

Article

Biotope Mapping and Nature Conservation in Cities

Part 2: Results of Pilot Study in the Urban Agglomeration of Tokyo
(Yokohama City)¹⁾

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都市におけるバイオトープ地図化

2. 東京周辺の都市集中地域—特に横浜市におけるパイロットスタディの結果について¹⁾

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Synopsis

Biotope mapping involves an investigation of flora, vegetation, fauna and their habitats within the context of nature conservation. Biotope mapping is done in many European cities. The results are an important basis for nature conservation and infrastructure planning. In contrast, similar standardised investigations so far do not exist in Japan. Therefore, in the urban agglomeration of Tokyo-Yokohama, a pilot study was started in the summer of 1996 in order to test this method in Japan. Two test areas were selected: area 1 around the campus of the Yokohama National University and area 2 around Minato Mirai. These areas were selected for two reasons: 1) actual data of flora and vegetation already exist for the university campus; and 2) the areas include many different land-use types, which are typical for the agglomeration of Tokyo. For the investigation, a modification of the representative mapping method was used. After the investigation of the land-use types and after checking the biologically rich areas, an evaluation was done. In this way, areas worthy of protection were selected and described in more detail by standardised forms. The high number of biotopes worthy of protection in test area 1 is remarkable, when one compares the two test areas. By reasons are the hilly morphology and the development of settlements in recent times, areas with a steeper slope especially remained for spontaneous nature, mainly secondary forests as the dominant biotope type, followed by grass-dominated ruderal vegetation. In contrast, in test area 2, which belongs to the old city of Yokohama and has been settled for a long time, only a few areas remained for nature. Dominant biotope types worthy of protection are mainly parks and herbaceous ruderal vegetation. The pilot study shows that, by using this method, many information can be collected in a relatively short time, which is important for nature conservation in the city. Each biotope type is very important for ecosystems, but, a hierarchy for evaluation of biotope types is needed, because the Japanese land area is narrow and limited. Which kind of biotopes are more important and which should have priority for protection. These kind of studies should be continued.

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(Accepted Dec. 10, 1997)

1. Introduction

Nature conservation in cities has advanced in the last decades in many industrial countries, connected with the rapidly increasing urban population (e. g. Adams & Leedy 1988, Goode 1989, Muller 1997, Sukopp 1990, Sukopp & Sukopp 1987, Sukopp & Werner 1982, 1988). Nature conservation in cities focuses on the conservation of at least a minimum number of plants and animals, and their habitats (biotopes). These should be conserved as a basis for direct contact between urban dwellers and the natural elements of their surroundings, and in order to preserve biodiversity, and to improve the quality of the environmental media: air, water and soil.

The growing concern for urban nature is illustrated by the "Green Paper on the Urban Environment" published by the European Community (1990), which stresses the importance of nature conservation in cities. In Germany, for example, a special law for nature conservation demands that nature be conserved, maintained and developed in populated areas as well as in unpopulated areas.

In the 1970s, investigations started in Germany in order to take inventory of the habitats of flora and fauna which are important for nature conservation in cities (Starfinger & Sukopp 1994, Sukopp & Weiler 1988). The investigations, which became famous as "biotope mapping", focus mainly on floristic and phytosociological features. Additionally, some animal populations are studied (cf. Müller 1997). In general "biotope mapping" involves the investigation of plants and animals, their habitats (biotopes) and the assessment for nature conservation.

In contrast to most European countries, where biotope mapping is an important basis for nature conservation, similar standardised investigation methods so far do not exist in Japan. Therefore, in the urban agglomeration of Tokyo-Yokohama, a pilot study was started in the summer of 1996 in order to test this method in Japan.

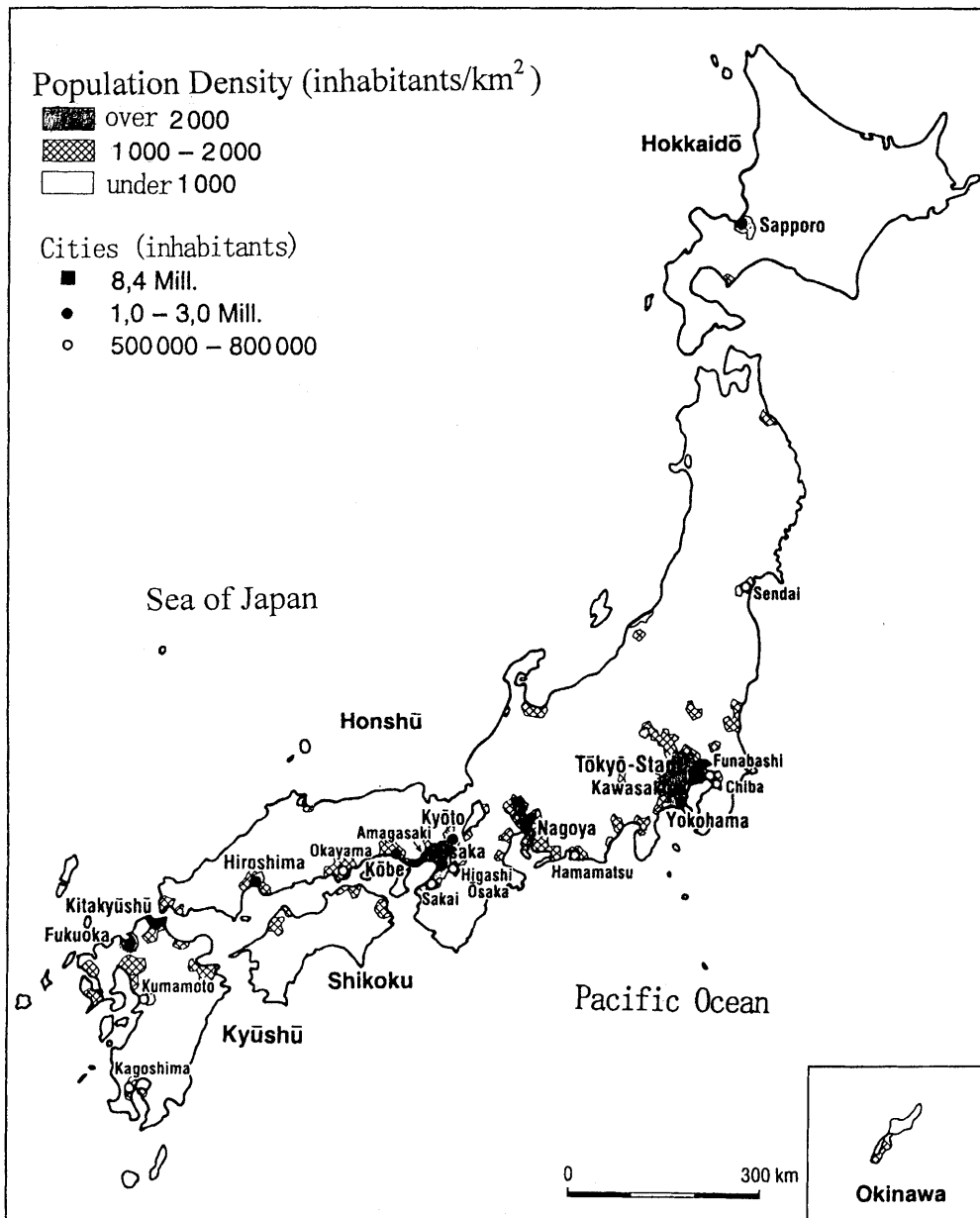
The background for this study and general features of urban habitats and methods of biotope mapping were explained in a recently published paper (Müller 1997). Methods and first results of the pilot study are presented in this publication, along with recommendations for the future.

