千葉中央博自然誌研究報告（J. Nat. Hist. Mus. Inst., Chiba）8(2)：89－96. March 2005

Surface Pollen Investigation in the Funada-ike Pond, Seitaien (Ecology Park) of the Natural History Museum and Institute, Chiba, Japan : an Implication on Pollen-Vegetation Relations

Masaaki Okuda

Natural History Museum and Institute, Chiba
955-2 Aoba-cho, Chuo-ku, Chiba 260-8682, Japan
E-mail: okuda@chiba-muse.or.jp

Abstract The Seitaien (Ecology Park) of the Natural History Museum and Institute, Chiba, which is an outdoor museum and experimental ecological research field, contains vegetation blocks of evergreen and deciduous oak forest, fir-hemlock conifer forest, coastal and inland pine forest and alder wetland forest, as well as derivative herbfields and exotic trees in and around the Seitaien, being appropriate to examine pollen-rain interaction from different vegetation types. Surface pollen spectra from 12 localities within Funada-ike, quasi-natural irrigation pond in the Seitaien, provide a deciduous broad-leaved palynoflora dominated by *Carpinus* and *Quercus* subgen. *Lepidobalanus* associated with *Alnus*, *Pinus* subgen. *Diploxylon*, *Ulmus*/*Zelkova*, *Celtis*/*Aphananthe*, *Mallotus*, *etc*, which is relatively simple and monotonous compared with the highly diversified vegetation distribution in the vicinity. *Cryptomeria japonica*, Cupressaceae (T-C-C type), herbs (*Ambrosia*, *Artemisia*, Poaceae, *etc*) also occur but are not dominant unlike the air-pollen composition of the southern Kanto District. The pollen spectra reflect the nearest forest patch with distant plant communities superimposed but with restricted influences, implying the validity of surface pollen investigation along 'transects' penetrating dense vegetation zonation in small distance.

Key words: Boso Peninsula, Chiba, palynology, pollen rain, ecology park, vegetation, surface pollen.

Surface pollen investigation is being focused worldwide. Objective confirmation of modern pollen-vegetation (and-climate) relations enables quantitative pollen-based reconstruction of palaeovegetation (*i.e.*, biomi zation) (Gotanda *et al.*, 2002) and of palaeoclimate (*e.g.*, modern analogue techniques by Nakagawa *et al.*, 2002) in order to understand the mechanisms of environmental and global climate changes. Originally, surface pollen investigations were performed on surface sediments in lake／sea floors literally (Traverse and Ginsburg, 1966 ; Cross *et al.*, 1966 ; Matsushita and Sanukida, 1986), but recently being applied to ground surface soils or living moss conolies (moss polsters) as natural pollen catchers (Heusser, 1995 ; Liu *et al.*, 1999 ; Igarashi *et al.*, 2003 ; Okuda *et al.*, 2004). This can provide significantly dense and continuous datasets because moss polsters exist more commonly than sedimentary basins. For example, surface pollen researches for altitudinal transects along basinless mountain slopes have provided dense surface spectra ranging from the subtropical zone in lowlands to the subalpine zone above the timber line (Bonnefille and Riollet, 1988 ; Bush, 2000 ; Zheng, 2000 ; Okuda *et al.*, 2005).

The growing bodies of surface pollen spectra, however, receive fundamental questions: (1) How regionally a tiny moss polster (or a surface soil sample) can represent the surrounding vegetation ; and (2) How correctly a surface pollen spectrum can represent the nearest vegetation type. The first question is based on the principle that the extent of pollen catchment areas is proportional to the size of the pollen catcher (Traverse, 1988). The second question becomes critical when the investigation is performed along vegetation transects, which penetrate diversified vegetation stratification adjoining in small distance. Pollen-based vegetation reconstruction is usually based on an assumption that the nearest major vegetation type (*i.e.*, biome) is most responsible to the pollen rain, and the influences of distant biomes are also superimposed but their contributions are certainly small. By contrast, some palynologists have pointed out that pollen rains, which are basically wind-blown, can sometimes overestimate long-transported pollen from distant vegetation, particularly when the nearest vegetation is significantly sparse (Sasaki, 1986 ; Morita, 1998 ;

Morita *et al.*, in press). Overall, surface pollen has a restricted research history compared with fossil pollen, requiring accumulation of basic researches on data stability and reproductivity.

