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Vegetation of Northwestern Kitakyushu City and Adjacent Areas

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Abstract: The phytosociological study on vegetation was done in northwestern Kitakyushu City and its vicinities. Kitakyushu City is located in the northern region of Fukuoka Prefecture. The following 13 associations or communities were identified and described. Natural forests were as follows; (1) Euonymo-Pittosporetum tobirae, (2) Cyrtomio-Litseetum japonicae, (3) *Aphananthe aspera* Community, (4) Arisaemeto ringentis-Machiletum (Perseetum) thunbergii, (5) Symploco glaucae-Castanopsietum sieboldii, (6) *Carpinus tschonoskii-Castanopsis cuspidata* var. *sieboldii* Community, (7) Distylio-Cyclobalanopsietum, (8) Skimmio-Quercetum acutae. Substitutional forests and afforestations were (9) *Castanopsis* coppice forest, (10) *Pinus thunbergii* afforestation, (13) *Phyllostachys heterocycla* var. *pubescens* afforestation. The number of character species in some associations we studied was fewer than the same ones found in Nagasaki Prefecture, western Kyushu. The standing vegetation map was drawn on the scale of 1:50,000. Small natural forests were remained on particular sites. Secondary forests and afforestations of *Cryptomeria japonica* and *Chamaecyparis obtusa* were distributed widely on hills and mountains. The ranges of forests have been contracted by the expansion of urban districts and orchards. Urban and industrial areas were the most predominant landscapes in the study area.

Key words: vegetation, simplification of association, Kitakyushu City.

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Introduction

Changes in the natural environment brought about by human activities have been particularly noticeable in the last ten years in Japan. Kitakyushu City is one of the areas where these changes are very apparent.

In the first report (Itow *et al.*, 1981), the aim of our vegetation studies were mentioned and an outline of the environment, actual and original vegetations in the study area was described. As a extension of that study, we (Itow *et al.*, 1984) ordinated the major forest vegetations by a resiplocal averaging method (RA) and pointed out the following three gradients of vegetation. They were the gradients (1) from the *Quercus serrata*-dominated forest to the *Machilus thunbergii*- or *Aphananthe aspera*-dominated forest, (2) from the *Quercus*- to the *Castanopsis cuspidata*-dominated forest, and (3) from the *Aphananthe*- or the *Machilus*- to the *Castanopsis*-dominated forest. The former two were referred to as successional seres of

forests in the moist (bottomland) habitat and in the less moist (foothill) one respectively, and the third as the environmental gradient from moist to less moist habitats in matured forests.

In the present paper, phytosociological remarks on forest vegetations are described and a standing vegetation map is presented.

Study Area and Methods

The study area is in the northernmost region of Fukuoka Prefecture, Kyushu (Fig. 1). It includes the northwestern area of Kitakyushu City and its western vicinity (Onga County). It consists of plains, hills and mountains (about 60–600 m above sea level), rivers, irrigation ponds and coastal sand dunes. The former two areas are the widest, and they are made up of urban and industrial areas, secondary forests, orchards, fields and paddy-fields.

The approximate meteolological data are as follows (based on the observation at Shimonoseki Meteolological Station in 1951–1980); annual mean temperature is 15.5°C, annual precipitation is 1718 mm, Kira's warmth index is 126.3°C. Kitakyushu City is climatically in a warm-temperate zone and vegetationaly in the evergreen broad-leaf (the laurel-leaf) forest zone.

Field work was carried out between 1980 and 1982. The quadrat size was 400 m^2 in a forest and 25 m^2 in a scrub. Eighty-two quadrats were set up to collect data and synthesized in Braun-Blanquet's phytosociological system (Braun-Blanquet, 1964). These data were treated by Ellenberg's tablework method (Ellenberg, 1956), and thirteen associations or communities were identified (Table 1).

To make the standing vegetation map, the identification of vegetation units was carried out by both field and desk work using air photographs, and their dispersal areas were traced on a topographical map on the scale of 1:50,000 (Fig. 2).

Results and Discussion

I. Natural forests

As our study area is highly urbanized and industrialized as described above, the natural forests remain only on particular sites such as coastal slopes, precincts of shrines and temples.

A. Coastal scrubs

1. Euonymo-Pittosporetum tobirae Suz.–Tok. *et* Hayashi 1951

(a) Physiognomy: A coastal evergreen broad-leaf scrub with an even canopy surface.

(b) Character and differential species: Species group 1 (hereafter see Table 1). These species were almost similar to those of the same association in Nagasaki Prefecture (Itow, 1977).

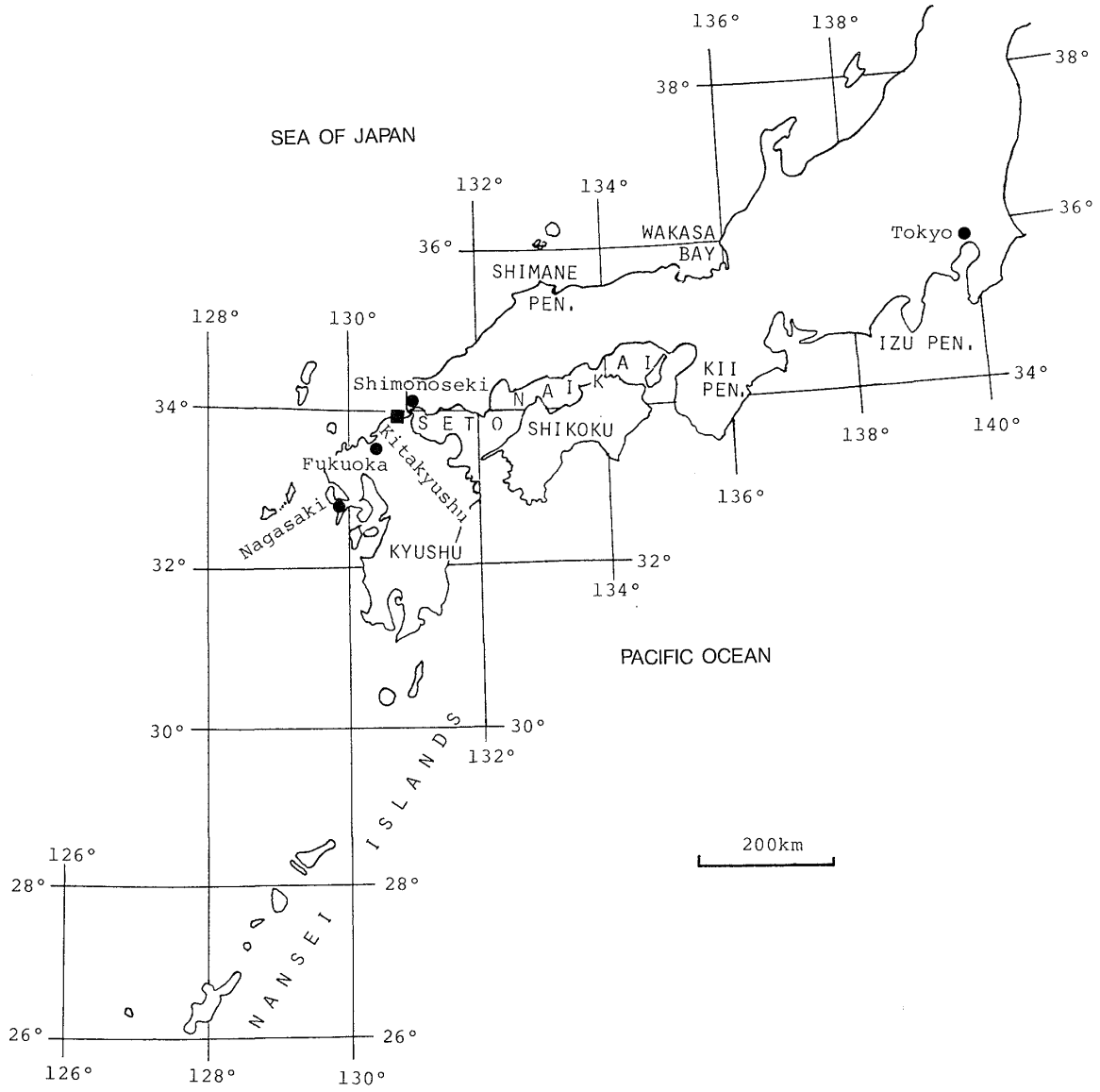


Fig. 1. Study area and related regions.

(c) Stratification and floristic composition: This association had shrub and herb layers. The shrub layer was usually 1–4 m in height and 0.5–1 m in height at wind-swept stands. The total coverage was 90–100%. Its dominants were one or two species among such species as *Pittosporum tobira, Euonymus japonicus, Eurya emarginata* and *Symplocos lucida.* Frequent species were, in addition to the dominants, *Raphiolepis umbellata, Daphniphyllum teijsmannii,* etc. The herb layer was at 0.5 m in height with 5–20% in coverage. Its flora was very poor and only *Farfugium japonicum* appeared frequently with a low coverage.