2. General Features of Japanese Cities

Japan is among the most densely populated countries of the world. In general, the archipelago is characterised by a high concentration of the population in cities, which are mainly situated on flat areas along the coastline. In the year 1990, 59% of the total population lived in cities (more than 100,000 inhabitants) and 21% in cities with more than one million inhabitants (Fluchter 1994). There are 10 cities with more than 1 million people and 21 cities with more than 0,5 Mill. inhabitants. The main urban agglomerations concentrate around Tokyo, Nagoya and Osaka, where more than 2000 inhabitants per square km are living (Fig.1). In general, the few flat areas along the coast are populated densely, whereas the hilly and mountainous areas remain unsettled or have a low population density.

The fast growth of settlements after the industrial period is typical in Japan. Besides the expansion of settlements in the open landscape, the reclamation of new land along the coast is typical. In order to satisfy the high demand for land in Tokyo Bay, The sea is filled with soil and rubbish to create new areas for settlement and industry.

Due to fast growth in this century and the high frequency of disasters such as earthquakes, and subsequent fires, there are few old settlements and old green spaces in Japanese cities compared with European. An exception and particular characteristics of Japan are Shinto shrines



Quelle: 1985 Population Census Population Maps of Japan, Part 2, Nr. 2; Population Density by Shi, Machi and Mura.

Bearbeitung: W. Flüchter

Fig. 1 Population density of Japan (from Flüchter 1994)

and Buddhist temples, where the woody vegetation has remained untouched since ancient times. Therefore relics of old forests can often be found (e. g. Miyawaki et al. 1980, Okuda 1972). Typical for urban habitats is the high number of alien plants, which have their origin mainly in Europe and North America (Asai 1993).

3. Methods

In order to test the European method for biotope mapping in a short time and with a small staff, the pilot study in the urban agglomeration of Tokyo was done at only two test areas in Yokohama City.

A modified method for the representative mapping was used for the investigation. After investigation of the land-use types and after checking the biologically rich areas, an evaluation was done. In this way, only areas worthy of protection were selected. A demonstration of all areas which are important for nature conservation (e. g. special land-use types which are important as corridors in the city) was not possible, due to the small size of the test areas.

3.1 Selection of the test areas

Many investigations in cities have shown (e. g. Gilbert 1991) that the land-use types are homogeneous habitats for flora, vegetation and wildlife. The test areas were selected in such a way that many typical land-use types of the urban agglomeration of Tokyo would be represented. Investigations were done: a) around the campus of Yokohama National University - test area 1; b) around Minato Mirai - test area 2.

3.2 Checking of the available biological data

Actual data of flora and vegetation exist for parts of test area 1, the campus of Yokohama National University (Okuda 1994, Thoma et al. 1994). Further basic information sources include old and actual vegetation maps of Yokohama City (Miyawaki et al. 1972, Yokohama City 1993).

3.3 Mapping of the land-use types

The land-use types were marked and controlled by field investigations on the basis of aerial photos at the scale 1: 4000. In this way, the biologically rich areas were marked, i. e. areas with a high amount of spontaneous vegetation and low human impact, e. g. green spaces, abandoned land, forests and plantations, agricultural areas, special land-use types with a high amount of green space and low-density development. They were investigated in more detail in the next step.

3.4 Checking the biologically rich areas and evaluation of biotopes worthy of protection

By field investigation, representative samples of flora and vegetation of the biologically rich areas were investigated. Relevés from typical plant communities and lists of the dominating vascular plants were compiled. Afterwards, the areas worthy of protection were selected and described with standardised forms. The fundamental parameters for all sites were:

- *Reproducibility and age of the site* - areas which are replaceable in the long or medium term (at least 3 - 4 years) were mapped.
- *Size* - for the selection of a biologically rich area the minimum size was in general 0.2 ha.

Additionally, at least one of the following parameters was necessary for selection as a biotope worthy of protection:

- *Spontaneous occurrence of the site* - areas with a typical spectrum of spontaneous species;
- *Structural variety of the site* - areas with a high variety of vegetation types and age (e. g. green spaces with different vegetation types, such as lawns, shrubs and plantations);
- *Rarity of a site and of the spontaneous species* - areas which are rare or contain rare species in settlements (e. g. wetlands and natural forests).

3.5 Summarising the data and displaying the results

After the field investigations maps were drawn at the scale 1: 5000 from the a) land-use types, b) biotopes - biologically rich and worthy of protection.

The biotopes worthy of protection were summarised on standardised forms with a short description of the biotope, the characteristic and dominant plants and special suggestions for further management, etc. (cf Table 1). Finally, a list with a short description of the biotopes worthy of protection was made.

4. Areas Studies and Land-use Types

4.1 Test area 1 - around the campus of the Yokohama National University

The test area is situated west of the centre of Yokohama and characterised by a hilly morphology (Fig. 2). The potential natural vegetation of the area is evergreen forest (*Quercetum myrsinaefoliae*) (Miyawaki et al. 1972). Today, low-density development with many private gardens dominates the test area (Fig. 2).

The southern part includes the campus of Yokohama National University (mapped as special land-use type "university"). The university was founded on a hill in the year 1949. Today the area includes vacant land at different ages due to the initial reservation of larger areas for the further development of the university. The high number of secondary forests, which is almost 50 years old, is remarkable. The forests remain on steep hills as relics of the former land-use. The forests have been cut regularly in order to get firewood. Larger agricultural areas are situated in the northern part of the test area. Mainly vegetables such as cabbage are cultivated here. Also larger areas for traffic can be found here, such as a goods depot and a highway. Larger vacant and/or abandoned areas are situated on the University campus and in the agricultural area.

4.2 Test area 2 - around Minato Mirai

The area embraces the old port of Yokohama - the leading international port in Japan, which was opened in the year 1859. The potential natural vegetation of the area is evergreen forest (*Polysticho-Perseetum thunbergii*) (Miyawaki et al. 1972).

Today the flat area along the sea is settled densely with a high concentration of buildings (Fig. 3). Dominant land-use types are high-density development, areas for traffic (main roads, parking areas) and multi-storey building development. Along the coastline are industrial areas. All these land-use types show high paved areas. Larger unpaved areas with waste grounds can be found only along the railways. There are three large public parks and several smaller intensively managed public green spaces mainly along the coast.


A particularity of the test area is reclaimed land. It can be found along all of Tokyo bay (cf Miyawaki et al. 1975). New areas for settlements are created by filling up the sea with soil and other deposits. In the test area, a modern city (Minato Mirai 21) is in development on filled land. New multi-storey buildings are dominant here beside younger vacant land for further development.

