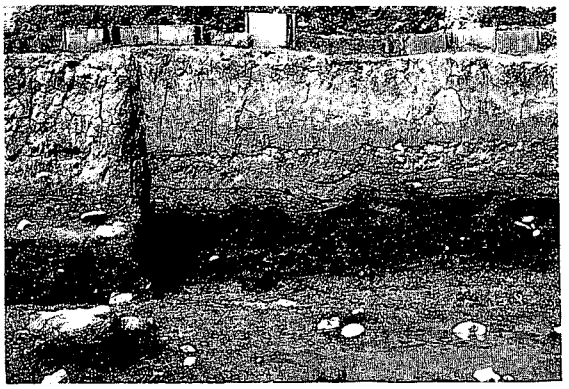
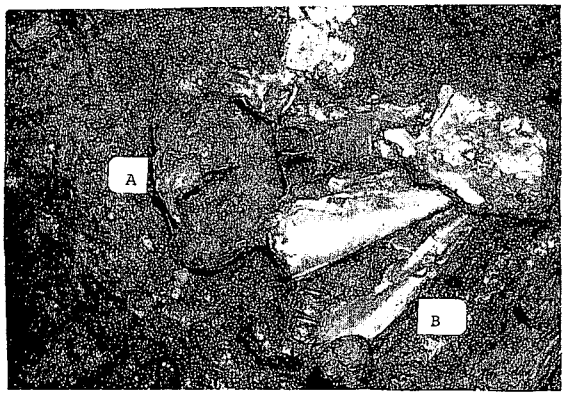
Photograph 1: Topography in and around the Mawaki Site from airplane.



Photograph 2: Excavation of the Mawaki Site.

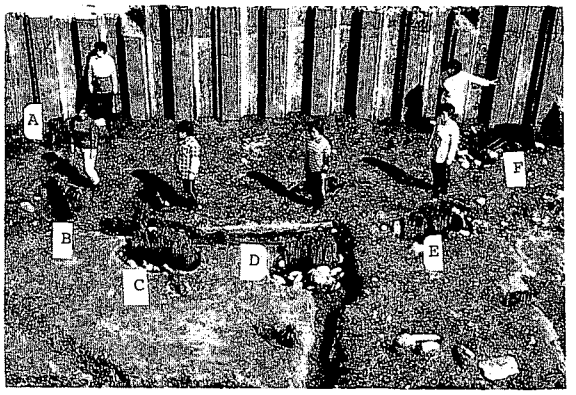


Photograph 3: Geological succession of the Mawaki Site.



Photograph 4: Dolphin and human's herd-born from the Mawaki Site.

Photograph 5: Manufactured wood as a totem pole from the Mawaki Site.



Photograph 6: Circular occurrence of large pillars in the Mawaki Site.