(d) Habitat: Its main habitat was coastal cliffs and steep slopes below 50 m above sea level, and plants frequently catch saline waters in winter. The surface soil was thin and rocky in arid places.

Table 1. Synthetic table of scrub and forest communities in Kitakyushu City. Roman (I—V) and Arabic (1—4) numerals show the degree of the frequency, and the epithet with Italic numeral is the range of the coverage (+ − 5)

Ⅰ. Natural scrubs and forests
1. Euonymo-Pittosporetum tobirae
2. Cyrtomio-Litseetum japonicae
3. *Aphananthe aspera* Community
4. Arisaemeto ringentis-Machiletum thunbergii
5. Symploco graucae-Castanopsietum sieboldii
6. *Carpinus tschonoskii-Castanopsis cuspidata* var. *sieboldii* Community
7. Distylio-Cyclobalanopsietum
8. Skimmio-Quercetum acutae

Ⅱ. Substitutional forest and afforestation
9. *Castanopsis* coppice forest
10. *Pinus thunbergii* afforestation
11. *Quercus serrata* Community
12. *Cryptomeria japonica* and *Chamaecyparis obtusa* afforestation
13. *Phyllostachys heterocycla* var. *pubescens* afforestation

Species group	Community	Ⅰ								Ⅱ				
		1	2	3	4	5	6	7	8	9	10	11	12	13
	Number of quadrats	6	12	4	3	12	4	1	7	12	7	10	2	2
1. *Eurya emarginata*	ハマヒサカキ	Ⅳ +-5	Ⅲ+-3	1+	1+	.	.	.	.	.	.	.	.	.
Raphiolepis umbellata	シャリンバイ	Ⅴ +-1	Ⅱ+	.	.	.	.	.	.	.	.	.	.	.
Paederia scandens v. *maritima*	ハマサオトメカズラ	Ⅰ +	Ⅱ+	.	.	.	.	.	.	.	.	.	.	.
2. *Litsea japonica*	ハマビワ	.	Ⅴ +-5	.	.	.	.	.	.	.	Ⅳ +-2	.	.	.
Phanerophlebia falcata	オニヤブソテツ	.	Ⅲ+-1	4+	1+	Ⅰ +	.	.	.	.	.	.	.	1+
3. *Aphananthe aspera*	ムクノキ	.	.	42-4	2+-3	Ⅲ+-2	.	11	.	Ⅰ 1	Ⅱ+	Ⅰ +	12	.
Celtis sinensis v. *japonica*	エノキ	Ⅰ +-4	Ⅰ 3	4+-2	.	Ⅱ+-2	.	.	Ⅱ+-2	.	Ⅲ+-2	.	12	1+
Piper kadzra	フウトウカズラ	.	.	31-3	2+	Ⅰ +	.	.	.	.	.	.	23	.
Viburnum awabuki	サンゴジュ	.	.	21	2+-1	Ⅰ +	.	.	.	.	.	.	.	.
Dennstaedtia scabra	コバノイシカグマ	.	.	2+	.	.	.	.	.	Ⅰ +	.	.	1+	.
Ophiopogon jaburan	ノシラン	.	.	2+	1+	.	.	.	.	.	Ⅰ +	.	.	.
Xylosma congestum	クスドイゲ	Ⅰ+	.	2+	.	.	.	.	.	.	Ⅲ+-1	.	.	.
Zelkova serrata	ケヤキ	.	.	23-4	.	.	.	.	Ⅰ +	.	.	.	.	.
4. *Arisaema ringens*	ムサシアブミ	.	.	.	3+	.	.	.	.	.	.	.	.	.
Cudrania cochinchinensis	カカツガユ	.	.	.	2+	.	.	.	.	.	.	.	.	.
Arisaema japonicum	マムシグサ	.	.	.	2+	.	.	.	.	.	.	.	.	.
5. *Symplocos glauca*	ミミズバイ	.	.	.	2+	Ⅴ +-3	.	.	.	.	.	Ⅰ +	1+	2+
Alpinia japonica	ハナミョウガ	.	.	.	2+	Ⅲ+-1	.	.	.	.	.	.	2+	1+
Elaeocarpus japonicus	コバンモチ	.	.	.	.	Ⅱ+-2	3+	.	.	.	.	.	.	.
Rumohra aristata	ホソバカナワラビ	.	.	13	2+	Ⅱ1-3	.	11	.	.	.	.	.	.
Quercus gilva	イチイガシ	.	.	.	2+-1	Ⅰ +-3	.	.	.	.	.	.	.	.
Meliosma rigida	ヤマビワ	.	.	.	.	Ⅱ2-3	.	.	.	Ⅰ +	.	.	.	.

6. *Carpinus tschonoskii*	イヌシデ	.	.	.	.	.	4*1-2*	.	V *1-3*	.	.	.	.	.
Ainsliaea apiculata	キッコウハグマ	.	.	.	.	I +	4+	.	.	.	I +	.	.	.
Lioaris nervosa	コクラン	.	.	.	.	I +	3+	.	.	I +	I +	.	.	.
Gardneria nutans	ホウライカズラ	.	.	.	.	.	3+	1*1*	.	.	.	.	.	1+
Marsdenia tomentosa	キジョラン	.	.	.	.	.	2+	.	II+	.	.	.	.	.
Lycopodium serratum	トウゲシバ	.	.	.	.	.	2+	.	.	.	.	.	.	.
Daphne kiusiana	コショウノキ	.	.	.	.	.	2+	.	I +	.	.	.	.	.
7. *Distylium racemosum*	イスノキ	.	.	.	1*2*	.	.	1*3*	I +	.	.	.	.	.
Rumohra pseudo-aristata	コバノカナワラビ	.	.	.	2+	.	.	1*4*	.	I +	.	.	.	.
Quercus salicina	ウラジロガシ	.	.	.	1*1*	.	.	1+	I *1*	.	.	.	.	.
Helicia cochinchinensis	ヤマモガシ	.	.	.	.	.	.	1*1*	.	I +	.	.	.	.
8. *Quercus acuta*	アカガシ	.	.	.	.	I *2*	.	.	V *+-4*	.	.	.	.	.
Machilus japonica	ホソバタブ	.	.	.	.	.	.	.	IV *+-2*	.	.	.	.	.
Illicium religiosum	シキミ	.	.	1*1*	.	.	.	.	III+	.	.	.	.	.
Asarum asaroides	タイリンアオイ	.	.	.	.	.	.	.	III+	.	.	.	.	.
Symplocos myrtacea	ハイノキ	.	.	.	.	.	.	.	II+	.	.	.	.	.
Cephalotaxus harringtonia	イヌガヤ	.	.	.	.	.	.	.	II+	.	.	.	.	.
Skimmia japonica v.*intermedia* f. *repens*	ツルシキミ		.	.	.	.	.	.	I +	.	.	.	.	.
Plagiogyria japonica	キジノオシダ	.	.	.	.	.	.	.	I +	.	.	.	.	.
9. *Pinus thunbergii*	クロマツ	III*+-1*	II*+-2*	.	1+	.	.	.	.	.	V *4-5*	.	.	.
Celastrus obiculatus v. *punctatus*	テリハツルウメモドキ	III+	III+	.	.	.	.	.	.	.	IV *+-1*	.	.	.
Luisia teres	ボウラン	.	.	.	.	.	.	.	.	.	IV *+-1*	.	.	.
Pleopeltis thunbergiana	ノキシノブ	.	.	.	.	.	2+	.	.	I+	IV +	.	.	.
Vitis ficifolia v. *lobata*	エビズル	.	.	.	.	.	.	.	.	.	III+	.	.	.
Asparagus cochinchinensis	クサスギカズラ	.	.	.	.	.	.	.	.	.	III+	.	.	.
Rosa wichuraiana	テリハノイバラ	I +	I +	.	.	.	.	.	.	.	III+	.	.	.
10. *Quercus serrata*	コナラ	.	.	.	.	.	.	.	.	I +	.	V *+-3*	.	1*1*
Histiopteris glauca	ウラジロ	.	.	.	.	II+	3+	.	.	III+	.	V *+-4*	.	.
Vaccinium bracteatum	シャシャンボ	.	.	.	.	II+	.	.	.	.	II*+-1*	III*+-2*	.	1+
Rhododendron kaempferi	ヤマツツジ	.	.	.	.	.	.	.	.	.	.	III*+-2*	.	.
Dicranopteris linearis	コシダ	.	I +	.	.	I +	.	.	.	II+	.	III*+-5*	.	.
Kalopanax pictus	ハリギリ	.	.	.	.	.	1*2*	.	.	.	.	III*+-1*	.	.
Mallotus japonicus	アカメガシワ	I +	I +	.	1+	.	1+	.	.	I *+-1*	I *+-2*	III*+-1*	1+	1*1*
Pinus densiflora	アカマツ	.	.	.	.	.	.	.	.	II+	.	II*+-1*	.	.
Lyonia ovalifolia v. *elliptica*	ネジキ	.	.	.	.	.	.	.	I +	I +	.	II*+-1*	.	.
Castanea crenata	クリ	.	.	.	.	.	.	.	.	.	.	II*+-1*	.	.
Pteridium aquilinum	ワラビ	.	.	.	.	.	.	.	.	.	.	II+	.	.
Miscanthus sinensis	ススキ	II+	I +	.	.	.	.	.	.	I +	I +	II+	.	.