5. Biotopes Worthy of Protection

In this chapter the biotopes worthy of protection are described briefly, by their vegetation and their characteristic species. A short description of all biotopes appears in the appendix (Table 2 and 3). More detailed information about plant communities can be found in Tohma et al. 1994

Table 1 Example of a form for a biotope worthy of protection

Biotope Mapping Japan - Urban areas						Biotope No.: 1	
Prefecture	Kanagawa	City	Yokohama	Map No.: 1	Scale: 1: 4500	Rev. No.	
Researcher	Müller N. & Tohma H.			Invest. Date	Year: 1996	Month: 7	Day: 17
Location	Southwestern part of Yokohama National University campus						
Size (m ²)	10660	No. of sections	2	Adjoining biotopes (No.)	2.1/ 3.1		
Landuse	forest			Landuse in the surrounding	University Campus		
Scope of replacement	high			Disturbance & endangering	trash deposit		
Biotope description: biotope structure, plant communities, history (e.g. former landuse), importance for nature conservation	<p><i>Old Cinnamomum camphora plantation with a rich herb and shrub layer.</i></p> <p><i>Originally this area was a Pinus densiflora - Quercus serrata forest, which was cut in 1930 for the construction of a golf course. At that time the Cinnamomum camphora trees were planted and the area was used as a golf course until the foundation of the university campus in 1968.</i></p> <p><i>After the establishment of the university the area was abandoned and the plantation developed undisturbed.</i></p>						
Recommendations for nature conservation & management	<p><i>-protection and undisturbed development and</i></p> <p><i>-removal of trash deposit</i></p>						

<p>Dominant & characteristic plants</p>	<p><u>Trees:</u> <i>Cinnamomum camphora</i></p> <p><u>Shrubs:</u> <i>Aucuba japonica</i> <i>Cornus controversa</i> <i>Fatsia japonica</i> <i>Hedera rhombea</i> <i>Ligustrum japonicum</i> <i>Magnolia kobus</i> <i>Nandina domestica</i></p> <p><u>Herbs:</u> <i>Houttuynia cordata</i> <i>Ophiopogon ohwii</i> <i>Rohdea japonica</i></p>				
<p>Observed animals</p>					
<p>Literature</p>	<p><i>Kitagawa, M., Miyawaki, A., Kawamura, Y. 1968: Vegetation and ecological survey of Yokohama National University Campus. The News of Yokohama National University: 1-13, incl. vegetation map</i></p> <p><i>Okuda, S. 1994: Flora of Yokohama National University, Tokiwadia Campus. Bull. Inst. Environ. Science & Techn. Yokohama National University 20: 147-159</i></p> <p><i>Tohma, H., Ishii, S. & Fujiwara, K. 1994: Actual vegetation in the Yokohama National University Campus - Vegetation change over 25 years. Bull. Inst. Environ. Science & Techn. Yokohama National University 20: 31-96, incl. vegetation map</i></p>				
	<p>Contact people: <i>Prof. Dr. K. Fujiwara, H. Tohma & Prof. Dr. S. Okuda, Yokohama National University Institute Environmental. Science & Technology</i></p> <table border="1" data-bbox="765 1541 1167 1725"> <tr> <td data-bbox="765 1541 971 1638">Date of photo</td> <td data-bbox="971 1541 1167 1638"><i>Jan. 1997</i></td> </tr> <tr> <td data-bbox="765 1638 971 1725">by</td> <td data-bbox="971 1638 1167 1725"><i>N. Müller</i></td> </tr> </table>	Date of photo	<i>Jan. 1997</i>	by	<i>N. Müller</i>
Date of photo	<i>Jan. 1997</i>				
by	<i>N. Müller</i>				

Biotope Mapping Japan
- Urban Areas

Pilot Study in the City of Yokohama
(Urban Agglomeration of Tokyo)

Test area 1:
around Yokohama National University

conducted by:
Norbert Müller
surveyed October - December 1996

in collaboration with:
Vitya Müller, Yoshinobu Kusumoto, Hiroko Tohma
& students of the seminar 'Biotope Mapping'

Yokohama National University
Institute of Environmental Science & Technology
Department of Vegetation Science

都市域におけるバイオトープマッピング

横浜市におけるパイロットスタディ
(東京の密集都市)

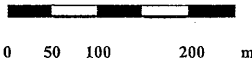
テストエリア 1:
横浜国立大学周辺

総指揮:
ノルベルト ミュラー
調査期間: 1996年10~12月

協同研究者:
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横浜国立大学
環境科学研究センター
植生学研究室