One of the appropriate research fields to pollen-rain behaviour is the Seitaien (Ecology Park) of Natural History Museum and Institute, Chiba (Fig. 1). The Seitaien, which faces on the museum building with the area of 6.6 ha, is a mosaic garden plot with restored vegetation blocks that are native to the Boso Peninsula, being suitable for evaluating palynological interaction among different vegetation patches. Approximately 1 ha plot in the northern part is occupied by the Funada-ike Pond as a huge pollen catcher. Moss colonies are sporadically growing on the ground surface along some trekking walks.

Outside, the Seitaien is surrounded by urban residence areas that are being in construction, where anemophilous herbs such as *Ambrosia Artemisia, Dactylis, Humulus, etc* prevail in innumerable open spaces. Japanese cedar forests are common in the northern Boso Peninsula, as well as the prefectures to the west of Tokyo Bay as the windward of westerly winds. These provide urban-type pollen rains of the southern Kanto District where *Cryptomeria japonica* (and/or Cupressaceae, *Pinus, etc*) occupies 50-80% of spring/early-summer air pollen (Nagano *et al.*, 1978, 1992). Seeing the correlation between the pollen and vegetation in the Seitaien as 'an isle in the cities' would help see the interaction between distant but voluminous pollen rains and close but smaller-scale pollen assemblages. This paper provides surface pollen spectra from 12 sediment samples from the Funada-ike Pond, as the initial report from the Seitaien on experimental researches for modern pollen-vegetation relations.

Site Information and Vegetation Distribution of the Seitaien

1. History and geographical settings

Seitaien (35°35′45″N; 140°8′30″E; 9-23m a.s.l.) was constructed in 1986-9 at the northwestern end of the Chiba Prefectural Aobanomori Park, aiming at natural habitat restoration / conservation, public environmental education and experimental basic researches on various ecological issues (Numata, 1993; Nakamura, 1994). The original topography consisted of a diluvial plateau of ca. 20m in altitude dissected by lowland water systems. Some landform modifications and soil imports were needed for the plateau surface that had been utilised for sparse pasturage, followed by transplanting juvenile trees to restore primary and secondary vegetation types being native to the Boso Peninsula. A part of evergreen broad-leaved forest in

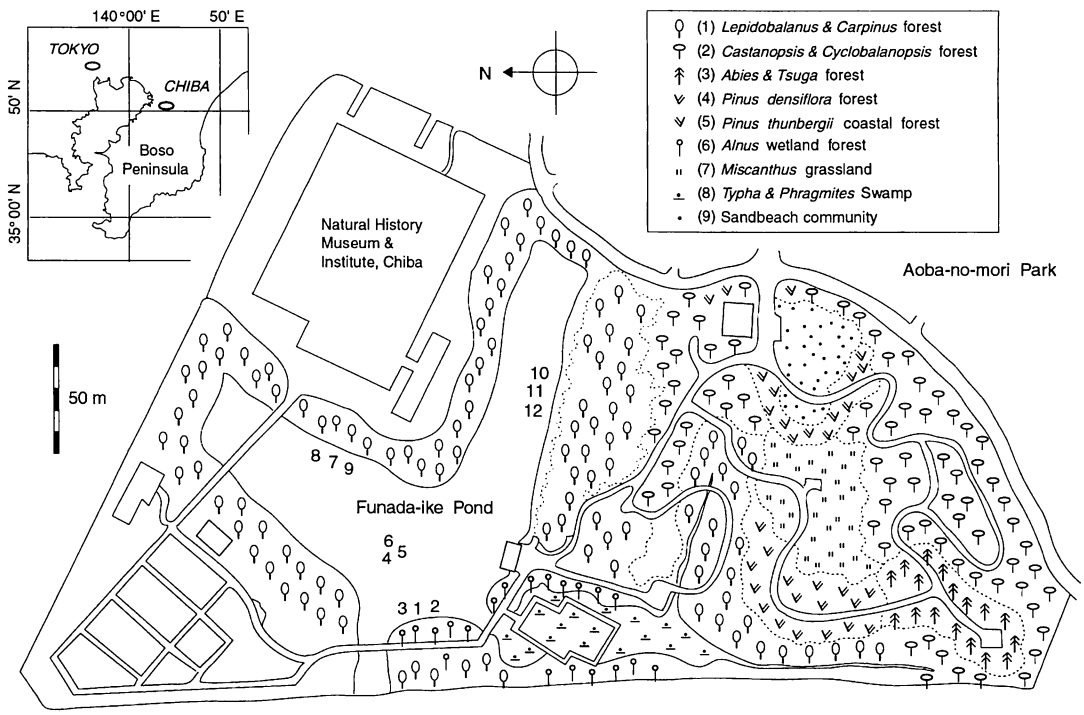

Fig. 1. Map of the Funada-ike Pond and the Seitaien with 9 major vegetation blocks, Chiba, central Japan.