Species group	Community	I								II				
	Number of quadrats	1	2	3	4	5	6	7	8	9	10	11	12	13
		6	12	4	3	12	4	1	7	12	7	10	2	2
11. *Cryptomeria japonica*	スギ	.	.	3*2*	.	.	2*1-2*	.	.	.	.	.	2*4*	.
Chamaecyparis obtusa	ヒノキ	.	.	.	.	.	.	.	.	.	.	.	2*2*	.
12. *Phyllostachys heterocycla* v. *pubescens*	モウソウチク		.	1*1*	.	.			.	I +	I +	I +	.	2*5*
13. *Castanopsis cuspidata* & v. *sieboldii*	コジイ・スダジイ		.	3*+-1*	(2*1*)	V *2-5*	4*3-5*	1*4*	I +	V *4-5*	.	.	1+	.
Machilus thunbergii	タブ		I +	3*+-2*	3*2-4*	V *+-5*	4*2*	1*3*	.	V *+-5*	II*+-1*	IV *+-2*	.	2+
Gardenia jasminoides f. *grandiflora*	クチナシ	.	.	1*1*	1+	III*+-2*	4*+-1*	.	.	IV *+-1*	I *+-1*	I +	1+	2+
Cinnamomum camphora	クスノキ		.	2*2*	.	IV *+-2*	1*1*	1*2*	.	III*+-2*	II*+-3*	I *1*	.	.
Quercus glauca	アラカシ	.	.	4*1-2*	.	III*+-1*	2*1*	.	.	II+	.	I *1*	.	.
Ardisia crenata	マンリョウ	.	.	3+	2+	II+	2+	1+	.	III+	II+	.	.	.
Ficus nipponica	イタビカズラ	.	.	2*1*	2+	III+	1+	1+	.	II+	.	I +	.	.
Ilex chinensis	ナナメノキ	.	.	3*+-1*	.	II*+-1*	3*+-1*	.	.	I +	.	I *+-1*	1+	.
Damnacanthus major	ジュズネノキ	.	.	2+	.	II+	4*+-2*	1+	.	.	.	.	.	.
Elaeocarpus sylvestris v. *ellipticus*	ホルトノキ		.	2*1*	1*1*	I *2*	.	.	.	II*+-1*	.	.	.	.
Aucuba japonica	アオキ	.	.	2*1-3*	2+	II*+-4*	.	.	V *+-2*	I +	I +	.	1*1*	.
Myrica rubra	ヤマモモ	.	.	1+	.	I *+-1*	4*+-2*	.	.	III*+-2*	I *+-3*	II*+-1*	.	.
Actinodaphne lancifolia	カゴノキ	.	.	2*+-1*	1*1*	.	3*+-2*	.	I +	I +	.	I +	.	.
Thea sinensis	チャノキ	.	.	1+	.	I +	1+	.	.	II+	.	.	.	.
Michelia compressa	オガタマノキ	.	.	.	2*2-3*	I +	4*+-2*	1+	.	II*+-1*	I +	.	.	.
Ternstroemia gymnanther.	モッコク	.	.	.	1+	II*+-2*	3*+-1*	.	.	II+	.	.	.	.
Rhodea japonica	オモト	.	.	.	1+	II+	.	1+	.	I +	.	.	.	1+
Anodendron affine	サカキカズラ	.	.	.	2+	I +	3+	1+	.	.	.	.	.	.
Elaeagnus glabra	ツルグミ	.	.	.	1+	I +	2+	.	.	I +	.	.	.	.
Maesa japonica	イズセンリョウ	.	.	.	2+	I +	.	1+	.	.	.	.	(1+)	.
Myrsine seguinii	タイミンタチバナ	.	.	.	.	III*+-3*	.	1*1*	.	II*+-1*	.	I *1*	.	.
Woodwardia japonica	オオカグマ	.	.	.	.	II+	3*1-3*	.	I +	II*+-1*	.	.	1+	.
Pasania glabra	シリブカガシ	.	.	.	.	III+	.	.	.	II*+-1*	.	II*+-1*	.	.
Liriope platyphylla	ヤブラン	I +	.	4+	2+	V +	I+	1+	.	II+	V *+-1*	.	2+	1*2*
Trachycarpus fortunei	シュロ	I +	.	2+	1+	III+	2+	1+	.	I +	I +	.	1+	1+
Pittosporum tobira	トベラ	V *+-5*	V *+-5*	1*1*	2*+-2*	III+	3+	1+	.	IV *+-1*	V *+-2*	II*+-1*	.	.
Euonymus japonicus	マサキ	IV *+-4*	V *+-4*	2*1-2*	2+	II+	.	1+	.	I +	IV *+-2*	.	.	.
Ilex rotunda	クロガネモチ	I +	II+	2*2-3*	3*1-2*	III*+-2*	3*1-2*	1*1*	.	V *+-2*	.	II*+-1*	.	.
Smilax china	サルトリイバラ	IV *+-1*	III+	.	1+	III+	3+	.	.	V +	IV *+-1*	V +	.	.
Celastrus orbiculatus	ツルウメモドキ	III+	I +	1+	3+	II+	.	1+	.	III+	.	III+	.	.
Daphniphyllum teijsmannii	ヒメユズリハ	IV *+-1*	III*+-3*	.	2*1-2*	I +	4*+-2*	1*1*	.	IV *+-1*	V *+-4*	I *+-2*	.	.
Viburnum japonicum	ハクサンボク	II+	II+	2+	1+	.	.	.	.	II+	.	.	.	.
Ophiopogon japonicus	ジャノヒゲ	I +	I +	1+	2+	II+	.	.	.	I +	IV *+-1*	.	.	.

