Bull. Inst. Sci. Technol., Yokohama Natn. Univ. **12**: 105-124 (1985)

Phytosociological Study of the Vegetation of Shonan Sea Shore, Kanagawa Prefecture*

神奈川県湘南海岸における植物社会学的研究*

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Synopsis

This paper reviews mapping and classification of Shonan vegetation under heavy human impact. The dune vegetation of Shonan seashore has been subjected to ordination and community grouping, and the distribution patterns of some species have been explained through the characteristic cover degree and the interrelation of distributional aspects of communities and their environment. The actual vegetation was classified into 24 vegetation units. Am map of actual vegetation, with 22 legends at a scale of 1 : 10,000, was made for the Shonan area. Dune vegetation could be divided into 4 vegetation regions through the index of dissimilarity, considering characteristic cover degree of component species. The main local component species of the natural vegetation were discontinuous. The substitute species were shown to have continuous distribution patterns. The community web was described for understanding the interlocking patterns among communities based on characteristic cover degree of component species.

1. Introduction

Plant communities are constantly appearing, reflecting the integration of the natural environmental factors, and change depending upon the variety and intensity of human impacts, even under otherwise nearly constant environmental conditions. Schwickerath (1954) proposed a cycle of communities (Gesellschaftring) as an explanation of the interrelationships not only between early and final communities (Schlußgesellschaften) of each step but also between community development and each habitat (Standort) factor (Schumithüsen, 1960).

Many ecological studies concerning the succession and dynamics of dune Vegetation have been conducted around the world (Nobuhara et al. 1962, 1964, 1967, van der Maarel et al. 1985, Tagawa et al. 1985). In this paper, the Shonan coastal area of Kanagawa Prefecture, which continues to be developed and disturbed by human activities, was studied phytosociologically, including description of plant communities and mapping of the dune vegetation. Experiments were also made to determine the distribution patterns of component species of dune vegetation (Ishizuka 1961, van der Maarel 1966, van der Maarel and Leertouwer 1967). The community web, representing the interlocking patterns among communities on the sandy dune, was described by introducing, numerically, the dissimilarity of communities based on species cover percentage (characteristic cover degree) similar to Malmer's (1962).

In Shonan the original flora and vegetation have been highly impoverished. Since 1928 a green belt, with mainly *Pinus thunbergii* (black pine), has been built up along the coastal roads for protecting residential areas against the severe coastal environment. There are many difficulties with maintenance of the green belt, however, because of the quantitative and qualitative lack of

* Contribution from the Department of Vegetation Science, Institute of Environmental Science and Technology, Yokohama National University, No. 180.

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(Accepted July, 6, 1985)

plant communities for suppressing sand movement on the forward part of the dune experimental plantation. As a result, the Miyawaki research group at Yokohama National University has conducted phytosociological research here since 1984 in order to create sound environmental protection forests on Shonan seashore. In this paper the emphasis is on study of Shonan vegetation dynamics.

In preparing this paper the authors are much indebted to the research members of the Institute of Environmental Science & Technology, Y.N.U., for their invaluable discussion and their constant encouragement. We especially wish to acknowledge with many thanks the help of Dr. K. Fujiwara in the field research. Prof. E.O. Box of the University of Georgia (U.S.A.) contributed constructive comments on the manuscript. We wish to thank him also.

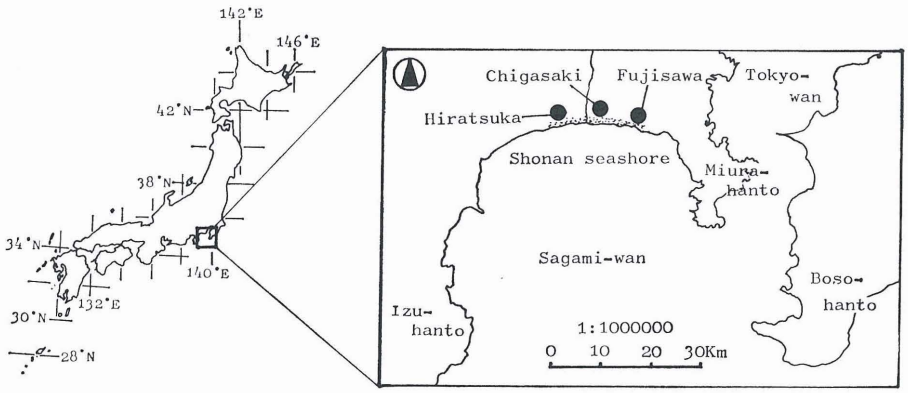

Fig. 1. The location of Shonan seashore in Kanagawa Prefecture.

Fig. 2. *Pinus thunbergii* afforestation established for protecting the hinterland against the severe coastal environment. Sandy beach is located on the left of the photo (Shonan seashore, Prefecture Kanagawa).

2. Description of the investigated area

The study area faces Sagami Bay and extends from the eastern part of the Miura Peninsula to the western part of the Izu Peninsula, 35°30′N, 139°41′E (Fig. 1). Shonan seashore is 14.29 km in length, with sandy beach and dunes. The 85.9 ha coastal dune, located 100 200 m from the shoreline, was planted mainly with *P. thunbergii* (black pine) for protecting the hinterland against the sea (Fig. 2).

The climate is warm-temperate. The mean annual temperature and the average annual precipitation are 15.5°C and 1759 mm, respectively. Winds are prevailingly northern in winter, southern in summer and southwestern in spring, with an average velocity of 4.1 m/sec.

The sand size of the dune is generally less than 2.0 mm. Nobuhara (1965) stated that the distribution of plant communities in the dune vegetation of the Tsujido area in Shonan seashore was determined by sand movement, especially from wind in winter. The increasing human impact, over the whole year but especially in summer, must also be an important influence on the distribution of plant communities on Shonan seashore.

3. Methods

3. 1. Table synthesis and mapping

After a first reconnaissance of the study area, all vegetation units were identified, recorded, and analyzed according to the Braun-Blanquet (1964) method. A total of 121 relevés (including 53 relevés on the dunes) was arranged in phytosociological tables based on the classical block structure-seeking handsorting method (Becking 1957, Ellenberg 1956). On this basis 21 communities (including 8 communities of sandy dunes) were identified.

The vegetation units identified were mapped at a scale of 1:10,000 (actual vegetation map) based on field surveys and air photos (Fig. 3, Miyawaki and Suzuki 1980).

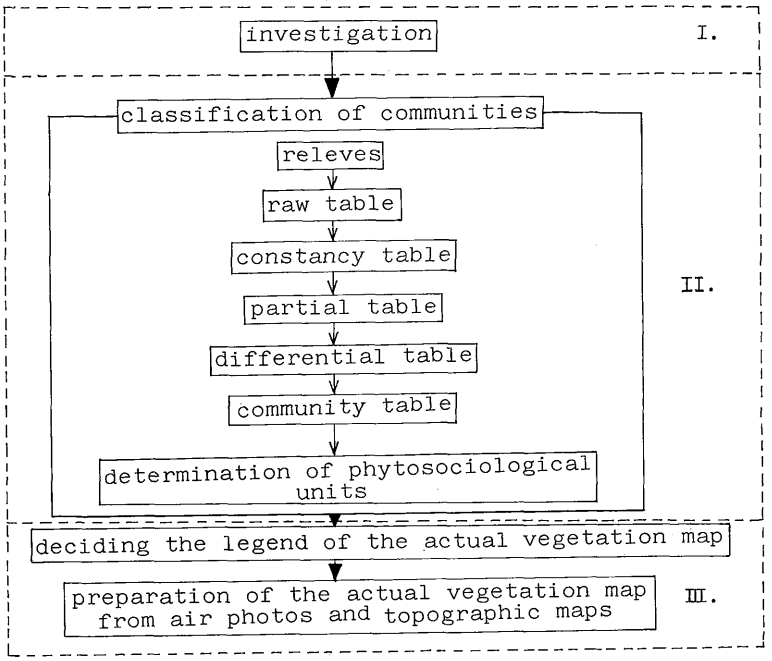

Fig. 3. Procedure for mapping actual vegetation.
I: Field works. II: Indoor works. III: Field and indoorwork.

3. 2. Dynamics of dune vegetation

The dune plant communities identified were compared using an index of dissimilarity (ID).