the Seitaien was even formed by transferring entire forest stands including trees, herbs, litter, boulders, surface soils, *etc* from natural forest in the southern Boso Peninsula. Afterwards, all the vegetation blocks have been maintained under 'natural' states. That is, primary vegetation blocks have been subject to natural succession without any human interference, whereas secondary vegetation blocks have been artificially thinned down to hinder excess plant succession for the climax vegetation. In 1994, ca. 8000 tree/shrub individuals of 120 species were observed and now, 15 years after the facility opening, the forest patches become analogous to natural forest in appearance, with most trees blooming in their flowering seasons producing quasi-natural pollen rains. The climate is warm temperate with mean annual temperatures of 14.9-15.8°C in 1990-1992, with annual precipitation of 1250-1983 mm centred in ca. 1350 mm (Yura, 1994). The hilly topography also produces microclimate gradients in the N-S direction, utilised for the vegetation-block distribution.

2. Forestal vegetation blocks

The forestal blocks of the Seitaien mainly consist of (1) Deciduous broad-leaved forest, (2) Evergreen broad-leaved forest, (3) *Abies-Tsuga* forest, (4) *Pinus densiflora* forest, (5) Coastal forest and (6) *Alnus* wetland forest, representing major forest types of the Boso Peninsula from lowland warm-temperate forest to inland temperate conifer forest.

(1) The deciduous broad-leaved forest occupies the northern slopes of the Seitaien, dominated by *Carpinus tschonoskii* and *Quercus serrata*, associated with *Celtis sinensis, Aphananthe aspera, Quercus acutissima, Rhus japonica, Mallotus japonicus, Zelkova serrata, Cornus macrophylla, Morus australis, Prunus jamasakura, Robinia pseudoacacia, etc.* Tree trunks are attached by *Parthenocissus tricuspidata, Hedera rhombea, Ampelopsis brevipedunculata, Wisteria floribunda, etc. Fagus* (*crenata* and *japonica*) is not planted in the Seitaien.

(2) The evergreen broad-leaved forest occupies the sunny southern slopes of the Seitaien, dominated by *Castanopsis cuspidata, Quercus acuta, Q. glauca, Q. myrsinaefolia, Q. salicina, etc.* The following trees also grow : *Cinnamomum japonicum, Ilex integra, Ligustrum japonicum, L. obtusifolium, Osmanthus heterophyllus, Myrica rubra, Ficus erecta, Camellia japonica, Cleyera japonica, Eurya japonica, Illicium anisatum, Dendropanax trifidus, Fatsia japonica, Aucuba japonica, Podocarpus macrophyllus, Trachycarpus fortunei, etc.* Below are the rare taxa : *Magnolia obovata Viburnum dilatatum, Symplocos chinensis, Idesia polycarpa, Ailanthus altissima, Picrasma quassioides, Broussonetia kazinoki, Zanthoxylum piperitum, etc.*

(3) The *Abies-Tsuga* forest is analogous to the temperate conifer forest by Kira (1976) in the central Boso Peninsula overlying the warm-temperate forest zone. In the Seitaien, the forest type forms a small block with *Abies firma, A. homolepis, Torreya nucifera, Tsuga sieboldii*, and *Pinus parviflora.*

(4) The *Pinus densiflora* forest is analogous to the secondary pine forests in the northern Boso Peninsula. This vegetation block is dominated by *P. densiflora* with *Sasa nipponica* in the understories but some deciduous broad-leaved trees also grow such as *Fraxinus japonica, Styrax japonicus, Castanea crenata, Weigela coraeensis, Deutzia crenata, Rosa multiflora, Pourthiaea villosa* and *Callicarpa japonica.*

(5) The coastal forest occupies the entrance zone of the Seitaien, subdivided into (5a) *Pinus thunbergii* forest and (5b) *Machilus thunbergii* forest, containing *Pittosporum tobira, Euonymus japonicus, Rhaphiolepis indica, Elaeagnus umbellata, etc.* In Figure 1, the *Machilus* forest is included into the evergreen broad-leaved forest block.