Dendropanax trifidus	カクレミノ	II+	II+	4*1*	3+	V +-3	4+-2	1*1*	.	V +-1	IV +-3	V +-3	2*1*	2+-1
Symplocos lucida	クロキ	IV +-4	IV +-1	3+-1	3+-1	V +-1	4*1*-2	1*2*	.	V +-2	IV +-3	V +-3	2+	2+-1
Ficus erecta	イヌビワ	IV +-1	III+-2	4*2*	3+-3	V +-3	4+-3	1+	.	V +-2	V +-2	III+-1	1*1*	2*1*
Ilex integra	モチノキ	III+	IV +-2	2+-1	3+-4	V +-4	4+-3	1*1*	.	V +-2	.	III+-1	.	1+
Farfugium japonicum	ツワブキ	V +-2	IV +-1	2+	2+	IV +	4+	1+	.	IV +	III+-1	III+	1+	2+
Kadsura japonica	サネカズラ	I +	II+	.	3+	III+	4+	1+	.	III+	III+-1	III+	2+	1+
Rubus buergeri	フユイチゴ	II+	.	1+	.	III+	3+	.	.	II+	.	III+	1+	2+
Fatsia japonica	ヤツデ	I +	I +	4+	3+	III+	1+	1+	.	III+	II+-1	I +	2+-1	2+
Neolitsea sericea	シロダモ	III+	III+-1	4+-2	2+	V +-2	4+-2	1+	IV +-2	V +-3	I +	V +-1	2+	2+
Dryopteris erythrosora	ベニシダ	II+	I +	4+-3	2+	V +-2	4+-1	1+	V +-2	V +	I +	V +-3	2+-1	2+-1
Cinnamomum japonicum	ヤブニッケイ	III+-2	IV +-3	3+-2	3*1*-2	V +-2	4+-1	1*3*	V *1*-3	IV +-2	V +-3	IV +-2	2+	2+
Ligustrum japonicum	ネズミモチ	V +-2	IV +-1	2+-1	2+	IV +-1	4+	1+	IV +-1	V +-1	V +-3	V +-2	.	1+
Stauntonia hexaphylla	ムベ	I +	II+	2+	3+	V +	3+	1+	II+	V +	III+	II+	1+	1+
Eurya japonica	ヒサカキ	III+-2	II+-2	3+-2	3+-1	V +	3+	1+	IV +-3	V +-2	II+-1	V +-4	2+	2+-1
Ophiopogon ohwii	ナガバジャノヒゲ	II+	I +	4+	2+	IV +	4+	1+	II+	IV +	.	II+	1+	1+
Ardisia japonica	ヤブコウジ	II+	III+	3+	2+	II+	4+	.	IV +	IV +	V +-1	IV +	2+	2+
Elaegnus pungens	ナワシログミ	II+	III+-2	4+	.	III+	2+	.	I +	II+	V +-3	II+	.	1+
Cymbidium goeringerii	シュンラン	I +	I +	1+	.	II+	4+	1+	I +	III+	V +	II+	.	2+
Hedera rhombea	キヅタ	II+	III+-1	4+-3	2+	V +-2	3+	1+	V +	III+	V +-3	I +	2*1*-3	2+-2
Camellia japonica	ヤブツバキ	IV +-3	III+-1	4*1*-2	3+-2	V +-3	3+-3	1*2*	V +-5	IV +-2	I +-1	I *1*-2	1+	.
Trachelospermum asiaticum	テイカカズラ	I +	I +	4*1*-3	2+	V +-4	4+	1*1*	IV +	III+	IV +-2	.	2*1*-3	1+
14. *Rhus succedanea*	ハゼ	II+	III+-1	3*2*	1*2*	V +-2	2*2*	1*1*	.	V +-2	V *1*-2	V *1*-4	2+	1*1*
Paederia scandens v. *mairei*	ヘクソカズラ	I +	III+	.	3+	IV +	2+	.	I +	V +	V +	IV +	2+	.
Oplismenus undulatifolius v. *japonicus*	チヂミザサ		II+	3+-1	2+	IV +	3+-2	1+	I +	III+	V +-2	IV +-1	1+	1+
Wisteria floribunda	フジ	I +	.	1+	1+	II+	.	.	II+	III+	II+-1	III+	.	1+
Millettia japonica	ナツフジ	II+	III+	.	.	III+	1+	.	I +	III+	.	I +	2+	1+
Sasa japonica	ヤダケ	I +	I +	1+	3+	I +	.	.	.	III+-2	.	I +	.	.
Premna japonica	ハマクサギ	I +	I +	1*3*	1+	II+	1+	1+	.	III+	I +-1	II+	.	.
Prunus jamasakura	ヤマザクラ	.	I +	.	1*1*	II+-1	(1*1*)	.	III+-1	II+-2	II+-1	IV +-3	.	.
Carex lenta v. *lenta*	ナキリスゲ	II+	.	1+	1+	I +	1+	.	.	I +	.	III+	2+-1	1+
Microlepia marginata	フモトシダ	.	.	2+	.	II+	2+	.	.	.	.	II+	2+-1	.
Pueraria lobata	クズ	I +	II+	.	3+	III+	.	.	.	I +	.	I +	1+	.
Parthenocissus tricuspidata	ナツヅタ	.	I +	.	1+	I +	2+	1+	.	III+	V +-1	I +	.	1+
Dioscorea japonica	ヤマノイモ	I +	I +	.	1+	II+	.	.	.	II+	III+	I +	1+	.
Akebia trifoliata	ミツバアケビ	II+	I +	.	2+	I +	2+	.	.	.	IV +	III+	.	.
Callicarpa mollis	ヤブムラサキ	.	.	.	.	I +	2+	.	.	II+	.	I +	.	.
Lonicera hypoglauca	キダチニンドウ	.	II+	.	3+	I +	2+	.	.	III+	I +	II+	.	.
Clerodendrum trichotomum	クサギ	.	.	.	1+	I +	2+	.	.	I +	.	I +	.	.
Zanthoxylum ailanthoides	カラスザンショウ	.	.	1+	1+	.	.	.	.	II+-5	.	II*1*	.	.
Achyranthus japonica	イノコズチ	.	.	1+	1+	III+	.	.	.	I +	II+	.	1+	1+
Lophatherum gracile	ササクサ	.	.	1+	.	II+	1+	.	.	.	V +-1	(I +)	2+	.
Dioscorea quinqueloba	カエデドコロ	II+	II+	1+	1+	II+	.	.	.	I +	II+-1	.	.	.
Euscaphis japonica	ゴンズイ	I +	I +	.+	1+	I +	2+	.	.	II+	.	II+	.	1+

Species group	Community	I								II				
		1	2	3	4	5	6	7	8	9	10	11	12	13
	Number of quadrats	6	12	4	3	12	4	1	7	12	7	10	2	2
Polystichum polyblepharum	イノデ	.	.	1+	.	II+	1+	.	.	.	.	I +	1+	1+
Cornus brachypoda	クマノミズキ	.	.	2+-1	2+-1	I +-1	1+	.	III+-1	.	II+-3	.	.	.
Styrax japonica	エゴノキ	.	.	.	11	II+	.	.	I +	I +	.	.	.	.
Polypogon filiforme	ミズヒキ	.	I +	1+	1+	II+	.	.	.	.	.	.	.	.
Rubus hirsuta	クサイチゴ	.	.	.	.	.	.	.	.	I +	II+	II+	1+	.
Viburnum erosum	コバノガマズミ	.	.	.	.	.	1+	.	.	.	.	II+	.	.
Melothria japonica	スズメウリ	.	.	.	2+	I +	.	.	.	I +	.	.	.	.
Platycarya strobilacea	ノグルミ	.	I +	12	.	.	11	.	.	I +	.	I 1-2	.	.
Lilium cordatum	ウバユリ	.	.	2+	.	I +	.	.	.	.	.	I +	.	.
Cyclosorus acuminatus	ホシダ	.	I +	2+	.	I +	1+	.	.	.	.	.	1+	.
Cocculus trilobus	アオツヅラフジ	IV +	III+	.	.	I +	.	.	.	I +	III+	II+	.	.
Ampelopsis brevipedunculata	ノブドウ	I +	II+	.	.	II+	.	.	.	.	IV +	I +	.	.
Zanthoxylum schinifolium	イヌザンショウ	.	.	.	.	I +	.	.	.	.	.	I +	.	.
Damnacanthus indicus	アリドウシ	.	.	.	.	I +	3+	.	.	.	II+	.	.	.
Podocarpus macrophyllus	イヌマキ	.	.	.	.	I +	.	1+	.	II+	.	.	.	.
Ficus erecta v. *sieboldii*	ホソバイヌビワ	.	.	.	.	I +	.	.	.	.	.	I +	1+	1+
Lastrea totta	ミゾシダ	.	I +	.	1+	I +	.	.	.	.	.	I +	.+	1+
Osmunda japonica	ゼンマイ	.	.	.	.	.	.	.	.	I +	.	I +	.	.
Arundinaria simonii	メダケ	.	.	.	.	I +	.	.	.	I +	.	.	1+	.
Euonymus alatus f. *ciliato-dentatus*	コマユミ	.	.	.	.	.	.	.	.	.	III+-2	II+	.	.
Pourthiaea villosa v. *laevis*	カマツカ	.	.	.	.	I +	.	.	II+	.	I +	I +	.	.
Zanthoxylum piperitum	サンショウ	.	.	.	.	I +	2+	.	.	.	.	.	.	.
Sambucus sieboldiana	ニワトコ	.	I +	2+	.	.	.	.	I +	.	.	.	1+	.
Lemmaphyllum microphyllum	マメヅタ	.	.	1+	.	I +	1+	.	.	.	.	.	.	.
Rumohra amabilis	オニカナワラビ	.	.	.	.	I +	.	.	.	.	.	.	1+	.
Lonicera gracilipes	ヤマウグイスカグラ	.	.	1+	.	.	.	.	.	.	.	I +	.	.
Viola grypoceras	タチツボスミレ	.	.	.	.	.	.	.	.	.	I +	I +	.	.
Phryma leptostachya v. *asiatica*	ハエドクソウ	.	.	.	.	I +	1+	.	.	.	.	.	1+	.
Prunus x *yedoensis*	ソメイヨシノ	.	.	.	.	I 1	.	.	.	I +	II+-1	.	.	.
Glochidion obovatum	カンコノキ	I +	.	.	.	I +	.	.	.	.	.	I +	.	.
Chloranthus glaber	センリョウ	.	.	.	.	I +	1+	.	.	.	.	.	.	.
Lygodium japonicum	カニクサ	.	I +	.	.	.	.	.	.	.	.	.	1+	.
Cleyera japonica	サカキ	.	.	.	.	I +	1+	.	I +	.	.	.	.	.
Ilex crenata	イヌツゲ	.	.	1+	.	.	.	.	.	.	I +	I +	.	.
Sinomenium acutum	オオツヅラフジ	.	.	1+	.	I +	.	.	.	.	.	.	.	.
Rubus palmatus	ナガバモミジイチゴ	.	.	.	.	.	1+	.	I +	.	I +	I +	.	.
Diospyros kaki	カキノキ	.	.	11	.	.	.	.	.	I 1	.	.	.	.
Morus bombycis	ヤマグワ	.	I +	1+	.	.	.	.	.	.	I +	.	1+	.
Arundinaria pygmaea v. *glabra*	ネザサ	I +	I +	.	.	.	.	.	.	.	I +	I +	.	.

