Phytosociological Studies of the Vegetation on the Dry Beds of the River Nagara and Its Tributaries

by

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Introduction

As the public open space—parks and squares for recreation, is decreasing in city areas, due to the recent cityward drifting of population in this country, the river space is beginning to attract public attention. The full, multi-purpose utilization of the river space is becoming more and more important, and the background data are very much in demand to secure this end. In this paper we report on the vegetation on the dry beds of the River Nagara in our efforts to respond to such a need.

I. The Outline of the River Nagara

The Nagara runs in the center of Honshu Island and is well known in history, culture and sight-seeing. It is also known as a river where no dam has been constructed. The nature along the river is kept mostly intact when that of mamy other parts of the country has been increasingly deteriorating.

The Nagara rises in the Okumino area in Gifu Prefecture and flows southward through Paleozoic ravines to join the River Itadori, forming an alluvian fan in Mino city. It joins the Mugi and the Tsubo and changes its course to the south-east in Seki city. After flowing past the foot of Kinkazan hill and through Gifu city, it joins the Ijira at Kagamishima, turns its course southward and flows through the Nobi plain. It joins the Itonuki at Hozumi-cho, then five rivers one

Table 1. Average Monthly Temperature (°C) and Warmth Index (Coldness Index)

Month / Locality	1	2	3	4	5	6	7	8
Shiratori	0.2	0.8	4.1	10.7	15.4	19.8	24.1	25.0
Gifu	3.3	4.0	7.3	13.0	17.9	21.7	25.8	27.0
Mino	3.6	4.1	7.4	13.2	17.4	21.5	25.9	26.9
Kuwana	4.4	4.9	8.0	13.6	18.1	22.4	26.9	27.8

Month / Locality	9	10	11	12	Annual mean (°C)	Warmth index (m.d.)	Coldness index (m.d.)
Shiratori	20.8	14.8	8.8	3.2	12.3	99.4	−11.7
Gifu	22.9	16.8	11.3	6.0	14.7	119.7	−2.7
Mino	23.0	17.1	11.3	5.9	14.8	119.6	−2.3
Kuwana	24.0	17.9	11.9	6.9	15.6	127.5	−0.7

Table 2. Average Monthly Precipitation (mm)

Locality \ Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Shiratori	159.5	126.4	165.4	222.7	207.3	322.5	373.5	300.6	361.1	200.3	148.7	166.6	2,754.6
Gifu	69.2	73.1	120.1	177.1	197.6	294.9	255.8	173.6	251.6	139.7	84.3	66.4	1,903.6
Mino	71.2	78.3	138.1	212.4	194.5	283.3	281.8	225.2	261.2	157.0	98.0	84.3	2,085.3
Kuwana	51.8	63.1	108.0	147.8	162.8	231.0	184.2	193.7	220.7	155.4	83.6	58.2	1,660.2

Average value for 30 years from 1941 to 1970

after another. After running in parallel with the Kiso in Hajima city, it discharges into Ise Bay, ending its 159 km course.

Its climatic factors are shown in Tables 1 and 2.

II. The Vegetation on the Dry Beds of the River Nagara

In this research, the Nagara basin was divided into 4 parts—mountain stream district, upper stream district, midstream district and downstream district, from the viewpoints of river-topography and vegetation. The typical vegetation was selected and examined, and by using the resultant data, the vegetation was classified.

Except in a part of the mountain stream district, the Nagara basin, having the warmth indices varying 99.4 to 127.5, is the area of *Camellia japonica* class consisting mainly of *Camellia japonica*, *Oak kind*, *Castanopsis cuspidata* and *Cleyera japonica*.

We will describe the vegetation of each district in order.

1. The vegetation in the upper stream district

In the areas above the Gujo and Mugi districts, the Nagara flows through the valley between mountains of 500 to 1000 meters above sea level.

The greater part of mountains of this river basin is covered with the afforestation of *Cryptomeria japonica*, *Chamaecyparis obtusa*. Only in the Tree zone of rock-ridges and riversides, the basin is covered with the vegetation of *Quercus mongolica* var. *grosseserrata* (3.3), *Carpinus tschonoskii* (2.2), *Acer mono* (1.2), *Quercus serrata* (1.2), *Pterocarya rhoifolia* and *Aesculus turbinata* (1.2). In the Subtree zone it is covered with the vegetation of *Viburnum furcatum* (2.2), *Hamamelis japonica* (1.2), *Carpinus cordata* (1.1), *Acer crataegiforium* (1.1), *Corylus sieboldiana* (1.1). In the Shrub zone it is covered with the vegetation of *Sasa kurilensis* (2.3), *Alangium platanifolium* var. *trilobum* (1.2), *Viburnum wrightii* (1.1), *Rhus trichocarpa* (1.1), *Stachyurus praecox* (1.1), *Lyonia ovalifolia* var. *elliptica* (1.1), *Hydrangea paniculata* (1.1), and *Salix bakko* (1.1), and with climbing plants, such as *Wisteria brachybotrys* (1.1), *Schizophragma hydrangeoides* (1.2), *Vitis coignetiae* (1.1), *Actinidia polygama* (1.1) and *Actinidia arguta* (1.1) and also with plants of high snowfall mountain type, such as *Cephalotaxus harringtonia* var. *nana* (2.2), *Ilex crenata* var. *paludosa* (1.2), *Tripterygium regelii* (1.1), *Torreya nucifera* var. *radicans* (1.1), *Ilex leucoclada* (1.1), *Ilex sugerokii* var. *brevipedunculata* (1.1) and *Aucuba japonica* var. *borealis* (1.1). In the field zone it is covered with fern plants, such as *Polystichum retroso-paleaceum* var.