This index of dissimilarity between two communities is calculated as $ID=\sum|\sum Cn'/R'-\sum Cn''/R''|/N$, where $\sum Cn$ is the sum of the cover values of the species in the relevés belonging to each community (one unit), R is the sum of the relevé numbers arranged as a unit, and N is the sum of species occurring in two of the communities. The $\sum Cn/R$ values (Tab. 3) vary between 0 and 100, because Cn values are entered as 10, 20, 40, 60, 80 and 100, which +, 1, 2, 3, 4 and 5 are converted into respectively. $\sum Cn/R$ values are quite similar to the 'characteristic degree' of cover, C/f, proposed by Malmer (1962). Malmer's 'f' is the number of relevés including the species. In this paper 'R' is the total number of relevés belonging to the community. $\sum Cn/R$ is considered in the quantitative and qualitative analysis, which originates from $\sum Cn/f \times f/R$, where $\sum Cn/f$ means the coverage of species and f/R means the frequency of species (cf. Malmer, N., 1962) (van der Maarel et al. 1985).

To understand the distribution patterns of species and the community web on the dune, community ordination was done by calculation using the Pythagorean theorem. (For further imformation on ordinating vegetation data, see Mueller-Dombois and Ellenberg, 1974).

4. Results and discussion

4. 1. Plant community and actual vegetation map

Tables 1, 2, 6–13 show that most vegetation units are easily summarized in the form of synthesis tables, which constitute an objective method of checking the accumulated data for homogeneity and validity of component species. Phytosociological survey of plant communities and mapping of actual vegetation were conducted from July to November 1984.

A. Natural vegetation

1. Polysticho-Perseetum thunbergii Suz.-Tok. 1952

The Polysticho-Perseetum thunbergii occurred on the alluvial plain originating from the Sagami river. This association is found as small groves around houses.

2-1) Wedelio-Caricetum kobomugi Ohba, Miyawaki et Tx. 1973 (Tab. 1)

The Wedelio-Caricetum kobomugi, characterized by the dominant species *Carex kobomugi*, occurs on the forepart of the dune. The Wedelio-Caricetum kobomugi was destroyed by human sports activities such as surfing, fishing, cycling, sea bathing and strolling. Accordingly, *Wedelia prostrata*, the characteristic species of this association, is not found on Shonan seashore. *W. prostrata* is easily disturbed by human treading because its aerial stems creep along the ground.

This association is divided into 3 subassociations: a typical subassociation without differential species, a subassociation differentiated by *Ixeris repens*, and a subassociation differentiated by *Cuscuta australis*, a plant parasitic on *Calystegia solanella*.

2-2) Wedelio-Ischaemetum anthephoroidis Ohba, Miyawaki et Tx. 1973 (Tab. 1)

The Wedelio-Ischaemetum anthephoroidis occurs along the cycling road located in front of the *Pinus thunbergii* afforestation belt. This association is also strongly disturbed by human activities in the part of Shonan seashore studied. This association is characterized by *Ischaemo anthephoroidis* developing in patches.

2-3) Imperato cylindricae-Viticetum rotundifoliae Ohba, Miyawaki et Tx. 1973 (Tab. 1)

The Imperato cylindricae-Viticetum rotundifoliae is sometimes found in narrow openings in the *Pinus thunbergii* afforestation. The natural habitat of this association is planted with *P. thunbergii* widely.

The Imperato cylindricae-Viticetum rotundifoliae is characterized by *Imperata cylindrica* var. *koenigii* and the dominant dwarf-tree *Vitex rotundifolia*.

3-1) *Digitaria adscendens* community (Tab. 2)

The *Digitaria adscendens* community (differentiated by *Digitaria adscendens*) dominates mainly on disturbed areas in the region of potential natural Wedelio-Ischaemetum anthephoroidis and Wedelio-Caricetum kobomugi. This community is divided into subunits, a typical subunit with only *D. adscendens* and a *Cyperus rotundus* subunit differentiated by *C. rotundus*.

Tab. 1. Coastal dune vegetation on Shonan seashore.

Glehnietea littoralis
 Glehnietalia littoralis
  Caricion kobomugi
  A = Wedelio-Caricetum kobomugi
   1 = Typical subassociation
   2 = subass. of Ixeris repens
   3 = subass. of Cuscuta australis
  B = Wedelio-Ischaemetum anthephoroides

Viticetea rotundifoliae
 Viticetallia rotundifoliae
  Ischaemo-Viticion rotundifoliae
   C = Imperato cylindricae-Viticetum rotundifoliae

Unit:	A			B	C
	1	2	3		
Number of relevés(R):	12	3	2	6	2
Mean number of species:	3	4	4	6	10
Character & differential species of ass.:					
Carex kobomugi	V(+-5)	3(1-2)	2(+-5)	V(+-3)	1(+)
Differential species of subass.:					
Ixeris repens	.	3(+-3)	.	.	.
Cuscuta australis	.	.	2(+-4)	I(+)	.
Character & differential species of ass.:					
Ischaemum anthephoroides	.	.	.	V(4-5)	2(+)
Differential species of higher unit:					
Calystegia solanella	IV(+-4)	2(+)	2(+-1)	III(+-2)	.
Glehnia littoralis	.	.	.	I(+)	.
Lathyrus japonicus	.	.	.	I(1)	.
Character & differential species of ass.:					
Vitex rotundifolia	.	.	.	I(3)	2(4)
Imperata cylindrica var. koenigii	.	.	.	.	1(2)
Companions:					
Digitaria adscendens	III(+)	2(+)	1(1)	III(+-1)	1(+)
Cynodon dactylon	III(+-1)	.	1(+)	III(+)	1(+)
Oenothera laciniata	II(+)	.	.	IV(+-1)	1(+)
Salsola komarovii	I(+)	.	.	I(+)	1(+)
Artemisia princeps	I(+)	.	.	I(+)	.
Paederia scandens var. mairei	.	.	.	II(+)	1(1)
Diodia teres	.	.	.	I(+)	1(3)
Chenopodium album	.	.	.	I(+)	.
Portulaca oleracea	I(+)	.	.	.	.
Sonchus oleraceus	.	.	.	I(+)	.
Oxalis corniculata	.	.	.	I(+)	.
Lespedeza cuneata	.	.	.	.	1(+)
Cocculus orbiculatus	.	.	.	.	1(+)
Bidens pilosa	.	.	.	.	1(+)
Euonymus japonicus	.	.	.	.	1(+)

3-2) *Elymus mollis* community (Tab. 2)

The *Elymus mollis* community occurs just at the base of the protection net of the *P. thunbergii* afforestation, used as protection against wind. *E. mollis*, which differentiates the *E. mollis* community, is planted on the forepart of the dunes. The *E. mollis* community found at present, is mostly a remaining as well as spreading stand from the original planted areas on the Shonan seashore. The natural distribution of *E. mollis* is northern Japan, mainly Hokkaido and North Honshu (Ohba 1979, Tüxen 1966).

3-3) *Cynodon dactylon* community (Tab. 2)

The *Cynodon dactylon* community, dominated by *Cynodon dactylon*, is found extensively on

Tab. 2. Disturbed coastal dune vegetation on Shonan seashore.