original scale 1 : 4.500

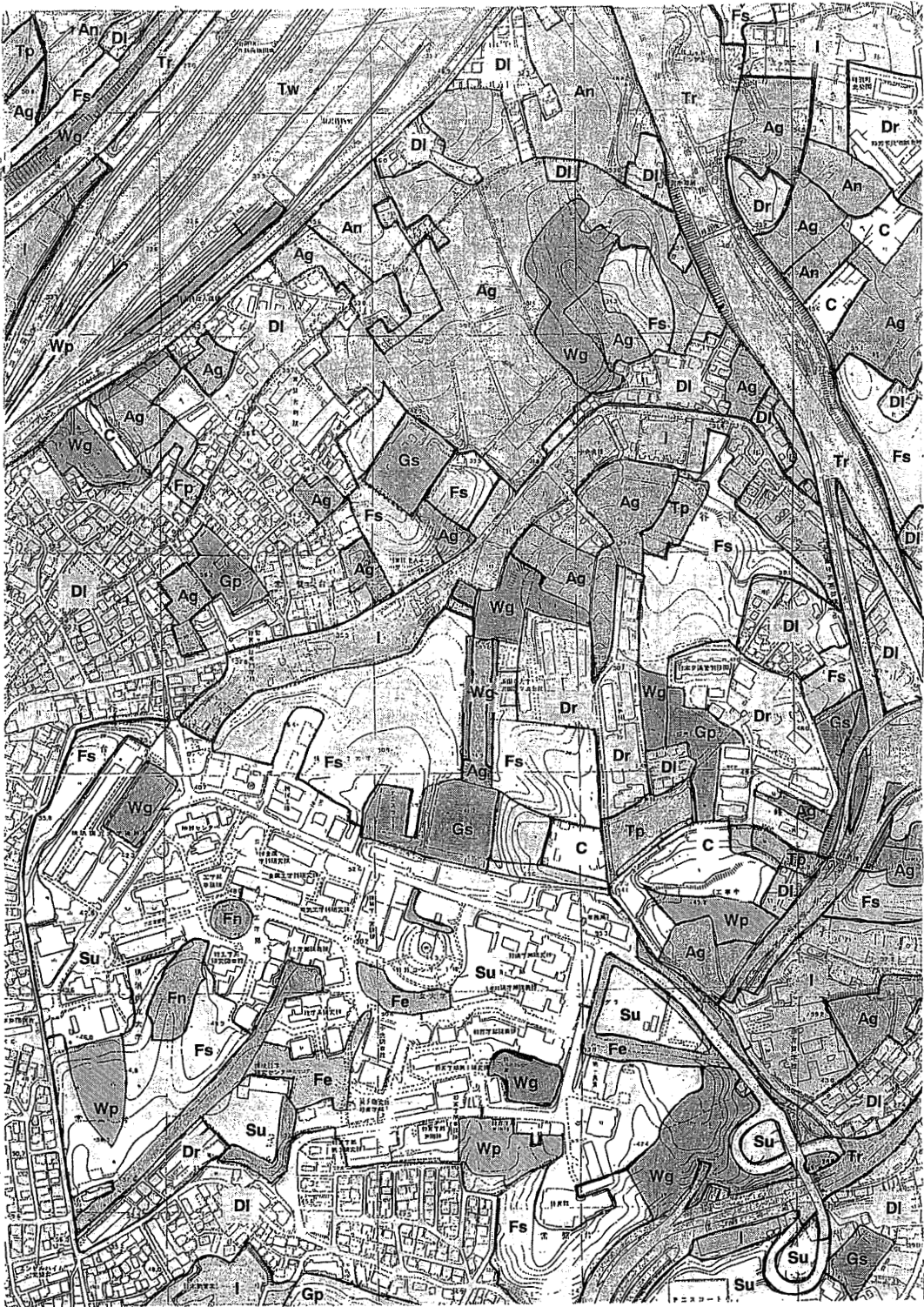


1. Stock taking:
Biotope- and land use types

1. 実績調査:
バイオトープタイプ - 土地利用タイプ

Development		開発地
low density development	Di	低密度開発地
ribbon development	Dr	带状開発地
Special land use		特殊な土地利用
university	Su	大学
Industrial areas	I	工業域
Construction areas	C	造成地域
Traffic areas		交通域
main roads, highways	Tr	主要道路, 高速道路
parking areas	Tp	駐車場
railways	Tw	鉄道
Agricultural areas		農耕地
market gardens	Ag	野菜畑
nurseries	An	苗圃
Green spaces		緑地
sports grounds & intensively managed green spaces	Gs	運動公園 & 集中管理緑地
parks	Gp	公園
Forests		森林
forests dominated by summergreen trees	Fs	夏緑広葉樹が優占する森林
forests dominated by evergreen trees	Fj	常緑広葉樹が優占する森林
environmental protection forests	Fe	環境保全林
plantations	Fp	植林
Waste grounds		放棄地
older waste grounds(perennial herbs dominating)	Wp	古い放棄地 (多年生草本優占地)
older waste grounds(grasses dominating)	Wg	古い放棄地 (イネ科草本優占地)

Fig. 2 Land-use types of test area 1



Biotope Mapping Japan
- Urban Areas

Pilot Study in the City of Yokohama
(Urban Agglomeration of Tokyo)

Test area 2: around Minato Mirai

conducted by :
Norbert Müller
surveyed October - December 1996

in collaboration with:
Vitya Müller, Yoshinobu Kusumoto
& students of the seminar 'Biotope Mapping'

Yokohama National University
Institute of Environmental Science & Technology
Department of Vegetation Science

都市域におけるバイオトープマッピング

横浜市におけるパイロットスタディ
(東京の密集都市)

テストエリア 2: みなとみらい地区周辺

総指揮:
ノルベルト ミュラー
調査期間: 1996年10~12月

協同研究者:
ヴァイタ ミュラー、楠本 良延
& バイオトープマッピングのセミナーの学生

横浜国立大学
環境科学研究センター
植生学研究室

original scale 1 : 5.000



0 50 100 200 m

N



1. Stock taking:
Biotope- and land use types

1. 実績調査:
バイオトープタイプ - 土地利用タイプ

Development high density development multi-storey building development	Dm	開発地 高密度開発地
	Dh	多目的高層ビルディング開発地
Special land use museum	Sm	特殊な土地利用 博物館
Industrial areas	I	工業域
Construction areas	C	商業域
Traffic areas main roads, highways parking areas railways harbours	Tr	交通域 主要道路, 高速道路
	Tj	駐車場
	Tr	鉄道
	Tb	港
Green spaces sports grounds & intensively managed green spaces parks	Gs	緑地 運動公園 & 集中管理緑地
	Gp	公園
Waste grounds young waste grounds(annual species dominating) older waste grounds (perennial herbs dominating) older waste grounds (grasses dominating)	Wa	放棄地 新しい放棄地 (一年生の種優占地)
	Wp	古い放棄地 (多年生草本優占地)
	Wg	古い放棄地 (イ科草本優占地)

Fig. 3 Land-use types of test area 2

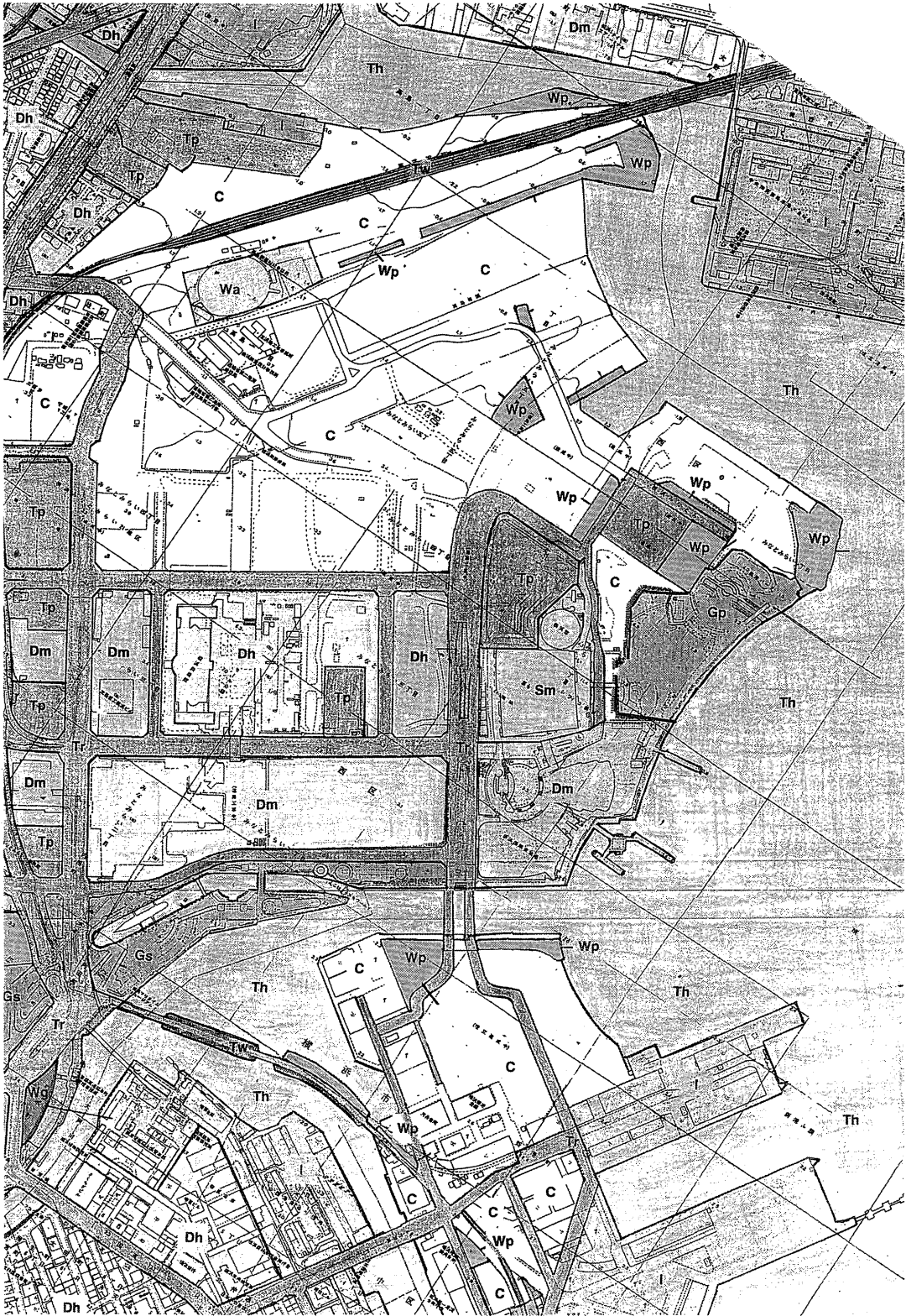


Table 2 Short description of the biotopes worthy of protection in test area 1.
Arround Yokohama National University