(6) The alder wetland forest consists of *Alnus japonica* and *Salix* (*S. subfragilis, S. integra, S. leucopithecia*) with *Platanus occidentalis* and *Sapium sebiferum* in some marginal stands. Most *Alnus* trees grow along the Funada-ike Pond, whereas *Salix* stands are restricted in the swamp block described below.

3. Herbaceous vegetation blocks

The derivative herbfield blocks of the Seitaien consist of (7) *Miscanthus* grassland, (8) *Typha* & *Phragmites* swamp and (9) Sandbeach community.

(7) The *Miscanthus* grassland contains various grasses (*Miscanthus sinensis, M. sacchariflorus, Festuca ovina, Bromus catharticus, Lolium multiflorum, Imperata cylindrica, Sorghum halepense, Setaria viridis, Pennisetum alopecuroides, etc*) and non-Poaceae herbs such as *Erigeron philadelphicus, Cirsium nipponicum, Trifolium pratense, Rumex conglomeratus, R. obtusifolius, R. acetosa, Reynoutria japonica, Solanum carolinense, Humulus japonicus, Oenothera biennis, Solidago altissima, etc.* some of which are reminiscent of the previous pasturage period in this area. The open tussock-grass landscape is maintained by annual mowing against forest succession.

(8) The *Typha* & *Phragmites* swamp has been created by artificial soil imports and water supplies to old rice paddies by the Funada-ike Pond. This block is currently on the way of hydrosere, being in the emerged herb stage. The dominant taxa are *Typha*

angustifolia, T. orientalis, Phragmites communis, etc, surrounded by the willow woodlands. This swamp is flooded 20-50 cm deep in summers, almost drained in winters.

(9) The sandbeach community has been created by spreading gravels and coarse sands for better drainage, being analogous to sandy coastline of the Boso Peninsula with Juniperus conferta, *etc.* This block has no vegetation cover during most seasons, but in early summer various seashore herbs bloom such as *Glehnia littoralis, Calystegia soldanella, Lathyrus japonicus, Carex kobomugi, Dendranthema pacificum, etc.* Frequent invaders (terrestrial herbs and pine shoots) are manually removed with no chemical treatments like spraying herbicide or sea waters.

4. Surrounding environments outside the Seitaien

Cryptomeria japonica, which is the most dominant air pollen type in urban areas of the Kanto District, is not common in the Seitaien except for only a few individuals in the deciduous broad-leaved forest block. Nevertheless, dozens of Japanese cedar trees are planted in the neighbouring Aobanomori Park, together with *Prunus mume, Cedrus atlantica, Liquidambar formosana, Lagerstroemia indica, etc.* The northwesternmost plot of Seitaien also has exotic trees such as *Quercus crispula, etc* but they are too little in number to affect the entire pollen rain. Outside the Seitaien/Aobanomori Park, various garden/roadside trees are planted such as *Machilus, Cinnamomum, Zelkova* and *Platanus* in urban residence areas. In late summer/autumn, open spaces are occupied with dense herbaceous communities of *Artemisia feddei, Ambrosia artemisiaefolia, Dactylis glomerata, Solidago altissima, etc.* Small pine-oak assorted forests survive in the vicinity. More regionally, the northern Boso Peninsula and the southern Kanto District have a lot of afforested trees of *Cryptomeria japonica* and *Pinus densiflora.*

5. Environmental history of the Funada-ike Pond

Funada-ike (9 m a.s.l.) is originally an old irrigation pond built before 1677. Nevertheless, all lacustrine muds available on the basin floor represent the last 15 years after the Seitaien opening, because in 1988-9 winter the Funada-ike Pond was filled with eutrophicated rotten sludge due to waste water inflows, which has been dredged basinwide replaced by imported clean coarse sands (Urabe *et al.*, 1994). At present, the Funada-ike Pond is a sancurtary of wild ducks, grebes, *etc* migrating from the north in winters. This pond is also inhabited by small fishes and aquatic insects so the bottom conditions may not completely be static. The water level varies seasonally with averaged water depths of 2-3m. Eutrophication is still crucial today due to increasing bird excrements, and periodical artificial drainages are indispensable to oxydise the basin floor maintaining decent water quality.