Lespedeza cyrtobotrya	マルバハギ	.	.	.	.	.	.	.	.	I +	.	I +	.	.
Albizzia julibrissin	ネムノキ	.	.	.	.	.	.	.	.	.	I +	I +	11	.
Botrychium sp.	ハナワラビsp.	.	.	.	.	.	.	.	.	.	.	I +	.	1+
Coniogramma fraxinea	イワガネゼンマイ	.	.	.	.	.	.	.	.	.	.	.	1+	1+
Houttunia cordata	ドクダミ	.	I +	.	1+	.	.	.	.	.	.	.	1+	.
Sanicula chinensis	ウマノミツバ	.	.	.	.	.	.	.	.	.	.	I +	1+	.
Symplocos theophrastaefolia	カンザブロウノキ	.	.	.	.	I +	.	.	.	.	.	I +	.	.
Agrimonia pilosa	キンミズヒキ	.	.	.	.	I +	.	.	.	.	I +	.	.	.
Prunus spinulosa	リンボク	.	.	.	.	I +	.	.	.	.	I +	.	.	.
Akebia quinata	アケビ	.	.	.	.	.	1+	.	.	.	IV +-1	.	.	.
Pteris multifida	イノモトソウ	.	.	1+	.	.	.	.	.	.	I +	.	.	.
Rosa multiflora	イノバラ	I +	.	.	.	.	.	.	.	.	.	I +	.	.
Aralia elata	タラノキ	.	I +	.	.	.	.	.	.	.	.	I +	.	.
Desmodium oxyphyllum	ヌスビトハギ	.	I +	.	.	.	1+	.	.	.	.	.	.	.
Solidago virga-aurea v. *asiatica*	アキノキリンソウ	.	.	.	.	.	.	.	.	.	I +	I +	.	.

Others (Species without evaluation are I+ or 1+.)

Comm. No. 3 : *Clematis terniflora, Celtis leveillei* 11, *Pyrrosia lingua* 1+, *Asplenium incisus, Ardisia crispa, Rumohra simplicior, Salvia lutescens* v. *intermedia, Torilis japonica, Aquilegia adoxoides, Cryptotaenia japonica, Urtica thunbergiana*, No. 4 :*Elaeagnus macrophylla, Callicarpa japonica* v. *luxurianus, Broussonetia kaempferi*, No. 5 : *Ardisia pusilla, Zanthoxylum planispinum, Trichosanthes multiloba, Cladrastis platycarpa, Sapindus mukorossi, Quercus aliena, Iris japonica*, No. 6 : *Cremastra appendiculata* 2+, *Nandina domestica, Caphalanthera longibracteata, Citrus* sp., *Goodyera schlechitendaliana*, No. 7 : *Dryopteris fuscipes*, No. 8 : *Boehmeria spicata* II+, *Acer palmatum* v. *palmatum, Lindera erythrocarpa, Clethra barbinervis, Acer rufinerve, Schizophragma hydrangeoides, Hydrangea luteo-venosa, Calanthe discolor*, No. 9 : *Desmodium caudatum* II+-1,*Lonicera japonica* II+, *Rubia akane* II+, *R. cordiflora* v. *pratensis* II+, *Erechtites hieracifolia, Aspidistra elatior, Quercus accutissima, Solanum lyratum, Viola ovato-oblonga, Phytolacca americana*, No. 12 : *Amelanchier asiatica, Platanthera minor, Aster scaber, A. ageratoides* v. *semiamplexicaulis, Lysimachia clethroides, Fraxinus languinosa, Rhynchospermum verticillatum, Adenostemma lavenia, Eragrostis ferruginea, Plectranthus inflexus, Youngia denticulata, Eupatorium chinense* v. *simplicifolium, Viola verecunda, Calamagrostis* sp., *Pyrola japonica, Ixeris dentata, Viola violacea, Lapsana humilis*, No. 12 : *Pteris cretica, Pollia japonica*

2. Cyrtomio-Litseetum japonicae Sumata, Mashiba *et* Suz.-Tok. 1969

(a) Physiognomy: A coastal evergreen broad-leaf scrub with an even canopy surface.

(b) Character and differential species: Species group 2. This association in Kitakyushu City was identified as a typical subassociation of Cyrtomio-Litseetum japonicae identified in Nagasaki Prefecture (Itow, 1977).

(c) Stratification and floristic composition: The shrub layer was 1–2 m in height in wind-swept stands, and 2–6 m in other stands. The total coverage was 100% in both of them. Dominant species were one or two of *Litsea japonica, Pittosporum tobira* and *Euonymus japonicus*. Frequent species were nearly equal to those of Euonymo-Pittosporetum tobirae. The herb layer was at 0.5–5 m in height with 1–10% coverage. The feature of this layer was almost the same as that of Euonymo-Pittosporetum tobirae.

(d) Habitat: It was found on slopes facing the sea. The soil was more mesic, thicker and richer in organic matters than that of Euonymo-Pittosporetum tobirae.

As these two scrubs were under severe environment such as high aridity and strong winds, the floristic composition was simpler than that of neighboring lowland evergeen broad-leaf forests due to the loss of a number of evergreen species (species group 13).

The Euonymo Pittosporetum tobirae is distributed over the coastland from Kyushu to Wakasa Bay and to Izu Peninsula including the Setonaikai Inland Sea. Cyrtomio-Litseetum japonicae is distributed over the coastland from Nansei Islands to Shimane Peninsula and to the Kii Peninsula excluding the Setonaikai Inland Sea. In the present study area, these two associations were found on the coastline from the estuary of the Onga River to the eastern reclaimed land.

B. Lowland forests

3. *Aphananthe aspera* Community

(a) Physiognomy: A deciduous broad-leaf forest.

(b) Differential species: Species group 3. Due to the floral affinity of this community with Arisaemeto ringentis-Machiletum thunbergii, it is considered as a subassociation or a variant of Arisaemeto ringentis-Machiletum thunbergii.

(c) Stratification and floristic composition: The height of canopy varied with microtopographical features. It was 12 m on steep slopes with thin soils and exposed rocks or low cliffs, and 20 m on gentle slopes with thick soils. The total coverage of both areas was 100%.

Dominants of the tree layer were deciduous trees such as *Aphananthe aspera, Celtis sinensis* var. *japonica* and *Zelkova serrata* whose diameter at breast height (DBH) was 30–60 cm. Also, the following evergreen trees were found in small numbers; *Castanopsis cuspidata, Machilus thunbergii, Cinnamomum camphora* and *Quercus glauca*. The subtree layer was at 6–8 m in height with 40–60% coverage. It was composed of *Camellia japonica, Dendropanax trifidus, Eurya japonica, Ficus erecta*, etc. The shrub layer was at 2–4 m in height with 20–50% coverage. The flora was similar to that of the subtree layer. The herb layer

was at 0.5–1 m in height with 50–100% coverage. This layer was characterized by predominant lianas such as *Hedera rhombea, Trachelospermum asiaticum* and *Piper kadzura.* Also, the following species were observed in small coverage; *Liriope platyphylla, Phanerophlebia falcata, Dryopteris erythrosora, Farfugium falcata, Ardisia japonica* and seedlings of trees of the upper strata. The physiognomy and dominants of the canopy were similar to those of Aceri-Zelkovetum Miyawaki *et al.* 1970 and Parabenzoino-Perseetum japonicae Ohno 1981, however, there was no species of Fagetea crenatae Miyawaki *et al.* 1964.

(d) Habitat: This community was found only in two sites on basaltic hillsides (30–50 m above sea level) near the Onga River. The soil texture varied as described before, but soil moisture was higher than that in Arisaemeto ringentis-Machiletum thunbergii.

4. Arisaemeto ringentis-Machiletum (Perseetum) thunbergii Miyawaki *et al.* 1971

(a) Physiognomy: An evergreen broad-leaf forest.

(b) Character and differential species: Species group 3 and 4. In comparison with the same association in Nagasaki Prefecture (Itow, 1977), some character species were lacking in our stands (Table 2.).

(c) Stratification and floristic composition: The tree layer was at 20–30 m in height with 90–100% coverage. The following trees were found in this layer; *Machilus thunbergii* (dominant), *Ilex rotunda, Symplocos lucida, Cinnamomum japonicum,* etc. *Castanopsis cuspidata* and its variety *sieboldii* were not so frequent as other laurel-leaf forests in the study area. The subtree layer was at 6–10 m in height with 30–70% coverage. It was composed of *Dendropanax trifidus, Ilex integra, Camellia japonica,* etc. The shrub layer was at 1–3 m in height with 10–20% coverage and composed of *Ficus erecta, Fatsia japonica, Eurya japonica,* etc. The herb layer at 0.5–1 m in height and with 10–40% coverage was composed of *Arisaema ringens, Kadsura japonica, Stauntonia hexaphylla, Piper kadzura,* etc.

(d) Habitat: This association was found from the bottom to the middle portion of gentle slopes and the hollow among hills near the sea. The soil was thick and humid. It appeared below 200 m above sea level. This association distributes in moist coastal regions from Kyushu to Shikoku and the Kii Peninsula.

5. Symploco glaucae-Castanopsietum sieboldii Miyawaki *et al.* 1971

(a) Physiognomy: An evergreen broad-leaf forest.

(b) Character and differential species: Species group 5. Some of the character species in the same association in Nagasaki Prefecture (Itow, 1977) were not found in Kitakyushu stands (Table 2).