1 = Elymus mollis community
2 = Cynodon dactylon community
3 = Digitaria adscendens community
a = Typical subunit
b = Subunit of Cyperus rotundus
4 = Diodia teres community

Unit:	1	2	3		4
			a	b	
Number of relevés(R):	3	7	4	2	3
Mean number of species:	7	4	8	7	5
Differential species of communities:					
Elymus mollis	3(5)	.	1(+)	1(+)	1(1)
Cynodon dactylon	3(+-1)	V(3-5)	1(+)	.	2(+-2)
Digitaria adscendens	.	III(+-2)	4(3-5)	2(+-1)	2(+)
Differential species of lower unit:					
Cyperus rotundus	.	.	.	2(4)	1(+)
Differential species of community:					
Diodia teres	.	.	2(+)	.	3(3-4)
Companions:					
Oenothera laciniata	1(+)	III(+)	3(+-3)	1(+)	2(+)
Carex kobomugi	1(+)	III(+)	1(+)	1(+)	2(+)
Calystegia soldanella	.	III(+-2)	2(+-1)	1(+)	1(+)
Artemisia princeps	2(+)	.	1(+)	.	.
Salsola komarovii	2(+)	I(+)	.	.	.
Chenopodium album	2(+)	.	3(+-2)	.	.
Eleusine indica	.	.	1(+)	1(+)	.
Oxalis corniculata	.	.	1(+)	.	.
Lespedeza cuneata	.	.	.	.	1(+)
Commelina communis	.	.	1(+)	.	.
Digitaria timorensis	.	1(+)	.	.	.
Gramineae sp.	.	1(+)	.	.	.
Luzula capitata	.	1(+)	.	.	.
Euphorbia supina	.	1(+)	.	.	.
Galium spurium f. strigosum	.	.	.	1(+)	.
Rumex acetosa	.	.	2(+)	.	.
Chenopodium ambrosioides	.	.	2(+)	.	.
Setaria glauca	.	.	1(+)	.	.
Eragrostis ferruginea	.	.	1(+)	.	.
Arthraxon hispidus	.	.	1(+)	.	.
Calystegia japonica	.	.	1(+)	.	.
Digitaria violascens	.	.	1(+)	.	.
Paederia scandens var. mairei	1(+)	.	.	.	.
Rosa wichuraiana	1(+)	.	.	.	.
Sporobolus fertilis	1(+)	.	.	.	.

trodden areas near both sides of the cycling road.

3-4) *Diodia teres* community (Tab. 2)

The *Diodia teres* community, differentiated by the exotic plant *Diodia teres*, occurs in the area of the Imperato cylindricae-Viticetum rotundifoliae, i. e. behind the *P. thunbergii* afforestation. This represents the stable part of the dunes.

4. *Phragmites australis* community (Tab. 10*)

The *Phragmites australis* community, which is differentiated by the dominant species *Phragmites australis*, has a limited development on tributaries of the Sagami river near Yanagishima. This

* Table 3 to 10 are shown in page 118 to 124.

community includes two subunits, an *Equisetum arvense-Commelina communis* subunit and a typical subunit.

5. Miscanthetum sacchariflori Miyawaki et Okuda 1972 (Tab. 3)

The Miscanthetum sacchariflori, which is characterized by the dominant species *Miscanthus sacchariflori*, is presented in three subassociations and two variants: a typical subassociation without characteristic species except *Miscanthus sacchariflori*, an *Arundinaria hirta-Lespedeza cuneata* subassociation with differential species *A. hirta* and *L. cuneata*, and an *Amphicarpaea trisperma-Humulus scandens* subassociation with differential species *Polygonum nodosum*, *P. thunbergii*, *Stellaria neglecta*, *A. trisperma* and *H. scandens;* plus a *Rosa multiflora-Metaplexis japonica* variant with differential species *R. multiflora*, *Achyranthes fauriei*, *Cardamine flexuosa*, *Rumex acetosa*, *Gramineae* sp. and *Metaplexis japonica*.

This association is developed along the Hanamizu river and branches of the Sagami river.

B. Substitute vegetation

6. *Pinus thunbergii* afforestation (Tab. 4)

The *Pinus thunbergii* afforestation planted with only *P. thunbergii*, occurs 100–200 m from the shoreline. Interestingly, the *P. thunbergii* afforestation community clearly reflects the floristic contrast between the dune and areas further inland. This community includes many inland species, such as *Celtis sinensis* var. *japonica*, *Parthenocissus tricuspidata*, *Ampelopsis brevipedunculata*, *Lonicera japonica* and *Ligustrum obtusifolium*, and evergreen *Ophiopogon ohwii* and *Fatsia japonica*.

7. *Euonymus japonicus-Pittosporum tobira* plantation mixed with *P. thunbergii* (Tab. 4)

The *Euonymus japonicus-Pittosporum tobira* plantation mixed with *P. thunbergii* occurs on the seaward side of the *P. thunbergii* afforestation. This plantation community characteristically consists of *Cyperus rotundus*, *Elymus mollis*, *Calystegia soldanella* and *Oenothera laciniata*, which ordinarily occur on the sandy dune.

8. *Robinia pseudo-acacia* afforestation

The leguminous tree *Robinia pseudo-acacia* occurs sporadically in the *P. thunbergii* afforestation. *Robinia pseudo-acacia* afforestations, are not found on Shonan seashore. The ground under *Robinia pseudo-acacia* often is covered by nitrophilous herbs.

9-1) Puerario lobatae—Humuletum japonici Miyawaki 1967 (Tab. 5)

The Puerario lobatae—Humuletum japonici is one of the representative associations among the Rosetea multiflorae. This association, which is characterized by *Artemisia princeps*, *Wisteria floribunda* and *Miscanthus sinensis*, is divided into the *Celastrus orbiculatus-Paederia scadens* subassociation and *Polygonum perfoliatum-Cayratia japonica* subass., from the viewpoint of phytosociological species composition.

9-2) *Lycium rhombifolium* community (Tab. 5)

The *Lycium rhombifolium* community is one of forest-edge shrubs. It is differentiated by the dominant species *Lycium rhombifolium*.

9-3) *Rubus trifidus* community (Tab. 5)

The *Rubus trifidus* community is also included in the Rosetea multiflorae. This community, differentiated by the nitrophilous *R. trifidus*, is found on the banks of the second stream in Tsujido of Shonan seashore.

10. Arundinario chino—Miscanthetum sinensis Miyawaki 1971 (Tab. 7)

The Arundinario chino—Miscanthetum sinensis is characterized by *Arundinaria chino* and *Miscanthus sinensis*. This association of Shonan seashore characteristically has many climbing plants such as *Paederia scandens* var. *mairei*, *Lonicera japonica*, *Polygonum sentigosum*, *Rosa wichuraiana* and *Desmodium mandshuricum*.

11. *Zoysia japonica* community (Tab. 6)

The weed vegetation, mainly on roadsides but also golf courses, is represented by the *Zoysia japonica* community, which is differentiated by dominant *Zoysia japonica*.

12-1) *Digitaria adscendens-Setaria glauca* community (Tab. 8)

The *Digitaria adscendens-Setaria glauca* community, which is differentiated by *D. adscendens*, *S. glauca*, *D. timorensis*, *Eleusine indica*, *Paspalum thunbergii* and *Lespedeza cuneata*, occurs on roadsides and newly built-up grounds.

12-2) *Erigeron canadensis-Artemisia princeps* community (Tab. 8)

The roadside weed vegetation is often represented by the *Erigeron canadensis-Artemisia princeps* community, which is differentiated by *Erigeron canadensis* and *Artemisia princeps*.

13-1) Eragrostio ferrugineae—Plantaginetum asiaticae Tx. 1977 (Tab. 7)

The Eragrostio ferrugineae—Plantaginetum asiaticae, which is characterized by *Eragrostis ferruginea*, *Plantago asiatica* and *Digitaria violascens*, is frequently found at the roads near the banks of the Hanamizu river.

13-2) Bryo—Saginetum japonicae Ohba 1971 (Tab. 7)

The Bryo—Saginetum japonicae, which is characterized by *Bryum argenteum* and *Sagina japonica*, often occurs in sidewalk gaps.

14. Pinellio ternatae—Euphorbietum pseudochamaesycis Miyawaki 1969 (Tab. 9)

Weed communities of cultivated fields are represented by the Pinellio ternatae—Euphorbietum pseudochamaesyis.

15. *Erigeron canadensis* community (Tab. 9)

The weeds of fallow fields are often represented on Shonan seashore by the *Erigeron canadensis* community.

C. Others

16. Residential areas with evergreen broad-leaved trees.
17. Residential areas planted mainly with *Pinus thunbergii*.
18. Residential areas with little green vegetation.
19. Industrial areas.
20. Newly built up areas.
21. Natural bare lands.
22. Open water areas.