Materials and Methods

The 12 sediment samples from the Funada-ike Pond (FN1-12) were collected in 2002-3 winter when the latest water drainage was performed basinwide. Samples FN1-3 were located along the *Alnus* wetland forest (see Fig. 1) with weak water currents from adjacent filtration facilities and/or the swamp block, whereas samples FN4-6 were from the static depocentre which more or less typifies the pollen assemblages within the pond. Samples FN7-12 were located near the coast along the deciduous broad-leaved forest. In 2002-3 winter, the surface sediments of the Funada-ike Pond were no more than 5-10 cm in thickness, consisting of very fine, homogeneous, strongly deoxydised bluish-grey clay. The sediments were immediately underlain by yellowish-grey artificially spread coarse sands. Ca. 20-30 grams of sediments were collected from the mud layer. Ca. 1-2 grams of sediments (dry weight) were subsampled after complete stir, used as the materials for the analysis.

The pretreatment for pollen analysis followed the standard KOH-acetolysis method (Moore *et al.*, 1991). The sediment samples were boiled in 10% KOH solution, with pollen grains extracted from inorganic detritus by heavy liquid flotation with $ZnCl_2$ and repeated decanting. Finally the samples were acetolysed and mounted with a 100% glycerol solution. More than 500 grains of arboreal pollen (AP) excluding *Alnus* were counted for each sample, used as the pollen sum for percentage calculation. Percentages of non-arboreal pollen (NAP) were based on a separate sum including the NAP itself. Percentage of wetland taxa including Alnus and fern spores were based on the total pollen plus spore sum.

Results

Results of the surface pollen analysis for the Funada-ike sediments are shown in Figure 2. The dominant taxa are *Carpinus, Quercus* subgen. *Lepidobalanus,* with their values coherently exceeding 40% altogether. *Ulmus / Zelkova, Celtis / Aphananthe, Mallotus, Quercus* subgen. *Clyclobalanopsis, Castanopsis, Myrica* are main associates with their values ranging 2-10%. Various minor hardwoods yield such as *Ostrya, Castanea, Acer, Fraxinus,* Araliaceae, *Viburnum,*