ovato-paleaceum (2.2), *Rumohra standishii* (2.2), *Polystichum tripteron* (2.2) and *Matteuccia orientalis* (1.1), and with *Quercus mongolica* var. *grosseserrata–Sasa kurilensis* community, *Carpinus tschonoskii–Sasa kurilensis* community consisting of *Carex stenostachys* (1.2), *Disporum smilacinum* (1.1), *Epimedium cremeum* (+), *Viola varinata* (+), *Viola kusanoana* (+) and *Boehmeria tricuspis* (1.1). And on the riversides there are towering trees of *Aesculus turbinata*, *Cercidiphyllum japonicum*, *Pterocarya rhoifolia*, *Juglans ailanthifolia*, *Zelkova serrata* and *Hovenia tementella*.

In the Hirugano moorland (900 meters above sea level), one of the sources of the Nagara, there are some parts where plants emerge, though scantily because of land development,——plants such as, *Lysichitum camtschatcense–Symplocarpus reniflolius* communities. In the peripheral part there grows the vegetation of *Veratrum stamineum* (2.2), *Scirpus wichurae* (2.2), *Inula ciliaris* (1.2) and *Lobelia sessilifolia* (1.2). Surrounding these plants are field communities of *Iris ensata* var. *spontanea* (2.3), *Miscanthus sinensis* (3.4), *Filipendula multijuga* (1.1) and *Senecio cannabifolius* (1.1), and in the outermost, the dry part, we see the vegetation of *Osmunda asiatica*, *Veratrum stamineum*, *Tofieldia japonica*, *Scirpus wichurae*, *Eupatorium linleyanum*, *Veratrum maackii* var. *japonicum*, *Sanguisorba officinalis*, *Carex maximowiczii* and shrubs of *Ilex crenata* var. *paludosa*, *Rhamnus crenata*, *Rhododendron japonicum*, *Alnus fauriei*, *Ilex serrata* and *Hydrangea paniculata*.

On the dry riverbeds of the mountain stream district, there are mamy boulders, 1 to 2 meters in diameter. On the water's edges we find the vegetation of *Salix integra* association–*Salix gracilistyla* subassociation, whose characteristic species are *Salix integra* and *Salix chaenomeloides*. Adjacent to it, away from the waters we find the vegetation of *Phagmitetum japonicae*, whose characteristic species are *Phragmites japonica*, *Equisetum arvense* and *Phalaris arundinacea*. We also find there *Alnus serrulatoides* associations, whose association characteristic species are *Alnus serrulatoides*, *Elaeagnus umbellata*, *Ligustrum obtusifolium* and *Lysimachia fortunei*.

On the sandbars are seen *Salix serissaefolia* subassociations consisting of *Salix serissaefolia* (2.2), *Salix gracilistyla* (1.2), *Artemisia princeps* (1.2), *Agrimonia pilosa* (1.2), *Paederia scandens* var. *mairei* (1.1) and *Pueraria lobata* (2.2).

2. The vegetation on the upper stream district

The upper stream district is the mountainous Chuno basin under 500 meters in height. The vegetation of the mountain ridges there is of *Pinus densiflora–Rhododendron macrosepalum* association for the most part, and the lower half of the mountains is covered with the afforestation of *Cryptomeria japonica* and *Chamaecyparis obtusa*. On the watersides of the riverbeds are seen *Salix integra* association–*Salix gracilistyla* subassociations, and adjacent to it, away from the water, *Phragmites japonica* associations and *Phragmites communis* associations are seen. On the sandbars we see *Salix serissaefolia* subassociation, and near the banks we see *Arundinaria simonii* associations, whose characteristic species is *Arundinaria simonii*, and which consist of *Arundinaria simonii* (5.5), *Imperata cylindrica* var. *koenigii* (1.2), *Rosa multiflora* (1.2) and *Comme–*

lina communis (1.1).