4. 2. The dynamics of dune vegetation

1) Ordination and grouping of communities

Seven communities (Tab. 1, 2) occurring on the Shonan dune were compared pairwise by means of ID, an index of dissimilarity which takes into consideration the characteristic cover degree of species components of each community: $ID=\sum|\sum Cn'/R'-\sum Cn''/R''|/N$. The characteristic cover degree ($\sum Cn/R$) is shown in Table 11 and the index of dissimilarity within and between two communities under comparison in Table 12. The range of ID values (7.65～14.96) was not so wide because of the small area studied. Ordination values of seven communities, obtained by using the Pythagorean theorem, are presented in Table 13. The position of the seven communities in a two-dimensional ordination model is shown in Figure 4. X-axis and Y-axis are correlated with the index of dissimilarity among the communities under comparison. By means of the agglomerative ordination, each community was clearly divided into 4 groups. Group I is formed of only Wedelio—Caricetum kobomugi (under WC), with characteristic species *Carex kobomugi* occuring mainly on the forward part of the dune. Group II is formed of one association and three communities: Wedelio—Ischaemetum anthephoroidis (under WI) with characteristic species *Ischaemo anthephoroidis* distributed mainly along the middle part of the dune plus the *Cynodon dactylon* comm. (under Cd), *Digitaria adscendens* comm. (under Da) and *Diodia teres* comm. (under Dt), with differential species *Cynodon dactylon*, *Digitaria adscendens* and *Diodia teres*, respectively. Group III is formed of Imperato cylindricae—Viticetum rotundifoiae (under IV) with characteristic species *Vitex rotundifolia* and *Imperato cylindrica* var. *koenigii*. Group IV is formed of the *Elymus mollis* comm. (under Em) with planted *Elymus mollis* as differential species.

2) Distribution patterns of component species

Distribution patterns of several dune species, *C. kobomugi*, *C. soldanella*, *I. antheporoides*, *V. rotundifolia*, *E. mollis*, *D. teres*, *C. dactylon*, *D. adscendens*, *O. laciniata*, reflecting characteristic

Tab. 11. Characteristic cover degree of species components in seven communities on Shonan seashore arranged by the phytosocialogical method.

Symbol of community	W C	W I	I V	E m	C d	D a	D t
Number of releves	17	6	2	3	7	6	3
Total number of species	11	17	16	12	11	25	8
Carex kobomugi	64.6	16.7	5.0	-	7.1	3.3	6.7
Ischaemum anthephoroides	-	90.0	10.0	-	-	-	-
Vitex rotundifolia	-	10.0	80.0	-	-	-	-
Elymus mollis	-	-	25.0	100.0	1.4	3.3	6.7
Cynodon dactylon	4.7	5.0	5.0	13.3	85.7	1.7	16.7
Digitaria adscendens	5.3	6.7	5.0	10.0	11.4	58.3	6.7
Diodea teres	-	1.7	30.0	-	-	3.3	73.3
Calystegia soldanella	18.8	8.3	-	6.7	8.6	6.7	3.3
Cyperus rotundus	0.6	1.7	5.0	3.3	-	28.3	-
Oenothera laciniata	1.8	8.3	5.0	6.7	4.3	16.7	6.7
Artemisia princeps	0.6	1.7	-	6.7	-	1.7	-
Salsola komarovii	1.2	-	-	6.7	1.4	-	-
Paederia scandens var. mairei	-	5.0	10.0	3.3	-	-	-
Chenopodium album	-	1.7	-	6.7	-	10.0	-
Cuscuta australis	5.3	1.7	-	-	-	-	-
Oxalis corniculata	-	1.7	-	-	-	1.7	-
Lespedesa cuneata	-	-	5.0	-	-	-	3.3
Commelina communis	-	-	5.0	-	-	1.7	-
Sporobolus fertilis	-	-	-	3.3	-	1.7	-
Ixeris repens	7.6	-	-	-	-	-	-
Portulaca oleracea	0.6	-	-	-	-	-	-
Sonchus oleraceus	-	1.7	-	-	-	-	-
Glehnia littoralis	-	1.7	-	-	-	-	-
Lathyrus japonicus	-	3.3	-	-	-	-	-
Imperata cylindrica var. koenigii	-	-	20.0	-	-	-	-
Cocculus orbiculatus	-	-	5.0	-	-	-	-
Bidens pilosa	-	-	5.0	-	-	-	-
Euonymus japonicus	-	-	5.0	-	-	-	-
Rosa wichuraiana	-	-	-	3.3	-	-	-
Digitaria timorensis	-	-	-	-	1.4	-	-
Gramineae sp.	-	-	-	-	1.4	-	-
Luzula capitata	-	-	-	-	1.4	-	-
Euphorbia supina	-	-	-	-	1.4	-	-
Eleusine indica	-	-	-	-	-	3.3	-
Rumex acetosa	-	-	-	-	-	3.3	-
Chenopodium ambrosioides	-	-	-	-	-	3.3	-
Setaria glauca	-	-	-	-	-	1.7	-
Eragrostis ferruginea	-	-	-	-	-	1.7	-
Arthraxon hispidus	-	-	-	-	-	1.7	-
Calystegia japonica	-	-	-	-	-	1.7	-
Digitaria violascens	-	-	-	-	-	1.7	-
Galium spurium f. strigosum	-	-	-	-	-	1.7	-
Lamium purpureum	-	-	-	-	-	1.7	-
Hydrocotyle maritima	-	-	-	-	-	1.7	-
Geranium thunbergii	-	-	-	-	-	1.7	-

Remarks: WC=Wedelio—Caricetum kobomugi, WI=Wedelio—Ischaemetum anthephoroidis, IV=Imperato cylindricae—Viticetum rotundifoliae, Em=*Elymus mollis* community, Cd=*Cynodon dactylon* community, Da=*Digitaria adscendens* community, Dt=*Diodia teres* community.

cover degree, are shown in Figure 5. The species above for each group describes the tendency to be continuous or discontinuous. The species which can be named as the native species of the dune vegetation in this region, such as *Carex kobomugii, Calystegia soldanella, Ischaemum anthephoroidis* and *Vitex rotundifoliae*, occured discontinuously. Secondary species such as *Cynodon dactylon, Diodia teres, Digitaria adscendens* and *Oenothera laciniata* occured continuously. Even if each community is summarized in the form of synthesis tables, which constitute an objective method of checking the accumulated data for homogeneity and validity of component species. It will be suggested that these tendencies to continuity or discontinuity may have been caused by certain environmental factors, human and natural, on the sandy beach. Dune plant communities

Tab. 12. Matrix of indices of dissimilarity for the seven communities on Shonan seashore.

Symbol of community	WC	WI	IV	Em	Cd	Da	Dt
Number of relevés	17	6	2	3	7	6	3
Total number of species	11	17	16	12	11	25	8
Wedelio—Caricetum kobomugi (WI)		(8) 9.93	(5) 13.72	(7) 14.96	(7) 11.2	(7) 8.09	(5) 13.64
Wedelio—Ischaemetum anthephoroidis (WI)			(9) 12.30	(8) 12.85	(5) 9.98	(10) 7.65	(6) 12.6
Imperato cylindricae—Viticetum rotundifoliae (IV)				(6) 13.72	(5) 14.05	(8) 10.06	(9) 14.44
Elymus mollis community (Em)					(6) 13.03	(9) 8.92	(5) 14.67
Cynodon dactylon community (Cd)						(6) 7.7	(6) 13.13
Digitaria adscendens community (Da)							(7) 8.86
Diodia teres community (Dt)							

(—): Number of species commonly found in two communities under comparison.

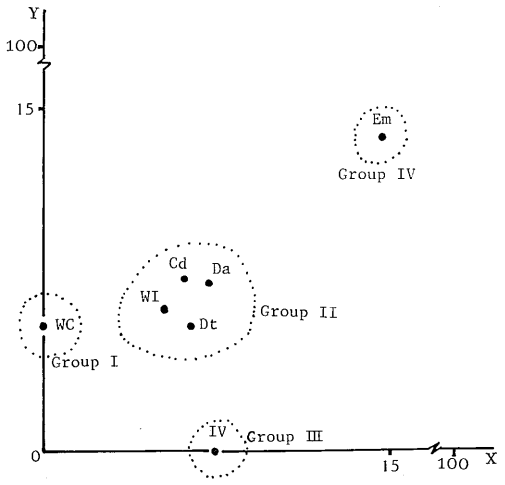

Fig. 4. Ordination of Y/X-values of the seven communities divided into 4 major groups arranged on Shonan seashore.

Tab. 13. Ordination values (X, Y) of seven communities on Shonan seashore.