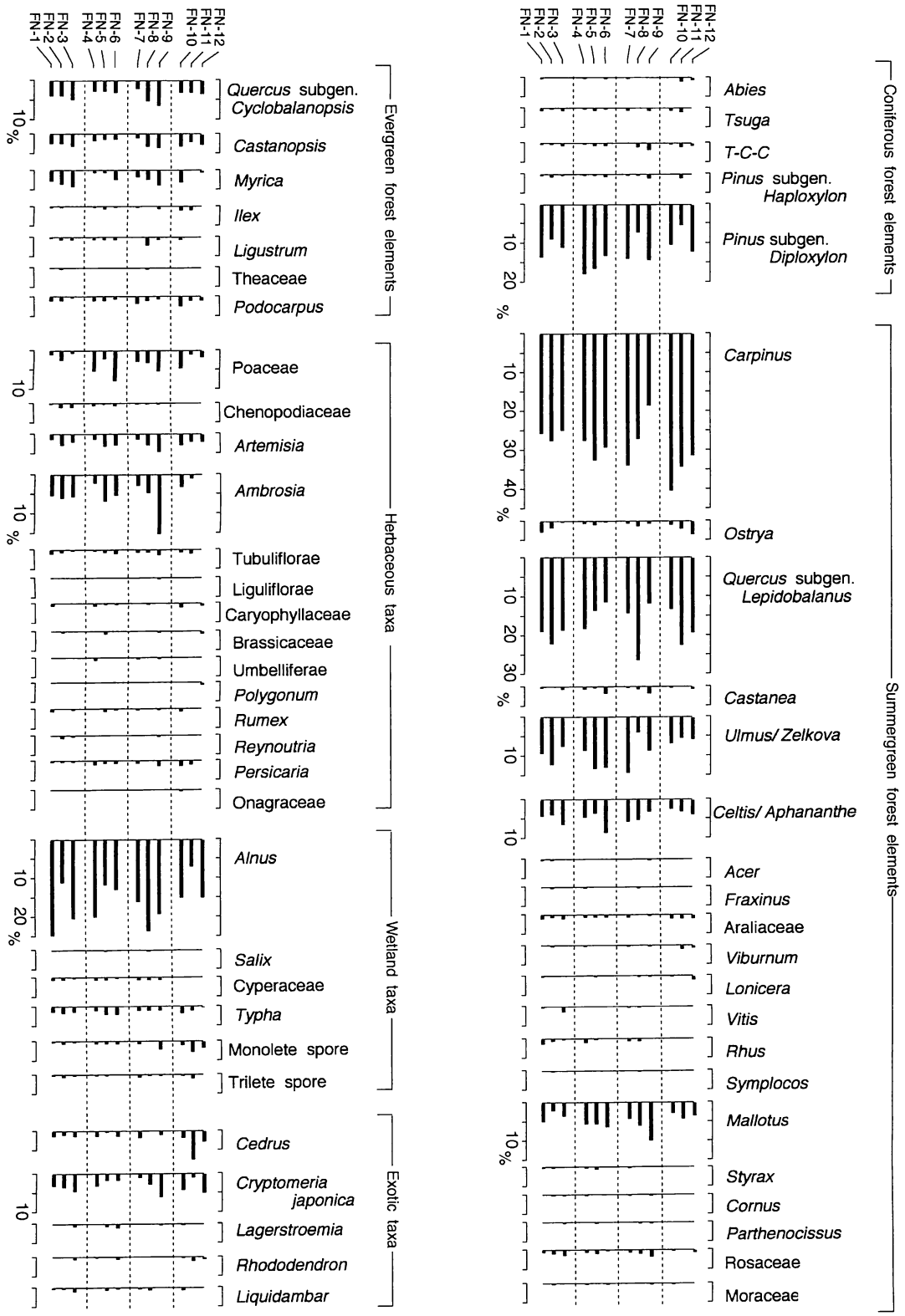

Fig. 2. Results of pollen analysis for surface sediments of the Funada-ike Pond, Seitaien, Chiba, central Japan.

Lonicera, Vitis, Rhus, Symplocos, Styrax, Cornus, Moraceae, *Ilex, Ligustrum,* Theaceae, *Rhododendron, Lagerstroemia, Liquidambar, etc* but their values rarely exceed 2%. Concerning conifer taxa, *Pinus* subgen. *Diploxylon* is the only major associate exceeding 10-15%. *Cryptomeria japonica* is no more than 1-5%. *Abies, Tsuga,* T-C-C (Taxaceae-Cephalotaxaceae-Cupressaceae) and *Pinus* subgen. *Haploxylon* are coherently less than 1%. *Cedrus,* apparently exotic taxon, shows a characteristic regular occurrence. Concerning herbs, *Ambrosia, Artemisia* and Poaceae occur regularly with sporadical occurrence of Tubuliflorae, Polygonaceae, Caryophyllaceae, Chenopodiaceae, *etc.* Concerning wetland taxa, *Alnus* is the only major associate with 10-25% in total sporopollen. *Typha* barely occurs but *Salix* and Cyperaceae are almost absent throughout the diagram.

Discussion and Conclusions

One of the significant consequences of the research for the Funada-ike surface sediments is that the pollen spectra reflect the nearest vegetation patch despite the highly diversified plant communities in and around the Seitaien. Artificial disturbance including the basinwide drainages does not affect data significance, although being possibly responsible for extra data homogeneity including unnaturally stable *Alnus* pollen among the data localities. Three dominant taxa (*Carpinus, Lepidobalanus* and *Alnus*) are the elements of the nearest vegetation blocks within the Seitaien. *Castanopsis* and *Cyclobalanopsis,* as the elements of the evergreen broad-leaved forest block are restricted in this data. The same holds for conifer trees except for *Pinus* subgen. *Diploxylon.* Exotic taxa from the outside of the Seitaien also occur, but their influences are generally restricted. The unimportance of *Cryptomeria japonica* and Cupressaceae pollen in the Funada-ike assemblage is almost surprising, when their well-known predominance in air pollen of the southern Kanto District (see Nagano *et al.*, 1978, 1992) is considered. The same holds for *Ambrosia, Artemisia, Dactylis, etc* which occupies innumerable open spaces in the residence areas around the Seitaien during early summers to autumns. These imply that even such predominant anemophilous pollen as the cause of pollinosis cannot replace the forestal assemblage (of *Carpinus, Lepidobalanus, Alnus, etc*), which is smaller-scale here but has high pollen productivity (Igarashi, 1987). It should be noted that the above implication becomes meaningful when the surrounding vegetation consists of closed forest. When the sampled site is surrounded by sparse herbfields, the results would be different and the influence of pollen from distant areas could be critical. This issue requires further examinations.