(c) Stratification and floristic composition: The tree layer was at 15–25 m in height with 80–100% coverage. Its component species were *Castanopsis cuspidata* and its variety *sieboldii* (dominant), *Machilus thunbergii, Quercus gilva, Cinnamomum japonica, Neolitsea sericea, Ilex integra,* etc. whose DBH was 45–60 cm. The subtree layer was at 8–10 m in height with 20–70% coverage. It was composed of *Ficus erecta, Dendropanax trifidus, Symplocos lucida, S. glauca, Meliosma rigida,* etc. The shrub layer was at 2–4 m in height with 20–70% coverage. It was composed of *Camellia japonica, Eurya japonica, Ligustrum japoni-*

cum, Myrsine seguinii, etc. The herb layer was at 0.5–1 m in height with 50–80% coverage and composed of *Damnacanthus major, Farfugium japonicum, Ophiopogon ohwi, Liriope platyphylla, Dryopteris erythrosora, Rumohra aristata, Woodwardia japonica, Trachelospermum asiaticum, Stauntonia hexaphylla, Hedera rhombea,* etc.

(d) Habitat: This association has been preserved on gentle slopes and flat places with thick and mesic soils lower than 300 m above sea level. As this association is one of the most common natural forests in the study area, it is presumed to be one of the widespread original vegetations in these areas before urbanization began. It distributes from Kyushu to Shikoku and the Kii Peninsula in Japan.

6. *Carpinus tschonoskii-Castanopsis cuspidata* var. *sieboldii* Community

(a) Physiognomy: An evergreen broad-leaf forest.

(b) Differential species: Species group 6.

(c) Stratification and floristic composition: The tree layer was at 18–20 m in height with 90–100% coverage. Its components were *Castanopsis cuspidata* var. *sieboldii* (dominant), *Myrica rubura, Symplocos lucida, Cinnamomum japonicum,* and *Carpinus tschonoskii* whose DBH was 40–60 cm. The subtree layer was at 6–8 m in height with 30–60% coverage. It was composed of *Michelia compressa, Ilex integra, Ficus erecta,* and *Daphniphyllum teijsmannii* which were 10–20 cm in DBH. The shrub layer was at 1.5–4 m in height with 20–50% coverage and composed of *Gardenia jasminoides* var. *grandiflora, Dendropanax trifidus, Neolitsea sericea, Ligustrum japonicum.* The herb layer was at 0.5–1 m in height with 30–60% coverage. Its members were *Damnacanthus major, Ardisia japonica, Farfugium japonicum, Ainsliaea apiculata, Ophiopogon ohwi, Cymbidium goeringerii, Trachelospermum asiaticum,* etc.

(d) Habitat: This community was on a gentle slope (between 20 m and 40 m above sea level) of a hillside with thick and humid soils. This stand was found in a farmer's residence (about 4 ha) near the Onga River. It showed slight evidence of artificial effects but it has been kept undisturbed in these few years. This community was not illustrated on the vegetation map (Fig. 2) because it is outside the area covered by this map.

7. Distylio-Cyclobalanopsietum Nomoto *et* Suganuma 1965

(a) Physiognomy: An evergreen broad-leaf forest.

(b) Character and differential species: Species group 7. Although *Machilus japonica* and *Actinodaphne longifolia* are frequent in this association in the mountan region of Camellietea, they were not found in our stands.

(c) Stratification and floristic composition: The following record was obtained in only one stand (20 m above sea level) in the precincts of a shrine. The tree layer was at 18 m in height with 100% coverage. Dominant tree was *Castanopsis cuspidata* which was 40–50 cm in DBH. Other components were *Distylium rasemosum, Machilus thunbergii, Cinnamomum japonicum, C. camphora, Aphananthe aspera, Ilex rotunda, Daphniphyllum teijsmannii, Quercus salicina,* etc. The subtree layer was at 8 m in height with 100% coverage, and the following trees (10–15 cm in DBH) were found; *Symplocos lucida, Camellia japonica, Helici-*

na cochinchinensis, Dendropanax trifidus, Ilex integra, etc. There was no predominant species in this layer. The shrub layer was at 2 m in height. Its total coverage was low as 20%, and the following shrubs were found sparsely; *Gardenia nutans, Ardisia crenata, Maesa japonica, Trachycarpus fortunei, Pittosporum tobira, Fatsia japonica, Eurya japonica,* etc. The herb layer was at 0.5 m in height with 95% coverage, and covered densely with *Rumohra pseudo-aristata.* Other components were *Rumohra aristata, Trachelospermum asiaticum, Damnacanthus major, Liriope platyphylla, Kadsra japonica, Dryopteris erythrosora, Ophiopogon ohwii,* etc.

(d) Habitat: This association was found on a gentle slope of a hillside with thick and mesic soils.

C. Mountain forest

8. Skimmio-Quercetum acutae Suz.-Tok. *et* Sumata 1965

(a) Physiognomy: An evergreen broad-leaf forest.

(b) Character and differential species: Species group 8.

(c) Stratification and floristic composition: The tree layer was at 10–15 m in height with 70–100% coverage. The height of canopy was lower than other matured evergreen forests owing to strong winds. It was composed of *Quercus acuta* (dominant), *Cinnamomum japonicum, Carpinus tschonoskii* whose DBH was 30–50 cm. *Castanopsis cuspidata* and its variety *sieboldii* were not so frequent and not dominant in this study area. The subtree layer was at 5–10 m in height with 20–80% in coverage. Its components were *Machilus japonica, Illicium religiosum, Neolitsea sericea, Camellia japonica,* etc. The shrub layer was at 3–5 m in height with 10–80% coverage. It was composed of *Symplocos myrtacea, Aucuba japonica, Ligustrum japonica, Cephalotaxus harringtonia,* etc. The herb layer was at 0.5–1 m in height with 30–50% coverage. The following species were found; *Skimmia japonica* var. *intermedia* f. *repens* (this is an equivalent species of *S. japonica* which is common in southern and western Kyushu), *Plagiogyria japonica, Asarum myrtacea, Dryopteris erythrosora, Stauntonia hexaphylla, Hedera rhombea,* etc.

(d) Habitat: This forest was located on the northern slopes of Mt. Hobashira (487 m above sea level). The stands were set on upper slopes with thick and mesic soils. The ground surface was covered with thick leaf litter. Skimmio-Quercetum acutae develops in the upper zone (about 500–800 m above sea level) of Camellietea in Kyushu. The typical forests of the association are frequently veiled in fog, which causes a luxuriant growth of epiphytes. As our stands were taken near the lower limit (350–487 m above sea level), low frequency, low coverage and few epiphytes were the characteristics of this forest.

The poverty of character species of some associations is characteristic of northern Kyushu in comparison with the comparable associations in western Kyushu. They are, for example, Arisaemeto ringentis-Machiletum thunbergii (Table 2), Symploco glaucae-Castanopsietum sieboldii (Table 2), Distylio-Cyclobalanopsietum and Skimmio-Quercetum acutae. This phenomenon was described as "simplification of association" by Sasaki

Table 2. Comparison of character species of Arisaemeto ringentis-Machiletum thunbergii and Symploco glaucae-Castanopsis sieboldii in Kitakyushu City and Nagasaki Prefecture (Itow, 1977)

Species	Kitakyushu City	Nagasaki Pref.
Arisaemeto ringentis-Machiletum thunbergii		
Piper kadzra	+	+
Viburnum awabuki	+	+
Ophiopogon jaburan	+	+
Arisaema ringens	+	+
Ardisia sieboldii	−	+
Alpinia intermedia	−	+
Colysis pothifolia	−	+
Symploco glaucae-Castanopsietum sieboldii		
Symplocos glauca	+	+
Alpinia japonica	+	+
Elaeocarpus japonicus	+	+
Quercus gilva	+	+
Meliosma ringens	+	+
Damnacanthus macrophylla	−	+
Lasianthus japonicus	−	+
Antidesma japonicum	−	+
Symplocos prunifolia	−	+
Prunus spinulosa	−	+

(1958). It may be found in horizontally and altitudinally marginal areas of the distribution range of the association.

II. Substitutional forests and afforestations

9. *Castanopsis* coppice forest

(a) Physiognomy: An evergreen broad-leaf forest.

(b) Differential species: Because of immaturity of the forests, character and differential species have not appeared yet.

(c) Stratification and floristic composition: The canopy was at 8−15 m in height with 100% coverage. The differentiation of stratification was not so clear. The dominant was *Castanopsis cuspidata* (including its variety *sieboldii*) or *Machilus thunbergii* whose DBH was 10−20 cm. It was composed of many trees, lianas and herbs as shown in species group 13 and 14.

(d) Habitat: This coppice forest was found on hillsides in rural areas and on hilltops in urban areas. It was used as a source of fuel supply. As fossil fuel has been substituted for wood fuel, some stands have been left undisturbed for the last thirty years, and others were changed to *Cryptomeria japonica* and *Chamaecyparis obtusa* afforestations for

timber. Compared with the *Quercus serrata* Community, the human inpacts on those coppice forests were moderate, and the soils were thicker and moister.

10. *Pinus thunbergii* afforestation

(a) Physiognomy: An evergreen coniferous forest on coastal sand dunes.

(b) Differential species: Species group 9.