Community	X	Y
W C	0	5.56
W I	5.27	6.36
I V	7.48	0
E m	14.96	13.72
C d	6.01	7.88
D a	7.01	7.65
D t	6.51	5.60

Remark: X.Y values can be obtained by calculation using the Pythagorean theorem.

under much human impact will often be composed mainly of species occurring continuously. On the other hand, *Elymus mollis*, a substitute species, presents a discontinuous pattern. This may be the reason why *Elymus mollis* is not only local species in this region but also is intentionally planted in restricted areas for suppressing sand movements.

The associations WC, WI and IV, mainly dominated by species occurring discontinuously, are found inland from the beach, representing a zonal distribution. However, the original patterns of zonation are changed here and there by heavy human impact (Fig. 6).

3) Community web and distributional characteristics of the communities

Figure 7 illustrates the community web of seven communities, as summarized from Table 12. The dissimilarity index computed for any two communities under comparison is divided into 5 levels: from most (14.96–13.49) to leaet (9.11–7.65) similar. A community web describes interlocking patterns among communities on closed habitats such as coastal dune vegetation. Potential natural communities, such as WC, WI and IV, are closely related to the Da community, as seen by lower dissimilarity value. The Da is very characteristic of roadsides, parking places and open spaces of residential areas. Therefore, it may be supposed that the studied areas are disturbed by human activities like treading, motor-cycling, fishing and so on. Figure 8 presents the interre-

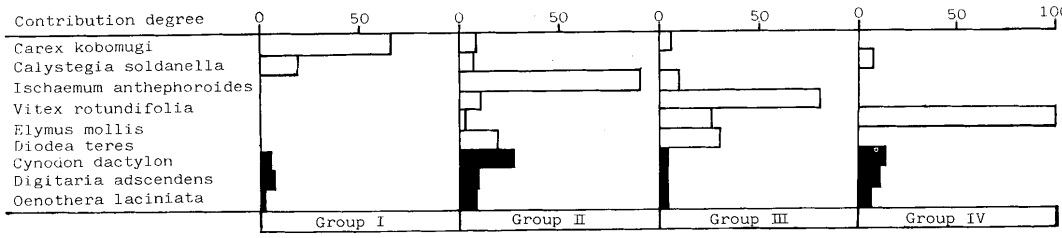

Fig. 5. Distributional patterns of the characteristic cover degree of several species in 4 groups in relation to X, Y values of each community.
Remarks: □ discontinuous pattern, ■ continuous pattern.

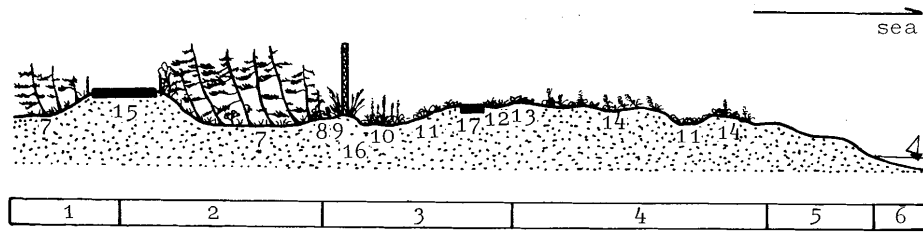

Fig. 6. Profile diagram of Shonan coastal vegetation, Pref. Kanagawa.

1. Region of Euonymo—Pittosporetum tobira
2. Region of Imperato cylindricae—Viticetum rotundifoliae
3. Region of Wedelio—Ischaemetum anthephoroidis
4. Region of Wedelio—Caricetum kobomugi
5. Beach
6. Sea
7. *Pinus thunbergii* afforestation
8. *Vitex rotundifoliae*
9. *Elymus mollis*
10. *Ischemum anthephoroidis*
11. *Digitaria adsendens*
12. *Cynodon dactylon*
13. *Calystegia soldanella*
14. *Carix kobomugi*
15. Highway
16. Protection net against wind
17. Cycling road

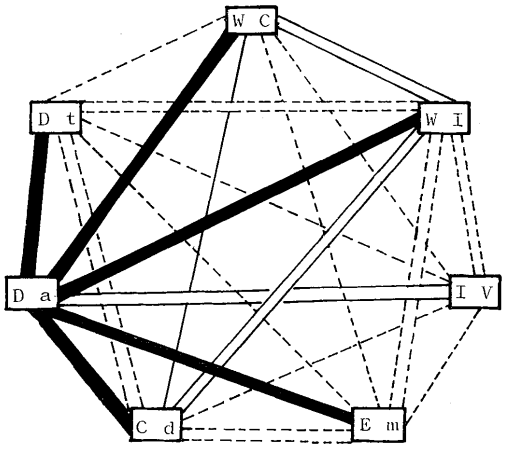

Fig. 7. Community web representing dissimilarity between communities of Shonan dune vegetation. The single and double broken line, the single and double fine line, and the bold line indicate dissimilarity levels of 14.96-13.49, 13.49-12.03, 12.03-10.57, 10.57-9.11 and 9.11-7.65, respectively.

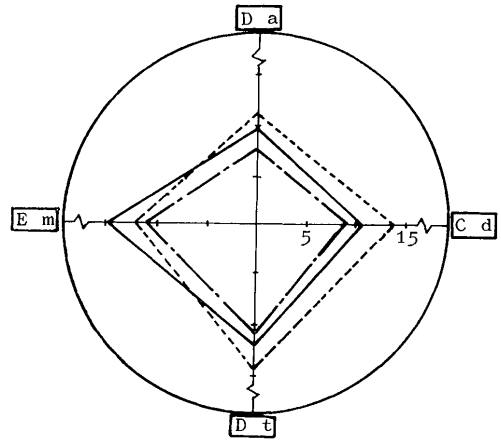

Fig. 8. The interrelation of seven communites of Shonan dune vegetation represented by the index of dissimilarity (ID).
Remarks:—Wedelio—Caricetum kobomugi
-·-Wedelio—Ischemetum anthephoroidis
- - -Imperato cylindricae—Viticetum rotundifoliae

lations of seven communities on th duene vegetation, as modified by the index of dissimilarity (ID; Tab. 12) which was derived from the characteristic cover degree of component species. As seen from Figure 8, the following context will be suggested: (1) WI, with the smallest dissimilarity index (compared with WC and IV), had the closest relationship to the substitute communities Da, Cd, Dt and Em. This close relationship between WI and 4 substitute communities may be the reason why the cycling road was established in the WI region on the middle of the dune. (2) IV, with the biggest dissimilarity index (contrasting with WC and WI), is the least related to the 4 substitute communities. This is the reason why the region of IV 's distribution was used for the afforestation belt with *Pinus thunbergii* for protection against the severe coastal environment. IV is distributed mainly in the open space of this afforestation area.

5. Summary

This paper has reviewed mapping and classification of Shonan vegetation under heavy human impact. The dune vegetation of Shonan seashore has been subjected to ordination and grouping of communities, and the distribution patterns of some species have been explained through the characteristic cover degree in addition to the interrelation between distributional patterns of communities and their environment.

(1) The actual vegetation in Shonan area was classified into 24 vegetation units. It was very difficult to find natural vegetation in Shonan area.

(2) The map of actual vegetation, at a scale of 1:10,000, was accomplished with 22 units to show the distribution of plant communities in Shonan area.

(3) Three associations and 4 communities were identified in the dune vegetation of Shonan seashore: Wedelio—Caricetum kobomugi (WC), Wedelio—Ischaemetum anthephoroidis (WI), Imperato cylindricae—Viticetum rotundifoiae (IV), plus the *Digitaria adscendens* community (Da), *Cynodon dactylon* community (Cd), *Diodia teres* community (Dt) and *Elymus mollis* community (Em). Three associations were recognized phytosociologically as native vegetation, and 4 communities as substitute or secondary vegetation on this dune.

(4) Dune vegetation could be divided into 4 vegetation regions (4 groups) through the index of dissimilarity (ID, $ID=\sum|\sum C'n/R'-\sum C''/R''|/N$), based on characteristic cover degree ($\sum Cn/R$) of component species, between communities under comparison. Group-I consisted of only WC, group-II of WI, Da, Cd and Dt, group-III of only IV, and group-IV of only Em.