As the next surface pollen research in the Seitaien, an analysis for moss polsters along the Funada-ike coast will be a good scope. It deserves attentions whether the deciduous broad-leaved assemblage in the Funada-ike Pond is shared by the surrounding moss samples, in order to know the data stability of the pollen catchers with much smaller sizes than a basin. Another research scope will be the surface sediment analysis for the neighbouring swamp block. One of the unexpected consequences of the present study is the rarity of wetland taxa except *Alnus.* It deserves attentions whether the *Typha, Salix* and Cyperaceae in the swamp simply produce little pollen, or there is an invisible barrier against pollen transports between the swamp and the Funada-ike basin. In addition, the southern end of the swamp is close to the evergreen broad-leaved forest and *Abies-Tsuga* forest blocks. Whether or not the above area is similar to the Funada-ike Pond in pollen compositions will provide additional information on the pollen behaviour in the Seitaien.

The author also notes that the present samples contain various, well-preserved pollen grains in high concentrations. Coupled with the presence of diversified plant communities with taxonomic information into species levels, the Funada-ike surface sediments can be a good educational samples for palynological beginners. The best pollen preservation and purity are found in samples FN10-12. Conversely, samples FN1-3 contain abundant charcoals and organic detritus, showing that the alder-dominated coast is not recommended for the sampling for educational purposes.

Acknowledgements

This work was funded by the Grant-in-Aid from the Ministry of Education, Science, Sports, and Culture of Japan to M. O. (No. 15740311).

References

Bonnefille, R. and G. Riollet. 1988. The Kashiru pollen sequence (Burundi) palaeoclimatic implications for the last 40,000 yr B.P. in tropical Africa. Quat. Res. 30: 19-35.

Bush, M. B. 2000. Deriving response matrices from Central American modern pollen rain. Quat. Res. 54: 132-143.

Cross, A. T., G. G. Thompson and J. B. Zaitzeff. 1966. Source and distribution of palynomorphs in bottom sediments, southern part of Gulf of California.

Marine Geol. 4: 467-524.

Gotanda, K., T. Nakagawa, P. E. Tarasov, J. Kitagawa, Y. Inoue and Y. Yasuda. 2002. Biome classification from Japanese pollen data: application to modern-day and Late Quaternary samples. Quat. Sci. Rev. 21: 647-657.

Heusser, C. J. 1995. Three Late Quaternary pollen diagrams from southern Patagonia and their palaeoecological implications. Palaeogeogr., Palaeoclimatol., Palaeoecol. 118: 1-24.

Igarashi, Y. 1987. Pollen incidence and wind transport in central Hokkaido (II). Research Bulletins of the College Experiment Forests, Hokkaido University 44: 477-506. (In Japanese with English abstract)

Igarashi, Y., G. Iwahana, N. Sento, S. Tsuyuzaki and T. Sato. 2003. Surface pollen data from different vegetation types in northeastern Russia: the basis for reconstruction of vegetation. The Quat. Res. (Tokyo) 42: 413-425. (In Japanese with English abstract)

Kira, T. 1976. Terrestrial Ecosystem. 166 pp. Kyoritsu Shuppan, Tokyo. (In Japanese)

Liu, H. Y., H. T. Cui, R. Pott and M. Speier. 1999. The surface pollen of the woodland – steppe ecotone in southeastern Inner Mongolia, China. Rev. Palaeobot. Palynol. 105: 237-250.

Matsushita, M. and S. Sanukida. 1986. Studies on the characteristic behavior of pollen grains and spores in Lake Hamana on the Pacific coast of central Japan. The Quat. Res. (Tokyo) 25: 71-79.

Moore, P. D., J. A. Webb and M. E. Collinson. 1991. Pollen Analysis. 216 pp. Blackwell, London.

Morita, Y. 1998. Forest history of subarctic conifer forest in Japan. *In* Yasuda Y. and N. Miyoshi (eds.), Vegetation History in the Japan Archipelago, pp. 179-193. Asakura, Tokyo. (In Japanese)

Morita, Y., C. Kamiya, H. Nasu and A. Momohara. in press. Pollen analytical studies on moss-polsters from mires in the subarctic and subalpine environment of Hokkaido, Japan. The Quat. Res. (Tokyo). (In Japanese with English abstract)

Nagano, H., M., Katsuta and T. Shida. 1978. Pollen Rain of the Japanese Archipelago. 106 pp. Hokuryu-kan, Tokyo. (In Japanese)

Nagano, H., S. Nishima, R. Kishikawa, N. Sahashi and T. Yokoyama. 1992. Pollen Rain of the Japanese Archipelago II. 103 pp. Hokuryu-kan, Tokyo. (In Japanese)

Nakagawa, T., P. E. Tarasov, K. Nishida, K. Gotanda and Y. Yasuda. 2002. Quantitative pollen-based climate reconstruction in central Japan: application to surface and Late Quaternary spectra. Quat. Sci. Rev. 21: 2099-2113.