List of Biotopes					
No. of Bio- tope	Short description	Location	Size (ha)	No. of sect- ions	Date of investigation (month/day/year) & researcher
1	Old plantation (dominated by <i>Cinnamomum camphora</i>)	South-west part of University Campus	1,1	2	07/17/96 Mü N. & To
2	Environmental protection forest with species of the pot. nat. vegetation (dominated by <i>Persea thunbergii</i> and <i>Quercus</i> spp.) 20 years old	In different areas of west part of University Campus	2,2	4	10/31/96 Mü N. & al.
3	Secondary forest about 30 years old	West part of University Campus	3,5	2	11/14/96 Mü N. & al.
4	Perennial ruderal community (dominated by <i>Pueraria lobata</i>)	West part of University Campus	0,6	1	11/14/96 Mü N. & al.
5	Wet grassland community (dominated by <i>Phragmites australis</i>)	University Campus in rainwater pool	0,5	1	11/14/96 Mü N. & al.
6	Wasteland area with different stages of succession (<i>Solidago altissima</i> -community, <i>Miscanthus sinensis</i> -grassland and some plantations)	South-east of the main entrance of University Campus	1,5	1	11/21/96 Mü N. & al.
7	Perennial ruderal communities	South border of University Campus	0,6	1	11/28/96 Mü N. & al.
8	Secondary forest and <i>Cryptomeria japonica</i> plantation	South border of University Campus	1,9	1	11/28/96 Mü N. & al.
9	Secondary forest (dominated by <i>Cornus controversa</i> & <i>Prunus jamasakura</i>)	University Campus (9/1) north of University Campus (9/2)	5,4	3	12/09/96 Mü N., Mü V., Ku & To
10	Secondary forest (dominated by <i>Quercus serrata</i> & <i>Styrax japonica</i>)	North of University Campus	0,4	1	12/09/96 Mü N., Mü V., Ku & To
11	<i>Pleioblastus</i> grassland	North of University Campus	0,2	2	12/09/96 Mü N., Mü V., Ku & To
12	Old environmental protection forest	Centre of University Campus	0,7	1	06.01.97 Mü N. & Mü V.
13	Plantation with summergreen trees	Centre of University Campus	0,3	1	06.01.97 Mü N. & Mü V.
14	Public park with <i>Cinnamomum camphora</i> plantation	South of University Campus	0,3	1	1/6/97 Mü N. & Mü V.
15	Wasteland on rich soil with perennial ruderal communities	North-east of University Campus	0,6	1	1/6/97 Mü N. & Mü V.

16	Remnant of old plantation (dominated by <i>Cryptomeria japonica</i>)	East of University Campus	0,2	2	12/16/96 Mü V. & To
17	<i>Miscanthus</i> grassland	North-west of University Campus at highway embankment	0,5	3	06.01.97 Mü N. & Mü V.
18	Secondary forest	North-west of University Campus along the highway	0,7	2	06.01.97 Mü N. & Mü V.
19	Public park with <i>Prunus yedoensis</i> plantation	East of University Campus	0,6	1	12/16/96 Mü V. & To
20	Secondary forest (dominated by <i>Quercus serrata</i>)	East of University Campus	0,4	1	12/16/96 Mü V. & To
21	Secondary forest	North-east of University Campus west of highway	2,4	1	06.01.97 Mü N. & Mü V.
22	<i>Miscanthus</i> grassland	north of University Campus	0,7	1	06.01.97 Mü N. & Mü V.
23	Secondary forest	North of University Campus	1,6	1	12/19/96 Mü N. & al.
24	<i>Pleioblastus</i> grassland & remnant of secondary forest	North of University Campus	1,3	1	12/19/96 Mü N. & al.
25	Secondary forest	North of University Campus	1,2	4	12/19/96 Mü N. & al.
26	Old plantation with summergreen trees	North of University Campus	0,3	1	01/07/97 Mü N., Mü V. & Ku
27	<i>Pleioblastus</i> grassland with remnants of secondary forest	North of University Campus	0,7	2	01/07/97 Mü N., Mü V. & Ku
28	Annual and perennial ruderal communities on rough gravel (dry and wet sites)	Railway area north of University Campus	0,2	1	01/07/97 Mü N., Mü V. & Ku
29	<i>Miscanthus</i> grassland	Highway and railway embankment north of University Campus	0,7	2	01/07/97 Mü N., Mü V. & Ku
30	Secondary forest	North of University Campus		1	01/07/97 Mü N., Mü V. & Ku
31	Old private park	North of University Campus	0,5	1	01/07/97 Mü N., Mü V. & Ku
32	Secondary forest along a highway	North east of University Campus	1,2	2	1/20/1997 Mü N. & Mü V.

Abbreviations: Mü N. = Müller, N., To = Tohma H., Mü V. = Müller V., Ku = Kusomoto, Y.

Table 3 Short description of the biotopes worthy of protection in test area 2.
Around Minato Mirai.

List of Biotopes					
No. of Bio- tope	Short description	Location	Size (m ²)	No. of sections	Date of investigation (month/day/year)
1	Old park mainly with evergreen trees, ornamental beds & Japanese garden	Yokohama Park, Kannai	3,2	1	12/14/96 Mü N. & Mü V.
2	Perennial ruderal communities (dominated by <i>Artemisia princeps</i> & <i>Solidago altissima</i>) between old industrial buildings	Island of Shinko-cho	0,4	3	12/14/96 Mü N. & Mü V.
3	Perennial ruderal communities (dominated by <i>Aster subulatus</i>) along a recently constructed road	Island of Shinko-cho	0,8	2	12/14/96 Mü N. & Mü V.
4	Old park with evergreen trees, lawns and ornamental beds	Yamashita Park, Kannai, at the seaside	1,6	1	12/15/96, 01/13/97 Mü N., Mü V., Ku & Na
5	Different perennial ruderal communities on construction area	Eastern part of Minato Mirai	0,9	5	01/04/96 Mü N. & Mü V.
6	Young park (founded about 1993), mainly with single trees, ornamental beds and lawns	Seaside Park, eastern part of Minato Mirai, at the seaside	3,9	1	01/04/96 Mü N. & Mü V.
7	Perennial ruderal communities, on construction area	Eastern part of Minato Mirai, north of Seaside Park at the seaside	1,3	2	01/04/96 Mü N. & Mü V.
8	Permanent ruderal communities beside a recently created green space	Island of Shinko-cho	1,1	1	01/04/96 Mü N. & Mü V.
9	Former larger abandoned land area along railway, with perennial ruderal communities and grasslands	Northern part of Minato Mirai	1,6	4	01/13/96 Mü N., Ku & Na
10	Ruderal grassland on wasteland area (dominated by <i>Miscanthus sinensis</i>) along the port	At Sakuragicho station	0,3	1	01/13/96 Mü N., Ku & Na
11	Annual and perennial ruderal communities	At Sakuragicho station	0,8	1	01/16/96 Mü N., Ku & Na

Abbreviations: Mü N. = Müller, N., Mü V. = Müller V., Ku = Kusomoto Y., Na = Nagaoka F.

(campus of Yokohama National University), in Miyawaki et al. (1972) and Yokohama City (1993) (vegetation of Yokohama). A flora of the campus of Yokohama National University was published by Okuda (1994).