(5) Distribution patterns of some species were determined on the dune vegetation. Main component species of the native vegetation, such as *Carex kobomugi*, *Calystegia soldanella*, *Ischaemum anthephoroidis* and *Vitex rotundifoliae*, were discontinuous. The secondary species *Cynodon dactylon*, *Digitaria adscendens* and *Oenothera laciniata* were shown to have continuous cover patterns. *Elymus mollis* occured discontinuously, however, though being a substitute species at Shonan. *E. mollis* was planted additionally in some areas of the dune.

(6) The community web was described for understanding the interlocking patterns among communities. This showed that the *Digitaria adscendens* community (one of the trodden communities) has the closest relationship to all other communities on the dune, due to heavy human impact like treading.

(7) The most disturbed vegetation on the dune is the Wedelio—Ischaemetum anthephoidis.

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Tab. 3. Miscanthetum sacchariflori (1) Typical subassociation, (2) *Arundinaria* hirta subass., (3) Amphicarpaea trisperma-Humulus scandens Subass.

Lfd.Nr.:	1	2	3	4	5	6	7	8
Feld-Mr.:	SN	SN	SN	SN	-	SN	-	-
	74	59	77	78	5	56	-	-
Datum d. aufnahme:	'84	'84	'84	'84	'75	'84	'74	'74
	110	10	10	10	10	10	9	9
	5	5	5	5	5	5	5	5
Größe d. Probefläche(m^2):	6	9	10	4	25	6	-	-
Höhe d. Vegetation(m):	2	2	2	2	2.5	1.5	-	-
Deckung d. Vegetation(%):	90	90	90	90	90	85	-	-
Zahl d. Aufnahme:	-	-	-	-	-	-	3	7
Artenzahl(Mittlere Artenzahl):	9	10	11	8	10	11	(17)	(9)
Kenn-u. Trennarten d. Ass.:								
Miscanthus sacchariflorus	5·4	5·5	5·5	5·5	5·3	4·4	3(3-5)	V(3-5)
Arundinaria hirta	·	·	(2·2)	+	+·2	·	·	·
Lespedeza cuneata	·	·	+·2	+	1·2	·	·	·
Polygonum nodosum	·	·	·	·	·	+	1(+)	I(+)
Polygonum thunbergii	·	·	·	·	+	+·2	·	I(+)
Stellaria neglecta	·	·	·	·	·	+·2	2(+)	·
Amphicarpaea Trisperma	·	·	·	+	·	+·2	·	I(+)
Humulus scandens	+.2	·	·	·	·	·	3(+)	V(+-1)
Rosa multiflora	·	·	·	·	·	·	3(+-1)	II(+-2)
Achyranthes fauriei	·	·	·	·	·	·	1(+)	II(+-1)
Cardamine flexuosa	·	·	·	·	·	·	3(+)	II(+)
Gramineae sp.	·	·	·	·	·	·	2(+)	II(+)
Rumex acetosa	·	·	·	·	·	·	1(+)	II(+)
Metaplexis japonica	·	·	·	·	·	·	1(+)	I(+)
Begleiter:								
Artemisia princeps	+	+:2	+·2	+·2	·	(+)	2(+)	II(+)
Commelina communis	2·2	+·2	+	·	+	+·2	·	II(+)
Equisetum arvense	3·3	1·2	·	1·2	+	2·3	·	I(+)
Paederia scandens ver. mairei	·	1·2	+	·	+	·	2(+-1)	V(+)
Cayratia japonica	·	+	·	·	+	+·2	1(+)	IV(+-1)
Miscathus sinensis	+·2	+·2	+	+	·	·	·	·
Calystegia japonica	+	+	·	·	·	+·2	1(+)	·
Phragmites australis	·	·	·	1·2	·	·	1(+)	·

Außerdem je einmal in Lfd.Nr.1: Clinopodium gracile +, Rumex japonicus +·2, in 2:Erigeron sumatrensis +, Setaria viridis +:2, in 3: Polygonum cuspidatum +, Pueraria lobata +, Phryma leptoatashya var. asiatica +, Arthraxon hispidus +.2, in 5: Panicum bisclcatum +.2, Salix integra +, in 6: Solidago altissima +, in 7: Lycium rhombifolium 3(+), Stellaria aquitica 3(+), Bidens frondosa 2(+), Raphanus sativus var. hortensis 2(+), Digitaria adscendens 1(+),Erigeron canadensis 1(+), Cucumis sativus var. tuberculatus 1(+), in 8: Polygonum perfoliatum II(+-3), Dioscorea japonica I(+), Melothria japonica I(+), Lactuca indica var. laciniata I(+), Sicyos angulatus I(+), Rubia akane I(+), Oenanthe javanica I(+), Euonymus japonicus I(+), Xanthium strumarium I(+),

Lage d. Aufn. in Lfd. Nr. 1: Stadt Hiratsuka, Hanamizu, 2-4,6: Stadt Chigasaki, Yanagishima, 5: Stadt Hiratsuka, 7,8: Stadt Chigasaki.

Nachweis der Vegetationsaufnahme in Lfd. Nr.5: Miyawaki et al 1979(Tab.12), 8 : Miyawaki et al 1976(Tab.10).

Tab. 4. Coastal afforestation on Shonan seashore
1 = *Euonymus japonicus-Pittosporum tobira*-plantation
2 = *Pinus thunbergii*-plantation

Unit:	1	2
Number of relevés (R):	4	5
Mean number of species:	23	26
Planting species:		
Pinus thunbergii	3(1-3)	V(4-5)
Euonymus japonicus	2(2-3)	IV(+)
Pittosporum tobira	4(1-4)	V(+-3)
Differential species of lower comm.:		
Cyperus rotundus	4(+)	.
Digitaria adscendens	4(+-1)	.
Calystegia soldanella	3(+)	.
Oenothera laciniata	3(+)	.
Lonicera japonica	1(2)	V(1-3)
Celtis sinensis var. japonica	1(+)	V(+-2)
Parthenocissus tricuspidata	.	V(+)
Ophiopogon ohwii	.	V(+-4)
Fatsia japonica	.	V(+-1)
Ligustrum obtusifolium	1(+)	V(+-1)
Ampelopsis brevipedunculata	1(+)	IV(+-1)
Cocculus orbiculatus	1(+)	IV(+-1)
Companions:		
Paederia scandens var. mairei	4(+-1)	V(+-3)
Miscanthus sinensis	4(+)	V(+)
Ligustrum japonicum	2(1-2)	V(+-3)
Commelina communis	2(+-2)	V(+-4)
Artemisia princeps	4(+-2)	III(+-1)
Rosa multiflora	2(+-1)	IV(+-3)
Oxalis corniculata	3(+-2)	III(+)
Rosa wichuraiana	3(+)	II(+)
Erigeron sumatrensis	4(+)	II(+)
Oplismenus undulatifolius	1(+)	III(2)
Ilex crenata	2(+)	II(+)
Sonchus oleraceus	3(+)	I(+)
Oenothera biennis	2(+)	I(+)
Bidens biternata	2(+-1)	I(+)
Bidens pilosa	1(+)	II(+)
Morus bombycis	1(+)	II(+-1)
Vitis ficifolia var. lobata	1(+)	II(+-3)
Polygonum senticosum	1(+)	II(+)
Rumex acetosa	2(+)	I(+)
Achyranthes japonica	1(+)	I(+)
Dioscorea japonica	1(+)	II(+-2)
Cayratia japonica	1(+)	I(+)
Arundinella hirta	1(+)	I(+)
Robinia pseudoacacia	1(+)	I(2)
Ixeris dentata	1(+)	I(+)
Liriope minor	1(+)	I(+)
etc.		

Tab. 5. Puerario lobatae—Humuletum japonici (1): a— *Celastrus orbiculatus-Paederia scandens*, b— *Polygonum perfoliatum-Cayratia japonica* subass., *Rubus trifidis* community (2), *Lycium rhombifolium* community (3).