Nakamura, T. 1994. The Ecology Park (Seitaien) of the Natural History Museum & Institute, Chiba. J. Nat. Hist. Mus. Inst., Chiba, Special Issue 1: 7-17. (In Japanese with English abstract)

Numata, M. 1993. Ecology park: nature in urban area. Tosho 525: 35-39. (In Japanese)

Okuda, M., H. Nishida, K. Uemura, A. Yabe, T. Yamada and M. Rancusi. 2004. Palynological investigation and implications on the relationship between modern surface pollen and vegetation / climate (especially precipitation) in the Riesco Island (Isla Riesco), subantarctic Patagonia, Chile. Nat. Hist. Res. 8: 1-11.

Okuda, M., T. Nakagawa, L. S. Wang and Y. Yasuda. 2005. Modern surface pollen investigation for pollen-climate relations along altitudinal transects across subtropical to lower montane zones (1950-3500m a.s.l.) in Zhongdien, NW Yunnan province, China. Nat. Hist. Res., in press.

Sasaki, S. 1986. Comparison of surface pollen spectra between peat bogs with different vegetation types. The Quat. Res. (Tokyo) 25: 13-19. (In Japanese with English abstract)

Traverse, A. and R. N. Ginsburg. 1966. Palynology of the surface sediments of Great Bahama Bank, as related to water movement and sedimentation. Marine Geol. 4: 417-459.

Traverse, A. 1988. Paleopalynology. 600 pp, Unwin Hyman, Boston.

Urabe, J., R. Kuranishi, M. Hasegawa, N. Kobayashi, N. Ogura and K. Yashiro. 1994. Changes in water quality and fauna in Funada-ike Pond: an assessment of restoration treatment. J. Nat. Hist. Mus. Inst., Chiba, Special Issue 1: 333-343. (In Japanese with English abstract)

Yura, H. 1994. Outline of meteorological observing and recording system ; Ecology Park, Natural History Museum and Institute, Chiba. J. Nat. Hist. Mus. Inst., Chiba, Special Issue 1: 33-44. (In Japanese with English abstract)

Zheng, Z. 2000. Late Quaternary vegetational and climatic changes in the tropical and subtropical areas of China. Acta Micropalaeont. Sinica 17: 125-146.

(Accepted 10 March 2005)

千葉県立中央博物館・生態園舟田池の表層花粉調査
—園内の植生と花粉群との相関について—

奥田昌明

千葉県立中央博物館
〒260-8682 千葉市中央区青葉町 955-2
E-mail: okuda@chiba-muse.or.jp

要　旨　千葉県立中央博物館・生態園にはシイ－カシ林・イヌシデ－コナラ林・モミ－ツガ林・アカマツ林・海岸林・ハンノキ林・草本植生など多様な植生区画が密集配置されており，園外には外国産の樹木も植栽されており，様々な植物群集の花粉群への反映のされ方を調べるための実験園として好適である．本稿では生態園における表層花粉調査の第1報として，園内，舟田池底の表層堆積物に対する調査結果を報告する．池の4水域から採取された計12点の表層試料中の花粉群は，いずれもクマシデ属・コナラ亜属に優先されハンノキ属・二葉マツ亜属・ニレ／ケヤキ属・エノキ／ムクノキ属・アカメガシワ属などが随伴する類似の落葉広葉樹主体の組成を示しており，シイ／カシなどの照葉樹林要素・スギ／ヒノキ類などの温帯性針葉樹・ブタクサ／ヨモギなどの草本類・フウ／ヒマラヤスギなどの外国産樹木などは，産出はあるものの一貫して少量だった．舟田池の表層花粉は園内外の複雑多様な植生状況にも係わらず直近のイヌシデ－コナラ林を最大に反映しており，スギ・ヒノキ類・ブタクサ属・ヨモギ属といった南関東地方の空中花粉組成の過半を占める周辺地域からの花粉の影響は小さかった．このことは，多様な森林植生が密に隣接するいわゆる植生トランセクトに沿って実施するタイプの表層花粉調査の有効性を支持する一証拠と見ることができる．