5.1 Test area 1 - around the campus of the Yokohama National University (Fig. 4)

Almost 18 % of the test area was covered with secondary forests (*Prunus jamasakura* - *Cornus controversa* community). Characteristic species are summergreen trees, such as *Prunus jamasakura* and *Cornus controversa*. In the dense shrub layer, the main species are *Aucuba japonica* and *Fatsia japonica*. *Pleioblastus chino* often dominates in the herb layer. A relict of a primary forest with evergreen trees (*Ardisio-Castanopsietum sieboldii*) remains in the centre of the University campus. Many environmental protection forests were planted in the campus area 20 years ago. Evergreen trees (*Persea thunbergii*, *Quercus* div. spec., *Castanopsis cuspidata* var. *sieboldii*, etc.) of the potential natural vegetation were used for these plantations. Since then, many native species of shrubs and herbs of the evergreen forest have invaded. Some old plantations (mainly with *Cinnamomum camphora*) were mapped as biotopes worthy of protection due to their natural herb and shrub layers. In grass-dominated old abandoned areas *Miscanthus sinensis* and *Pleioblastus chino* form a dense layer. An earlier stage of succession on vacant areas is dominated by perennial herbs. Due to human impact and the nutrient conditions in the soil, different plant communities have arisen. Dominant communities with the native pioneer species *Polygonum cuspidatum* or the alien species *Solidago altissima* are common on episodically disturbed areas. Many alien species (e. g. *Aster subulatus*, *Oenothera biennis*) are also characteristic for dry sites along the railway area. On fresh and nutrient-rich sites, liana communities with *Pueraria lobata* are characteristic.

5.2 Test area 2 - around Minato Mirai (Fig. 5)

This area shows fewer biologically rich areas. Parks and abandoned land with herbaceous ruderal vegetation cover about 2 percent of the whole area studied. Older large parks are the Yokohama Park and the Yamashita Park. Yamashita Park was founded on the area reclaimed with garbage from the Kanto Dai-Shinsai earthquake (in 1923). It is the oldest public park in Yokohama. The main plantation trees in Yokohama Park are *Castanopsis cuspidata* var. *sieboldii* and *Zelkova serrata*. In the older Yamashita Park *Lithocarpus edulis* and *Myrica rubra* are most commonly planted trees. Both green spaces are used frequently for recreation. Therefore the *Zoysia japonica* lawns are partly reduced by trampling to communities with *Poa annua* and *Taraxacum officinale*.

The seaside park, a young park, has until now had less spontaneous vegetation. Transplanted lawns, ornamental beds and solitary trees form this new park, constructed in the year 1994. The main planted trees are *Myrica rubra*, *Cinnamomum camphora* and *Pinus thunbergii*. Different old abandoned areas, situated mainly on reclaimed land, were studied as biotopes worthy of protection. In general these are remnants of former larger abandoned areas which are now under construction or already settled. The main species of the herbaceous ruderal vegetation are *Artemisia princeps*, *Oenothera biennis*, *Bidens pilosa* and *Solidago altissima*. On younger sites *Aster subulatus* is dominant. Tree seedlings of *Cinnamomum camphora*, *Ailanthus altissima* and *Celtis sinensis* are frequent. Naturalized cats are conspicuous in the parks and vacant land of the Minato Mirai area.

Biotope Mapping Japan
- Urban Areas

Pilot Study in the City of Yokohama
(Urban Agglomeration of Tokyo)

Test area 1:
around Yokohama National University

conducted by:
Norbert Müller
surveyed October - December 1996

in collaboration with:
Vitya Müller, Yoshinobu Kusumoto, Hiroko Tohma
& students of the seminar 'Biotope Mapping'

Yokohama National University
Institute of Environmental Science & Technology
Department of Vegetation Science

都市域におけるバイオトープマッピング

横浜市におけるパイロットスタディ
(東京の密集都市)

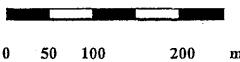
テストエリア 1:
横浜国立大学周辺

総指揮:
ノルベルト ミュラー
調査期間: 1996年10~12月

協同研究者:
グイテフ ミュラー, 楠本良延, 藤間照子
& バイオトープマッピングのセミナーの学生

横浜国立大学
環境科学研究センター
植生学研究室

original scale 1 : 4.500



2. Evaluation: Important biotopes -
biologically rich and worthy of protection

2. 評価: 重要なバイオトープ -
豊富な生物相, および保護の価値

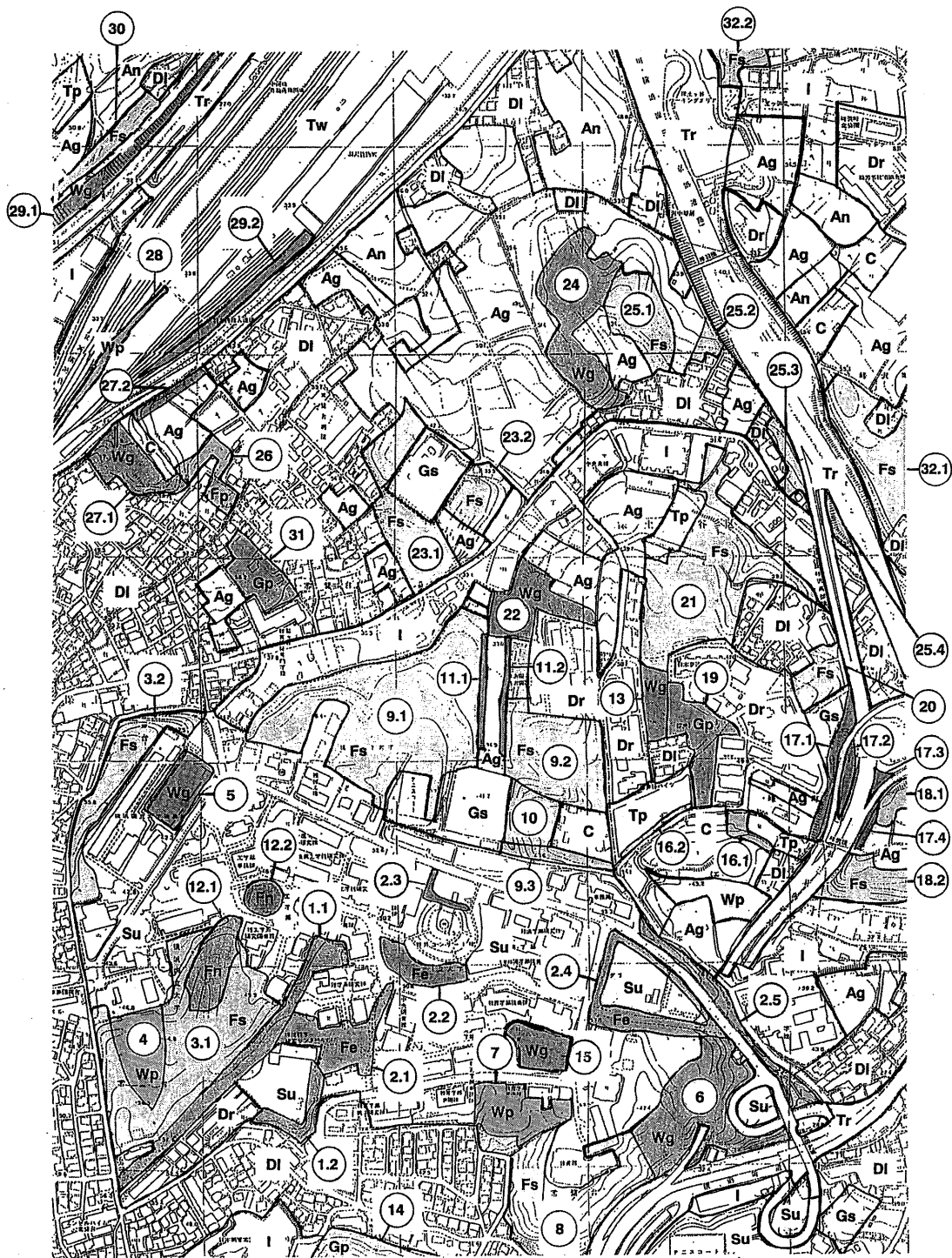
Investigation No. of biotopes, biologically rich and worthy of protection	③ バイオトープの調査地数, 豊富な生物相, および保護の価値
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Biotope- and land use types