Spalte:	1						2	3
	a			b				
Lfd. Nr.:	1	2	3	4	5	6	7	8
Feld-Nr.:	SN 68	SN 69	SN 67	SN 49	SN 48	SN 109	SN 36	SN 209
Datum d. Aufn.('85):	10 5	10 5	10 5	10 5	10 5	10 15	10 3	11 14
Größe d. Probefläche(m^2):	4	6	9	1	9	4	4	8
Exposition:	-	-	-	-	-	SE	-	S
Neigung(°):	-	-	-	-	-	15	-	30
Höhe d. Vegetation(m):	2	3	0.5	1	1.5	0.4	0.5	0.5
Deckung d. Vegetation(%):	100	80	100	100	100	100	70	90
Artenzahl:	11	9	7	5	17	6	9	10
Trennarten d. Gesellschaft:								
Artemisia princeps	1•2	•	+•2	+	+•2	+•2	•	1•2
Pueraria lobata	+	4•4	5•5	•	5•5	•	•	•
Miscanthus sinensis	5•5	2•2	1•2	•	+•2	•	•	+
Paederia scandens	+	+	+	•	•	•	•	1•2
Ampelopsis brevipedunculata var.	+•2	3•3	•	•	•	•	•	•
Celastrus orbiculatus	+•2	2•2	•	•	•	•	•	•
Arundinella hirta	1•2	+	•	•	•	•	•	•
Polygonum perfoliatum	•	•	•	2•3	1•2	5•5	•	•
Cayratia japonica	•	•	•	1•2	2•2	+•2	2•3	•
Humulus scandens	•	•	•	5•5	1•2	•	2•2	•
Trennarten d. Gesellschaft:								
Rubus trifidus	•	•	•	•	•	•	4•4	•
Trennarten d. Gesellschaft:								
Lycium rhombifolium	•	•	•	•	•	•	•	5•4
Begleiter:								
Commelina communis	•	1•2	+•2	+	(+)	•	1•2	•
Phryma leptostachya var.asiatica	•	•	+•2	•	+	•	•	•
Bidens pilosa	•	•	•	•	+	1•2	•	•
Polygonum nodosum	•	•	•	•	+	+	•	•
Erigeron sumatrensis	•	•	+•2	•	•	+•2	•	•
Equisetum arvense	+•2	•	•	•	•	•	2•2	•
Rosa multiflora	•	+•2	•	•	•	•	•	+•2

Außerdem je eimal in Lfd. Nr. 1: Erigeron annuus +•2, Artemisia japonica +•2, Calystegia japonica +, in 2: Dioscorea japonica +•2, in 5: Albizia julibrissin +•2, Erigeron canadensis +, Amphicarpaea triseerma +•2, Pteridium aquilinum var. latiusculum +, Oenothera stricta +, Bedens frondosa 1•2, Xanthium strumarium +, in 7: Diodia teres +, Setaria glauca +, Houttuynia cordata +, Phragmites australis +, in 8: Setaria viridis +, Lonicera japonica +•2, Achyranthes japonica +, Cocculus orbiculatus +•2, Digitaria adscendens +.

Lage d. Aufn. in Lfd. Nr. 1-3: Stadt Hiratsuka, Higashi-cho, 4.5: Stadt Chigasaki, Yanagishima, 6: Stadt Chigasaki, Hanamizudai, 7: Stadt Hiratsuka, 7: Stadt Chigasaki, Shiomidai, 8: Stadt Hiratsuka, Hanamizudai.

Tab. 6. *Zoysia japonica* community (1),
Arundinario chino—Miscanthetum sinensis (2).

Spalte:	1			2
Lfd. Nr.:	1	2	3	4
Feld-Nr.:	SN	SN	SN	SN
	60	24	100	38
Datum d. Aufn.('84):	10	10	10	10
	5	3	15	3
Größe d. Probefläche(m^2):	1	1	1	4
Höhe d. Vegetation(cm):	18	5	10	210
Deckung d. Vegetation(%):	90	95	85	95
Artenzahl:	4	4	6	15
Trennarten d. Gesellschaft:				
Zoysia japonica	5•5	5•5	4•2	•
Miscanthus sinensis	•	•	•	2•3
Arundinaria chino	•	•	•	4•2
Begleiter:				
Digitaria violascens	+•2	+	•	•
Digitaria timorensis	2•2	•	2•2	•
Liriope minor	•	+	+	•

Außerdem je einmal in Lfd.Nr. 1: Lespedeza cuneata +, in 2: Poa annua +, in 3: Cynodon dactylon +•2, Digitaria adscendens +•2, Eleusine indica 1•2, in 4: Artemisia priceps +•2, Erigeron sumatrensis +, Erigeron philadelphicus +•2, Paederia scandens +•2, Chenopodium album +, Lonicera japonica 1•2, Polygonum senticosum +•2, Oxalis corniculata +•2, Galium spurium f. strigosum +, Rosa wichuraiana +•2, Desmodium mandshuricum +•2, Equisetum arvense +, Commelina communis (+).
Lage d. Aufn. in Lfd. Nr.1: Stadt Hiratsuka,Sodegahama, 2: Stadt Chigasaki, Shirohama-cho, 3: Stadt Hiratsuka, Takahama-cho,4: Stadt Chigasaki, Midorigahama.

Tab. 7. Bryo—Saginetum jaonicae(1),
Eragostio ferrungineaginea—Plantaginetum asiaticae (2).

Spalte:	1			2									
Lfd. Nr.:	1	2	3	4	5	6	7	8	9	10	11	12	13
Feld-Nr.:	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN	SN
	200	201	202	54	28	53	52	50	51	74	41	40	29
Datum d. Aufn.('84):	11	11	11	10	10	10	10	10	10	10	10	10	10
	14	14	14	5	3	5	5	5	5	5	3	3	3
Größe d. Probefläche(m^2):	0.05	0.04	0.04	1.5	3	0.5	0.5	2	1	4	1	1	2
Höhe d. Vegetation(m):	0.01	0.05	0.03	0.3	0.35	0.4	0.2	0.35	0.5	0.5	0.15	0.15	0.2
Deckung d. Vegetation(%):	40	70	50	90	85	85	100	85	90	85	80	80	80
Artenzahl:	3	4	5	5	6	3	5	6	5	6	5	7	7
Kenn-v. Trennarten d. Ass.:													
Bryum argenteum	3.3	4•4	3•3	•	•	•	•	•	•	•	•	•	•
Sagina japonica	2•3	1•2	1•2	•	•	•	•	•	•	•	•	•	•
Kenn-u. Trennarten d. Ass.:													
Plantago asiatica	+	•	•	5•5	(+)	4•4	+•2	1•2	+•2	3•3	5•4	4•4	1•2
Digitaria violascens	•	•	•	+	+•2	•	•	+•2	•	+•2	3•2	2•3	4•4
Eragrostis ferrunginea	•	•	•	•	5•4	•	+	+•2	5•5	5•5	•	•	(+)
Polygonum aviculae	•	•	•	•	•	2•2	5•5	5•4	+	•	•	•	•
Trifolium repens	•	•	•	•	•	•	•	•	•	1•2	2•2	+•2	+
Lespedeza cuneata	•	•	•	•	•	•	•	•	+	•	•		+•2
Traxacum officinale	•	•	•	•	•	•	•	•	•	•	+	(+)	•
Begleiter:													
Eleusine indica	•	•	+•2	+	•	3•3	•	+	•	+	•	•	•
Cynodon dactylon	•	•	•	+	+•2	•	+•2	•	•	•	•	•	2•2
Digitaria timorensis	•	•	•	•	2•2	•	+	•	•	•	•	•	•
Juncus tenuis	•	•	•	•	1•2	•	•	•	•	•	•	•	2•3

Außerdem je einmal in Lfd. Nr.2: Poa annua 2•3, Stellaria media +, in 3: Athraxon hispidus +•2, Oxalis corniculata +, in 4: Carex incisa +•2, in 8: Rumex acetosa (+), in 9: Pennisetum alopecuroides +•2, in 10: Setaria glauca +, in 11: Paspalum thunbergii 1•2, in 12: Hydrocotyle maritima 1•2, Kyllinga gracillima +•2.
Lage d. Aufn. in Lfd. Nr. 1-3: Stadt Hiratsuka, Oiso, 4,6-9: Stadt Chigasaki, Yanagishima, 5,13: Stadt Chigasaki, Hamasuka, 12: Stadt Hiratsuka, Hanamizu, 11,12: Stadt Hiratsuka, Ttsujido.

Tab. 8. *Digitaria adscendens-Setaria glauca* community (1), *Erigeron canadensis-Artemisia princeps* community (2).