The vegetation in the precipice is of *Rhododendron indicum* association, whose characteristic species are *Rhododendron indicum*, *Lespedeza buergeri*, *Osmunda lancea* and *Arundinella hirta*.

3. The vegetation in the midstream district

The Nagara flows more slowly at Hino, Gifu city, where it is more than 250 meters in width. The vegetation there is more various in kind.

On the edges of the water there grows the vegetation of *Phragmites communis* association, whose characteristic species is *Phragmites communis*, and next to it, away from the water there grow *Miscanthus sacchariflorus* associations, whose characteristic species is *Miscanthus sacchariflorus*. We see the vegetation of *Zizania latifolia* community in the inlet-like, slack watered parts, of *Phalaris arundinacea-Oenanthe javanica* community, which is the dominant species of *Phalaris arundinacea* and *Oenanthe javanica*, on the damp ground of the riverbeds, amd of *Scirpus triqueter* community in puddles. In the peripheral part of the puddles, we see *Polygonum thunbergii*, *Polygonum lapathifolium* and *Panicum crus-galli* var. *echinata*. On the sand-muddy soil which is submerged in case of flooding, we see *Polygonum hydropiper* communities, whose dominant species are *Polygonum hydropiper* and *Polygonum sieboldii* var. *aestivum*, and on the unstable part we see *Xanthium canadense* communities, and *Setaria viridis* communities, whose dominant species are *Xanthium canadense*, *Chenopodium ambrosioides* and *Erigeron canadensis*. On the dry part there grow *Kummerovia striata–Artemisia capillaris* communities, *Imperata cylindrica* var. *koenigii* communities, *Erigeron bonariensis* communities, *Miscanthus sinensis–Arundinaria pygmaea* var. *glabra* associations and *Zoysia japonica* communities. In the low and damp part where soil is mixed with sand and pebbles, there grows the vegetation of *Salix integra* association–*Salix serissaefolia* subassociation, and near the downstream, on clayey soil there grow *Salix gilgiana* subassociations, whose dominant species are *Salix gilgiana* and *Salix subfragilis*.

On the stable parts of the riverbeds, there grow *Aphananthe aspera–Liriope platyphylla* communities and *Phyllostachys bambusoides–Oplismenus undulatifolius* var. *japonicus* communities, in which *Liriope platyphylla* is mixed with such as *Aphananthe aspera*, *Celtis sinensis* var. *japonica* and *Zelkova serrata*.

Most of the more stable places are utilized as *Morus alba* fields, vegetable fields, pastures and recreation squares.

4. The vegetation in the downstream district

The Nagara flows very gently at the place near Nannoh Ohashi Bridge (6 meters above sea level), where the river is more than 500 meters wide. There are wide riverbeds and the vegetation is diverse in kind.

On the brinks of the river, there are *Phragmites communis* associations and *Miscanthus sacchariflorus* associations, and in the inlet-like, slack-watered places, *Zizania latifolia* communities.

On the damp ground of the riverbeds, there grow *Phalaris arundinacea–*

Oenanthe javanica communities, *Typha angustasa* communities, *Scirpus triqueter* communities and *Cyperus serotinus* communities, and in the part where water is running, we find *Potamogeton berchtoldii* communities, *Vallisneria asiatica* communities, *Potamogeton perfoliatus* communities and *Myriophyllum verticillatum* communities.

On the banks are seen *Pinus thunbergii–Imperata cylindrica* var. *koenigii* communities, and on the riversides, *Salix integra* association–*Salix gilgiana* subassociations.

In the running water around and downstream from Nagara Ohashi Bridge, *Scirpus fluviatilis* and *Zostera nana* are seen.

III.

Phragmites japonica associations grow between the brinks and *Salix gracilistyla* subassociations in the mountain stream district and upper stream district. They grow even on pebbly ground and sandy ground.

IV.

As for *Salix* forests, *Salix gracilistyla* subassociations grow on the dry pebbly riverbeds as far down as Kinkazan hill, Gifu city. mixed with them, though small in volume, is the vegetation of *Salix integra* and of *Salix chaenomeloides*. They range from the upper stream to the downstream.

Salix gilgiana subassociations grow chiefly on the stable clayey soil of the downstream basins.

Salix serissaefolia subassociations grow on sandy soil mixed with pebbles in the upper- and midstream areas. The vegetation of *Salix subfragilis* grows on the clayey soil of the midstream and downward.

V.

As for grass heath community, tall herbaceous plants, such as *Miscanthus sinensis* and *Miscanthus sacchariflorus* grow little in the upper stream district, and about 10% in the midstream district. They do not grow abundantly in the downstream district, either where there are pastures. However, as pastures there, when abandoned, soon get covered with *Miscanthus sacchariflorus* associations, the district is thought to be mostly the habitat of *Miscanthus sacchariflorus*.