(c) Stratification and floristic composition: The tree layer was 15–20 m in height with 50–80% coverage. The dominant species was *Pinus thunbergii* only. Its DBH was 30–50 cm. Others were epiphytes such as *Luisia teres* and *Pleopeltis thunbergiana*, and lianas such as *Parthenocissus tricuspidata* and *Celastrus obiculatus* var. *punctatus*. The subtree layer was 8–15 m in height with 80–100% coverage. The components were many broad-leaf trees (5–20 cm in DBH) and lianas such as *Litsea japonica, Dendropanax trifidus, Daphniphyllum teijsmannii, Symplocos lucida, Cinnamomum japonicum, Ficus erecta, Rhus succedanea, Akebia trifoliata*, etc. The shrub layer was 2–5 m in height with 10–50% coverage and composed of *Pittosporum tobira, Euonymus japonicus, Ligustrum japonicum, Elaeagnus pungens, Paederia scandens* var. *mairei, Smilax china*, etc. These were common species of coastal scrub vegetations. The herb layer was 0.5–1 m in height with 5–10% coverage. The component species were common to evergreen broad-leaf forests in lowland areas. They were *Ardisia japonica, Trachelospermum asiaticum, Hedera rhombea, Liriope platyphylla, Ophiopogon japonicum, Cymbidium goeringerii, Lophatherum gracile, Oplismenus undulatifolius* var. *japonicus*, etc.
folius var. *japonicus*, etc.

(d) Habitat: This forest was found on coastal sand dunes whose soil condition was mesic and rich in litter. The afforestation of this conifer on coastal sand dunes began as a shelter-belt in the seventeenth century in Fukuoka Prefecture (Takeuchi, 1956). Until recently, people had collected leaf litters for manure and fuel. As it has been discontinued, natural regeneration has begun in many places.

11. *Quercus serrata* Community

(a) Physiognomy: A deciduous broad-leaf forest.

(b) Differential species: Species group 10.

(c) Stratification and floristc composition: The height of the canopy was 8–10 m, and was lower than that of the *Castanopsis* coppice forest. It was 60–80% in coverage. The main components were the following deciduous broad-leaf trees whose DBH was 10–20 cm; *Quercus serrata, Rhus succedanea, Kalopanax pictus, Prunus jamasakura, Castanea crenata*, etc. There were found also evergreen trees, although their dominancy was small, such as *Castanopsis cuspidata* and its variety *sieboldii, Machilus thunbergii, Dendropanax trifidus, Symplocos lucida*, etc. The forest floor was light owing to the sunshine coming through its transparent canopy, and covered thickly with *Histiopteris glauca, Dicranopteris linearis* and *Eurya japonica*, etc.

(d) Habitat: This community was a typical secondary forest on a xeric habitat, such as a ridge and its adjacent slope. The thin and dry soils have been caused by human impact and erosion in the past. Although *Pinus densiflora* grows as a co-dominant species

Fig. 2. Standing vegetation map of northwestern Kitakyushu City and its vicinity.

I. Natural scrub and forest vegetation

- Euonymo-Pittosporetum tobirae & Cyrtomio-Litseetum japonicae
- *Aphananthe aspera* Community
- Arisaemeto ringentis-Machiletum thunbergii
- Symploco glaucae-Castanopsietum sieboldii
- Distylio-Cyclobalanopisetum
- Skimmio-Quercetum acutae

II. Substitutional vegetation

- *Castanopsis* coppice forest
- *Quercus serrata* Community
- *Miscanthus sinensis* Community
- *Solidago altissima* Community
- *Pueraria lobata* Community

III. Aquatic vegetation

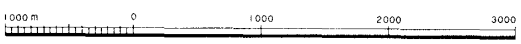
- *Phragmites communis* Community
- *Trapa japonica* Community

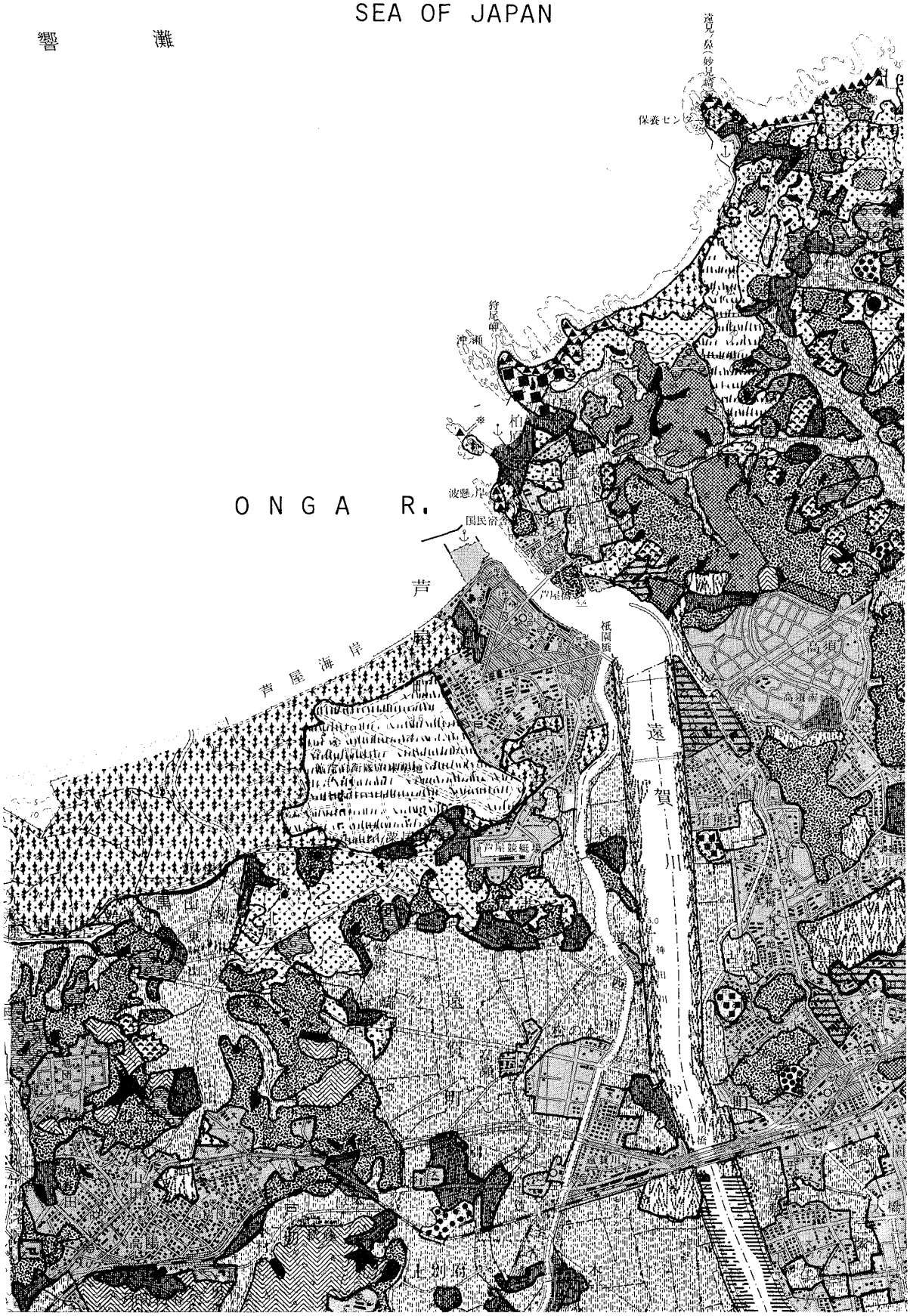
VI. Afforestation and artificial vegetation

- *Pinus thunbergii* afforestation
- *Cryptomeria japonica* & *Chamaecyoaris obtusa* afforestation
- *Phyllostachys heterocycla* var. *pubescens* afforestation
- Evergreen orchard
- Field
- Golf links & airfield
- Paddy-field

V. Others

- Urban district with a few trees
- Urban and residental district with many trees, park & grave yard
- Factory and industrial area
- Denuded land & open water