バイオトープタイプと, 土地利用タイプ

Development		開発地
low density development	DI	低密度開発地
ribbon development	Dr	帯状開発地
Special land use		特殊な土地利用
university	Su	大学
Industrial areas	I	工業域
Construction areas	C	造成地域
Traffic areas		交通域
main roads, highways	Tr	主要道路, 高速道路
parking areas	Tp	駐車場
railways	Tw	鉄道
Agricultural areas		農耕地
market gardens	Ag	野菜畑
nurseries	An	苗圃
Green spaces		緑地
sports grounds & intensively managed green spaces	Gs	運動公園 & 集中管理緑地
parks	Gp	公園
Forests		森林
forests dominated by summergreen trees	Fs	夏緑広葉樹が優占する森林
forests dominated by evergreen trees	Fb	常緑広葉樹が優占する森林
environmental protection forests	Fe	環境保全林
plantations	Fp	植林
Waste grounds		放棄地
older waste grounds (perennial herbs dominating)	Wp	古い放棄地 (多年生草本優占地)
older waste grounds (grasses dominating)	Wg	古い放棄地 (イネ科草本優占地)

Fig. 4 Biotopes worthy of protection in test area 1



Biotope Mapping Japan
- Urban Areas

Pilot Study in the City of Yokohama
(Urban Agglomeration of Tokyo)

Test area 2: around Minato Mirai

conducted by:
Norbert Müller
surveyed October - December 1996

in collaboration with:
Vitya Müller, Yoshinobu Kusumoto
& students of the seminar 'Biotope Mapping'

Yokohama National University
Institute of Environmental Science & Technology
Department of Vegetation Science

都市域におけるハ'イotope' マッピング

横浜市におけるパイロットスタディ
(東京の密集都市)

テストエリア 2: みなとみらい地区周辺

総指揮:
ノルベルト ミュラー
調査期間: 1996年10~12月

協同研究者:
グイテフ ミュラー, 楠本良延
& ハ'イotope' マッピング' のセミナーの学生

横浜国立大学
環境科学研究センター
植生学研究室

original scale 1 : 5.000



0 50 100 200 m



2. Evaluation:
Important biotopes - biologically rich
and worthy of protection

2. 評価:
重要なハ'イotope' - 豊富な生物相
および保護の価値

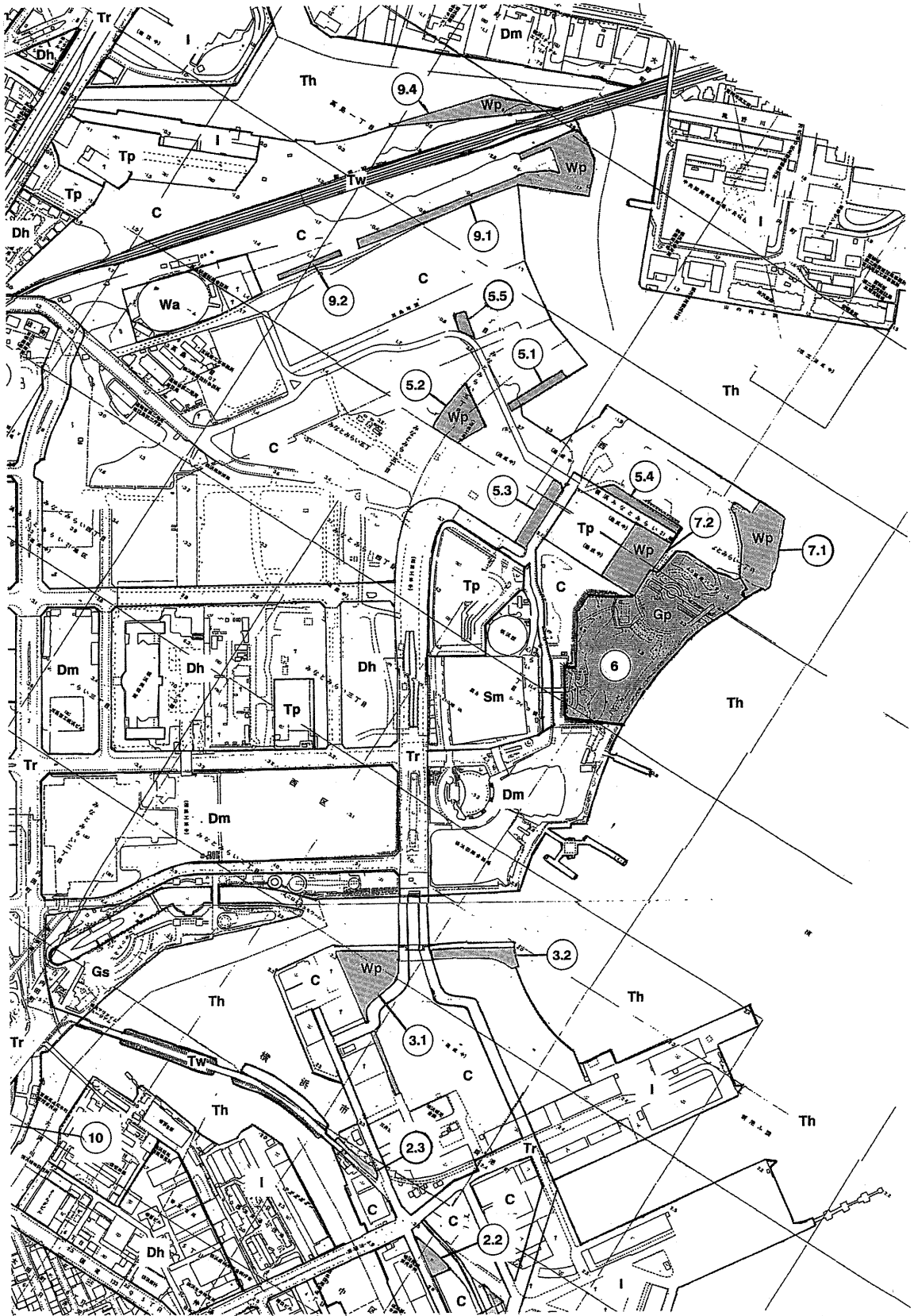
Investigation No. of biotope, biologically rich and worthy of protection	③	ハ'イotope' の調査地数, 豊富な生物相, および保護の価値
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Biotope- and land use types

ハ'イotope' タイプ - 土地利用タイプ

Development		開発地
high density development	Dm	高密度開発地
multi-storey building development	Dh	多目的高層ビルディング 開発地
Special land use		特殊な土地利用
museum	Sm	博物館
Industrial areas	I	工業域
Construction areas	C	造成地域
Traffic areas		交通域
main roads, highways	Tr	主要道路, 高速道路
parking areas	Tp	駐車場
railways	Tw	鉄道
harbours	Th	港
Green spaces		緑地
sports grounds & intensively managed green spaces	Gs	運動公園 & 集中管理緑地
parks	Gp	公園
Waste grounds		放棄地
young waste grounds (annual species dominating)	Wa	新しい放棄地 (一年生の種優占地)
older waste grounds (perennial herbs dominating)	Wp	古い放棄地 (多年生草本優占地)
older waste grounds (grasses dominating)	Wg	古い放棄地 (イネ科草本優占地)

Fig. 5 Biotopes worthy of protection in test area 2



5.3 Summarisation

The large number of biotopes worthy of protection in test area 1 is remarkable, compared with the other areas (Fig. 6). The reasons are the hilly morphology and the development of settlements recently. In contrast, test area 2 belongs to the old city of Yokohama and has been settled for a long time. Along the flat coast a high density of old settlement was possible, and therefore fewer areas remained for spontaneous nature.