Spalte:	1		2			
Lfd. Nr.:	1	2	3	4	5	6
Feld-Nr.:	SN 47	SN 66	SN 57	SN 110	SN 111	SN 26
Datum d. Aufn.('84):	10 5	10 5	10 5	10 15	10 15	10 3
Größe d. Probefläche(m^2):	4	6	9	6	9	9
Höhe d. Vegetation(m):	0.5	0.6	1	1	1.8	1.8
Deckung d. Vegetation(%):	80	60	90	100	90	70
Neigung(°):	-	-	-	10	30	-
Exposition:	-	-	-	W	W	-
Artenzahl:	18	18	13	9	14	12
Trennarten d. Gesellschaft:						
Digitaria adscendens	4•4	1•2	•	•	+	•
Digitaria timorensis	+•2	+•2	•	•	+	•
Lespedesa cuneata	+	2•2	•	•	•	+•2
Eleusine indica	+•2	1•2	•	•	•	•
Paspalum thunbergii	1•2	1•2	•	•	•	•
Setaria glauca	2•3	2•3	1•2	•	•	•
Erigeron canadensis	•	•	5•5	+•2	5•5	+•2
Artemisia princeps	•	+	+•2	+•2	+	+•2
Erigeron sumatrensis	•	•	+	+	•	+•2
Oenothera biennis	•	•	•	+	•	1•2
Miscanthus sinensis	•	•	•	+	•	4•4
Bidens pilosa	•	•	•	•	+•2	+
Oenothera laciniata	•	•	•	•	+	1•2
Begleiter:						
Setaria viridis	+•2	+•2	+•2	+•2	+•2	•
Echinochloa crus-galli	+	+	+	•	+	•
Commelina communis	+	•	•	•	+•2	•
Taraxacum officinale	+	•	+•2	•	•	•
Cayratia japonica	+	•	•	1•2	•	•
Plantago asiatica	•	+	+	•	•	•
Polygonum longisetum	•	•	+	•	+•2	•
Arthraxon hispidus	+	+	+	•	•	•
Setaria faberi	•	1•2	•	•	+	•

Außerdem je einmal in Lfd. Nr. 1: Paederia scandens var. mairei +, Sonchus oleraceus +, Euisetum arvense +, Justicia procumbens var. leucanta +, Dioscorea tokoro +, Rorippa indica +, in 2: Polygonum yokusaianum 1•2, Arundinella hirta +, Digitaria violascens 2•3, Trifolium repens +, Euphorbia supina +•2, Eragrostis ferruginea +, in 4: Polygonum nodosum +, Calystegia japonica +, Humulus scandens +, in 5: Glycine soja 5•5, Galium verum var. asiaticum +, in 6: Pueraria lobata +•2, Bidens frondosa +, Chenopodium ambrosioides 1•2, in 7: Erigeron philadephicus +, Diodia teres 3•3, Lathyrus japonicus +.
Lage d. Auf. in Lfd. Nr.1,4: Stadt Chigasaki, Yanagishima, 2: Stadt Hiratsuka, Higashi-cho, 3,5,6: Stadt Chigasati, Hamamae, 7: Stadt Chigasaki, Hamaska.

Tab. 9. *Erigeron canadensis* community (1) and Pinellio ternatae—Euphrbietum pseudochamaesycis (2).

Tab.13. Erigeron canadensis community(1) and Pinellia ternata-Euphorbia pseudochamaesyce-association(2).

Spalte:	1	2	
Lfd. Nr.:	1	2	3
Feld-Nr.:	SN	-	-
	108	-	-
Größe d. Probefläche(m^2):	12	-	-
Höhe d. Vegetation(m):	1.8	-	-
Deckung d. Vegetation(%):	90	-	-
Zahl d. Aufn.:	-	6	2
Mittlere Artenzahl(Artenzahl):	(2)	19	25
Kenn.-u. Trennarten d. Ass.:			
Erigeron canadensis	5·5	·	(1(+)
Kenn.-u. Trennarten d. Ass.:			
u. höheren Einheiten:			
Digitaria adscendens	+·2	V(+-5)	2(+-2)
Cyperus microiria	·	V(+-2)	2(+)
Portulaca oleracea	·	III(+)	2(+-2)
Polygonum longisetum	·	III(+-3)	1(+)
Oxalis corniculata	·	III(+)	2(+-2)
Echinochloa crus-galli	·	III(+)	1(+)
Acalypha australis	·	III(+)	1(+)
Chenopodium album	·	III(+-1)	1(+)
Euphorbia pseudochamaesyce	·	II(+)	1(+)
Lamium amplexicauls	·	II(+-1)	1(+)
Mallugo pentaphylla	·	II(+-1)	2(+)
Amaranthus lividus	·	V(+-2)	·
Stellaria neglecta	·	III(+-2)	·
Veronica persica	·	III(+-1)	·
Setaria viridis	·	II(+)	·
Commelina communis	·	II(+)	·
Senecio vulgaris	·	II(+)	·
Eleusine indica	·	II(+)	·
Cyperus iria	·	·	1(+)
Chenopodium ficifolium	·	·	1(+)
Begleiter:			
Equisetum arvense	·	V(+-1)	2(+-1)
Erigeron sumatrensis	·	I(+)	1(+)
Poa annua	·	I(+)	2(+)
Mazus japonicus	·	I(+)	1(+)
Kulturpflanzen:			
Raphanus sativus	·	II(+)	1(+)
Allium fistulosum	·	I(+)	1(+)
Solanum tuberosum	·	I(+)	·
Brassica oleracea	·	I(4)	·
Lycopersicon esculentum	·	I(+)	·
Citrus unshiu	·	I(3)	·
Brassica campestris	·	·	1(4)
Daucus carota	·	·	1(+)

Lage d. Aufn. in Lfd.Nr.1: Stadt Chigasaki, Mamamae('84.Oct.15)
2: Stadt Hiratsuka, 3: Stadt Chigasaki.

Arten, welche nur an einem Ort aufgefunden worden sind, werden nicht aufgefihrt.
Nachweis der vegetationsaufnahme in Lfd. Nr.2: Miyawaki et al 1976(Tab.32),3: Miyawaki et al 1976(Tab.34).

Tab. 10. *Phragmites australis* community.

Lfd.Nr.:	1	2	3	4
Feld-Nr.:	-	-	SN	-
	2	-	37	-
Datum d. Aufn.:	'75	'76	'84	'83
	10	-	10	-
	5	-	3	-
Größe d. Probeflähe(m^2):	25	-	4	-
Höhe d. Vegetation(m):	1.8	-	2.5	-
Deckung d. Vegetation(%):	95	-	80	-
Zahl d Aufn.:	-	3	-	3
Artenzahl(Mittlere Artenzahl):	1	(3)	9	(11)
Trennarten d. Gesellschaft:				
Phragmites australis	5•5	3(4-5)	4•4	3(3-4)
Equisetum arvense	•	•	1•2	3(3-5)
Commelina communis	•	•	+	1(+)
Begleiter:				
Oenanthe javanica	•	1(2)	•	3(2-4)

Außerdem je einmal in Lfd. Nr.2: Rosa multiflora 1(+), Gramineae sp. 2(+), Circaea erubescens 1(+), Stellaria alsine var. undulata 1(+), Ranunculus quelpaertensis var. glaber 1(+), in 3: Polygonum thunbergii 3(1), Phalaris arundinacea 1(2), Leersia sayanuka 1(+), Cardamine flexuosa 3(+), Lythrum anceps 1(1), Arenaria serph serpyllifolia 1(+), Galium spurium f. strigosum 1(+), Ampelopsis brevipedunculata 1(+), Agropyron racemiferum 1(1), Scirpus triqueter 1(2), Polygonum sieboldii 1(+), Veronica arvensis 1(+), in 4: Rumex japonicus 1•2, Echinochloa crus-galli 1•2, Humulus scandens 2•2, Paederia scandens var. mairei +, Lonicera japonica +•2, Rumex acetosa +.

Lage d. Aufn. in Lfd. Nr.1: Stadt Hiratsuka, 2:Stadt Chigasaki, 3: Stadt Chigasaki, Shiomidai, 4: Staft Fujisawa.

Nachweis der Vegetationsaufnahme in Lfd. Nr.1: Miyawaki et al 1976(Tab.12), 2: Miyawaki et al 1976 (Tab.12), 4: Miyawaki et al 1984 (Tab.30).