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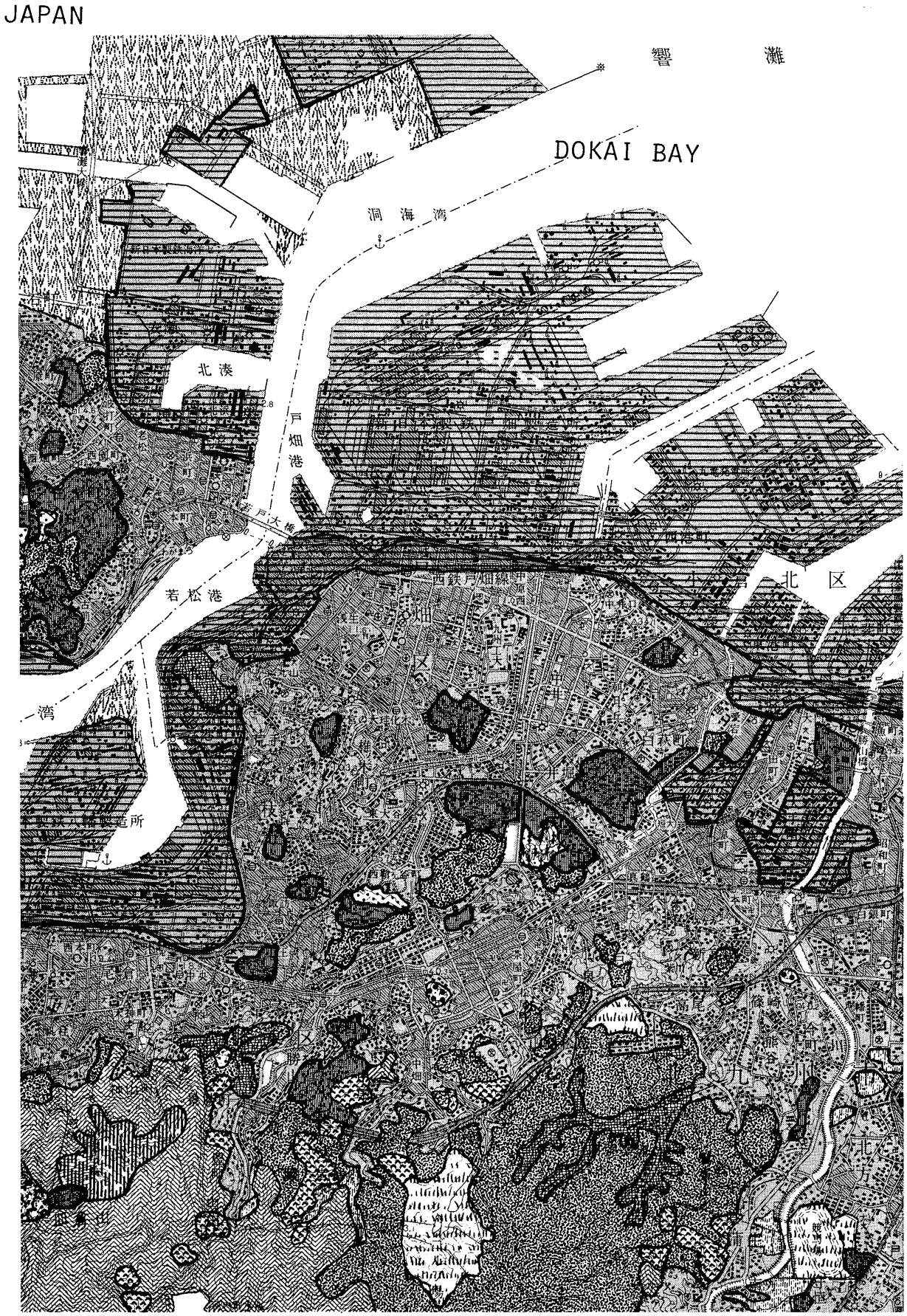

Table 3. Occupation area and its ratio for each community

Community	Occupation area (km^2)		Ratio of area (%)	
Euonymo-Pittosporetum tobirae and Cyrtomio-Litseetum japonicae	0.68	1.93	0.31	0.88
Aphananthe aspera Community	0.22		0.10	
Arisaemeto ringentis-Machiletum thunbergii	0.10		0.05	
Symploco glaucae-Castanopsietum sieboldii	0.66		0.30	
Distylio-Cyclobalanopsietum	0.02		0.01	
Skimmio-Quercetum acutae	0.25		0.11	
Castanopsis coppice forest	30.03	32.53	13.53	14.66
Quercus serrata Community	2.50		1.13	
Miscanthus sinensis Community	0.52	13.17	0.23	6.02
Solidago altissima Community	11.57		5.21	
Pueraria lobata Community	1.28		0.58	
Phragmites communis Community	0.42	0.82	0.19	0.37
Trapa japonica Community	0.40		0.18	
Pinus thunbergii afforestation	4.94	17.79	2.23	8.01
Cryptomeria japonica and *Chamaecyparis obtusa* afforestation	11.11		5.00	
Phyllostachys heterocycla var. *pubescens* afforestation	1.74		0.78	
Evergreen orchard	1.51	31.81	0.68	14.33
Field	7.06		3.18	
Golf link and Airfield	4.28		1.93	
Paddy-field	18.96		8.54	
Urban district with a few trees	75.24	120.31	33.90	54.20
Urban and residental district with many trees, park and graveyard	8.71		3.92	
Factory and industrial area	36.36		16.38	
Denuded land and open water (inland water)	3.39	3.39	1.53	1.53
Total	221.95	221.95	100.00	100.00

in our *Quercus serrata* stands, it has been greatly damaged by beatles and nematodes during the last ten years. Hence, its frequency and dominance were very small in many stands.

12. *Cryptomeria japonca* and *Chamaecyparis obtusa* afforestation

(a) Physiognomy: An evergreen coniferous forest.

(b) Differential species: Species group 11.

(c) Stratification and floristic composition: The height and DBH of the canopy trees varied with the stand age, but its coverage was almost 100%. The stand age was mostly from twenty to thirty years in these areas. The closed canopy darkened the inside of the forest, and subtree and shrub layers were often absent or developed only sparsely. Hence, the flora of the forest floor was very poor. The tree layer in sample plots was at 15 m in height with 100% coverage. Trees were 15–20 cm in DBH. Its forest floor was composed of species group 13 and 14. They were herbs, lianas and seedlings of tree species. Their dominance and sociability were small.

(d) Habitat: Usually *Cryptomeria japonica* trees are planted in thick and humid-mesic soils, while *Chamaecyparis obtusa* trees are planted in thin and mesic-dry soils. Both forests are found widely in Japan, and have become a common landscape of mountaineous regions.

13. *Phyllostachys heterocycla* var. *pubescens* afforestation

(a) Physiognomy: An evergreen bamboo forest.

(b) Differential species: Species group 12.

(c) Stratification and floristic composition: The canopy was at 10−15 m in height with 100% in coverage, and composed of only a *Phyllostachys* bamboo whose DBH was 10−15 cm. Although the forest floor was light due to the sunshine transmitted through the thin leaves of the bamboo canopy, its flora was poor (species group 13 and 14). This poor flora may be caused by the thickly accumulated litter of oligotrophic bamboo matters.

(d) Habitat: This forest was made on a slope behind houses, along gullies between hills, and at the foot of mountains so as to prevent landslides. In addition to this role, the bamboo is used as a material for architecture and handicraft, and its young shoot for food. There was a forest of another bamboo, *Phyllostachys bambusoides*, outside the study area. The forest feature was similar to that of *Phylostachys heterocycla* var. *pubescens*.

Standing Vegetation Map

The standing vegetation map (Fig. 2) shows the actual distribution of forests and other vegetations in our study area on the scale of 1: 50,000. Also, Table 3 shows the outline of the occupation area and its ratio of each vegetation.

A characteristic of this study area is that it was almost covered with substitutional and artificial vegetations, and that natural vegetations remained only on limited places in a small area on steep slopes, on coastal cliffs and in the precincts of a shrine and a temple. Plains were mostly covered by urban and industrial areas and paddy-fields. Forest vegetations including afforestations were limited to hills and mountains except for the *Pinus thunbergii* afforestation on coastal plains. The outline of other vegetations except for forest vegetations was as follows.

The *Miscanthus sinensis* Community was on slopes which have suffered from cyclic mowing and burning. The *Solidago altissima* Community appeared widely on reclaimed or newly constructed lands for residences and factories. Also this herbaceous community was found on banks along rivers, railways and road-sides. The *Pueraria lobata* Community was a mantle community found in open spaces on the hills. The above-mentioned communities are grassland vegetations.

The *Phragmites communis* Community appeared on the flood plain along the Onga River. The *Trapa japonica* Community was found in and on the surface of irrigation ponds of various sizes. There was no vegetation in the reservoirs that supply water to the city and factories. These two communities are aquatic vegetations.

Evergreen orchards (*Citrus* spp.) and fields were concentratively on hills near the estuary of the Onga River. Paddy-fields were seen on the west side of the Onga River. It was identified as Sagittario-Monochorietum Miyawaki 1960. The golf links and airfield were other grassland vegetations.

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北九州市北西部および近隣地の植生

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要　旨: 北九州市北西部および近隣地の森林植生82スタンドを調査した．それらは種組成上，ⅰ）マサキ-トベラ群集，ⅱ）オニヤブソテツ-ハマビワ群集，ⅲ）ムクノキ群落，ⅳ）ムサシアブミ-タブ群集，ⅴ）ミミズバイ-スダジイ群集，ⅵ）イヌシデ-スタジイ群落，ⅶ）イスノキ-ウラジロガシ群集，ⅷ）ミヤマシキミ-アカガシ群集，ⅸ）シイ萌芽林，ⅹ）クロマツ植林，ⅹⅰ）コナラ群落，ⅹⅱ）スギ・ヒノキ植林，ⅹⅲ）モウソウチク植林に区分された．北九州市付近のムサシアブミ-タブ群集，ミミズバイ-スダジイ群集は，西九州地方の同群集に比べ標徴種が少なく，群集の単純化現象がみられた．1:50,000現存植生図を描いた．調査地の約56%は宅地・工場であり，森林植生は約24%（自然林は1%未満）で，都市化が著しい．

J. UOEH（産業医大誌），7（2）: 151−173（1985）