VI.

In the midstream district there grow Climbing plants, such as *Pueraria lobata* communities, *Humulus japonicus* communities and *Cayratia japonica* communities. There are not many pastures in the downstream district.

VII.

The percentage of the vegetation area of each community in all the districts is as follows;

The percentage of midgrass communities, such as *Imperata cylindrica* var. *koenigii* communities, *Phalaris arundinacea–Oenanthe javanica* communities, *Polygonum thunbergii* communities, *Polygonum hydropiper* communities and

Xanthium canadense communities is 59%, that of tall herbaceous communities, such as *Miscanthus sacchariflorus* associations, *Phragnites japonica* associations, *Phragnites communis* associations, *Zizania latifolia* communities and *Miscanthus sinensis–Arundinaria pygmaea* var. *glabra* associations is 11%, that of climbing plants is 12%, that of *Kummerovia striata–Artemisia capillaris* communities and *Zoysia japonica* communities is 18% and that of lignosa-*Phyllostachys bambusoides* forests is 1%.

Summary

The River Nagara runs in the center of Honshu Island and is well known in history, culture and sight-seeing. It is also known as a river where no dam has been constructed and the nature along the river is kept mostly intact.

In this paper, the outline of the result of the research concerning the vegetation on the dry beds of the Nagara is reported as follows:

1. In this research, the Nagara basin was divided into 4 parts—mountain stream district, upper stream district, midstream district and downstream district—from the viewpoints of river-topography and vegetation. On the basis of the investigation the vegetation was classified as follows:

In the mountain stream district
Fagus crenata class
On the dry riverbeds
Phragmites japonica association
Alnus serrulatoides association
Salix integra association
Salix gracilistyla subassociation
Salix serissaefolia subassociation
In the riverside forests
Quercus mongolica var. *grosseserrata–Sasa kurilensis* community
Carpinus tschonoskii–Sasa kurilensis community
Camellia japonica class
Phragmites japonica association
Alnus serrulatoides association
Salix integra association
Salix gracilistyla subassociation
Salix serissaefolia subassociation
In the upper stream district
On the dry riverbeds
Salix integra association
Salix gracilistyla subassociation
Salix serissaefolia subassociation
Phragmites japonica association
Arundinaria simonii association
Rhododendron indicum association
In the riverside forests
Cryptomeria japonica–Chamaecyparis obtusa afforestation
Pinus densiflora–Rhododendron macrosepalum association

In the midstream district

Phragmites communis association
Miscanthus sacchariflorus association
Zizania latifolia community
Phalaris arundinacea–Oenanthe javanica community
Scirpus triqueter community
Polygonum thunbergii association
Polygonum hydropiper community
Xanthium canadense community
Kummerovia striata–Artemisia capillaris community
Imperata cylindrica var. *koenigii* community
Erigeron sumatrensis community
Setaria viridis community
Miscanthus sinensis–Arundinaria pygmaea var. *glabra* association
Zoysia japonica community
Salix integra association
Salix serissaefolia subassociation
Salix gilgiana subassociation
Arundinaria simonii association
Aphananthe aspera–Liriope platyphylla community
Phyllostachys bambusoides–Oplismenus undulatifolius var. *japonicus* community

In the downstream district

Phragmites communis association
Miscanthus sacchariflorus association
Phalaris arundinacea–Oenanthe javanica community
Scirpus triqueter community
Cyperus serotinus community
Potamogeton berchtoldii community
Vallisneria asiatica community
Potamogeton perfoliatus community
Myriophyllum verticillatum community

On the seashore

Pinus thunbergii-Imperata cylindrica var. *koenigii* community
Salix integra association
Salix gilgiana subassociation

Climbing plants grow mainly in the midstream district.

2. The result of the research on the growth environment of willow forests is reported in this paper.

3. The result of the research on the growth condition of herb plants is reported in this paper.

References

BRAUN-BLANQUET, J. 1964. Pflanzensoziologic. 3 Aufl., Wien.

CAIN, S. A. and G. M. de OLIVEIRA CASTRO 1959: Manual of vegetation Analysis. New York.

MINAMIKAWA M. 1963. Phytosociological Studies of the plant communities on the River-beds of the River Yahagi and its Tributaries, Natural of the River Yahagi.

——— 1959. Plant communities of the River Mitaki, Mie.

——— 1970. Vegetation of the River Hidagawa, Natural of the River Hidagawa.

MIYAWAKI, A. 1972. Realen Vegetation der Präfektur Kanagawa, Yokohama.

NARAHASHI Y. 1945. Ecological Studies of the plant community on the River-basin of the River Arakawa.

TÜXEN, R. 1961. Wesenzüge der Pflanzengesellschaften als lebendiger Bauthoff. Angew. Pflanzensozidogie **17** Weser.