6. Continuation of the Pilot Study and Recommendations for the Future

For a final evaluation for nature conservation the actual data are not enough. In test area 2, the special land-use type 'university' and the agricultural areas may be important as corridors in the city, due to their high number of small vacant areas. At the moment, an evaluation of this type is not possible, due to the limited investigation area. In the same way some areas may be important for urban wildlife, which were not investigated, due to the key of evaluation for biotopes worthy of protection, which only focused on floristic and phytosociological features.

To get basic information about all areas which are important for nature conservation, the pilot study should be continued in the following way:

1. Mapping of all land-use types and biologically rich areas in the city (by aerial photos)
2. Representative research on flora, vegetation and fauna of the land-use types and biologically rich areas in selected parts of the city, i. e. registration of:
 - spontaneous vascular plants
 - planted trees and shrubs
 - plant communities

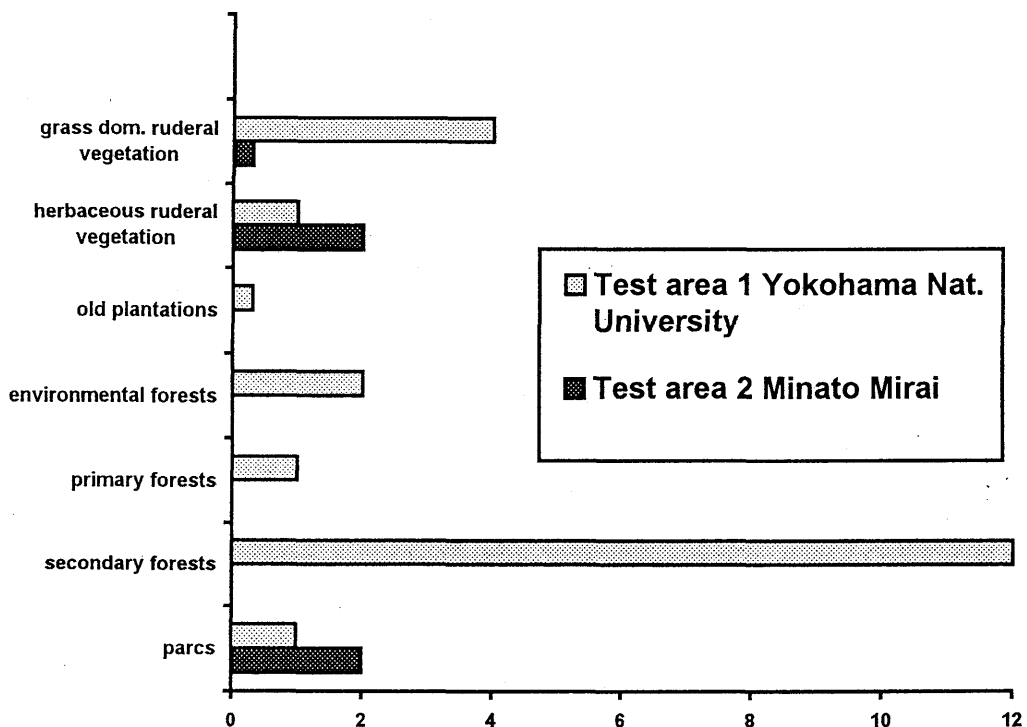


Fig. 6 Expanse of biotope-types worthy of protection (in percent) in the two test areas, as compared to the whole area investigated (100%).

- selected animal populations (especially species with a high value of indication for urban habitats). The following animals should be studied: birds; selected groups of mammals, e. g. bats, shrews and hedgehogs; amphibians and reptiles; grasshoppers, butterflies (Macrolepidoptera), beetles (Carabidae), dragonflies, spiders (Araneae) and wild bees (Apoidea) (Arbeitsgruppe "Methodik der Biotopkartierung im besiedelten Bereich" 1993)
- 3. Developing of specific mapping guidelines for biotopes worthy of protection and other land-use types important for nature conservation in the city (priority areas for nature conservation)
- 4. Investigation of priority areas for nature conservation in the whole city area
 - description of the biotopes worthy of protection, with standardized forms
 - description of the land-use types important for nature conservation in the city (such as important corridors)
- 5. Summarising the results and display on maps
 - map of biotopes worthy of protection would be important for nature conservation in the city
- 6. Development of general recommendations for management and green planning for all types from the viewpoint of nature conservation

After finishing the pilot study in Yokohama, the mapping guidelines can be used for further investigation in the agglomeration of Tokyo as well as in other Japanese cities. The results will be available shortly, following standardised method. The advantage is that, afterwards, the results from different cities can be compared. In this way an overview of the situation of nature in the different Japanese cities will be available. In addition to the information about National Parks in Japan, this will be important information for further strategies in nature conservation policy. In order to get comparable data, biotope mapping should be organised and conducted by the government.

7. Practical Use and Application

Through biotope mapping in urban areas, much biological information can be gained and summarised up in a short time. The advantage of this method is the practically orientated investigation and demonstration of the results on standard forms, with recommendations for further investigation as well as management and protection. After finishing the pilot study in Yokohama City and in other cities the results can be used for several purposes:

1. Infrastructure planning, for example:
 - basic information for the land-use plan (e. g. where are the priority areas for nature conservation?)
 - fundamental information for the landscape plan (kind of conservation status for the priority areas for nature conservation, location of important corridors and their development, information for the development of the different urban land-use types with special attention to nature conservation)
2. Programs and laws for nature conservation, for example:
 - programs for endangered species
 - fundamental information for the development of laws (e.g. for the protection of trees in cities)
3. Recommendations for nature management of the land-use types --especially green spaces, e. g.
 - no cutting of hedges,
 - no hoeing of leaves and ruderal plants,

- no removal of dead leaves, twigs or dead wood from wooded areas.
 - reduction of tree surgery,
 - measures to encourage local fauna e. g. reduction of cutting,
 - one-site composting,
4. Basic information for green planning
- which spontaneous plants are best adapted to the different ecological conditions in urban habitats and therefore should be used for green planning
 - the traditionally established parks can be expanded by a system of existing biologically rich areas, which can be used for non organised forms of recreation, e. g. walking, viewing nature,
 - new types of green spaces can be developed on bare ground by using the natural invasion and succession of wild plants
5. Nature education
- biologically rich areas such as old vacant land, and secondary forests can be used for education in schools and also for increasing awareness among adults (which plants and animals live in my immediate neighbourhood?)
 - development of nature trails
6. Bioindication and ecological research
- also the distribution of vascular plants or animals can be used for bioindication
 - the data can be used for research on urban ecology

To sum up, one can say that for the fast-growing Japanese cities it will be very important for the future to start with standardised investigations for the assessment of urban habitats. As a consequence of the re-creation of native forests in green spaces, which is based on vegetation mapping (e. g. Miyawaki et al. 1987), there will be a comprehensive network of planning guidelines for all urban land-use types and biotopes by applying the results of biotope mapping.

Acknowledgements

We thank Dipl. Biol. V. Muller (Augsburg, Germany) for collaboration by the investigations and evaluation of the pilot study. We are grateful to all students of the seminar "Biotope Mapping" especially Y. Kusumoto and H. Thoma for cooperation by the field investigations. We express cordial thanks to Prof. Dr. E. O. Box (University of Georgia, U. S. A.) spending time for English editing.

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