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May 19th 2010

Biodiversity and Ecosystem Services in Urban Areas for Smart Adaptation to Climate Change: “Do You Kyoto?” 賢い適応としての緑と京都

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Today's Topics

- なせ京都なのか。 Why Kyoto?
- 山紫水明の賢い適応 : Suggestions from Kyoto: Ecosystem dependent solutions.
 - (1) 周りの緑 surrounding greenery
City Planning: Smart response
 - (2) 内部の緑 島嶼生物地理学を超えて greenery
inside: Beyond Island Bio-geography:
Design, Management
 - (3) 水辺環境 洪水への賢い適応 Smart
adaptation to climate change through
restoration of waterside natural eco-
tone

なぜ京都なのか。 Why Kyoto?



CBD Executive Secretary
MR. AHMED DJOGLHAF

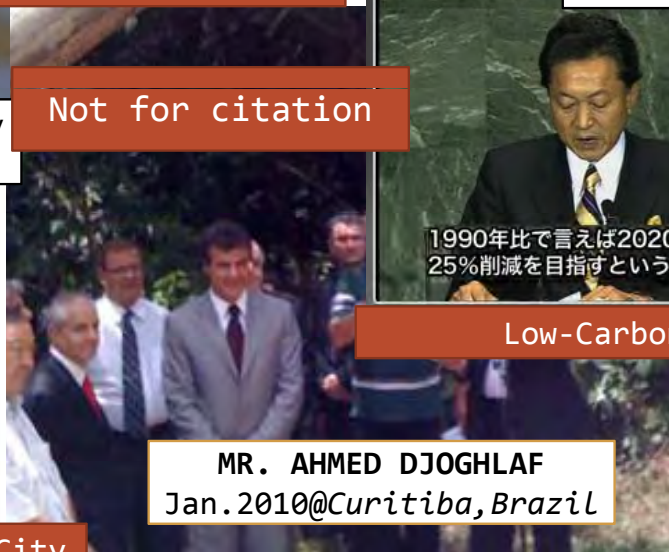
Biodiversity oriented

Not for citation



Environmental Model City

Kyoto city Mayor
Mr. TAISAKU KADOKAWA



Low-Carbon

なぜ京都なのか。 Why Kyoto?

— 山紫水明

“Blue Mountain and Clean Water”

— 環境モデル都市

Environment Model City

— 1200年の歴史都市、

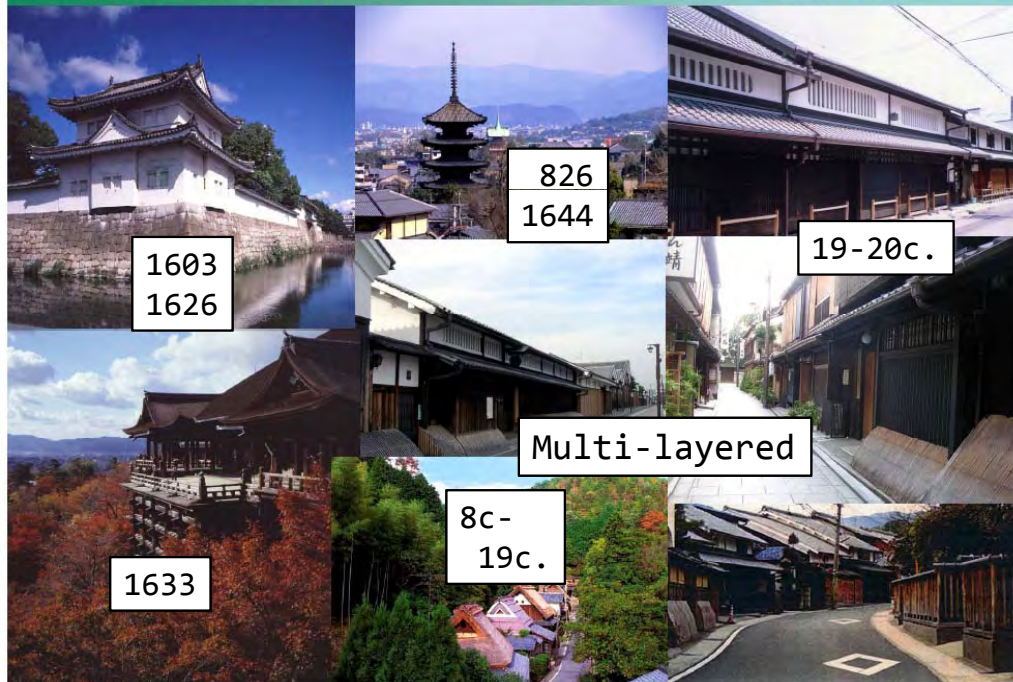
重層構造（建設と災害）
持続可能性、

Historically Multi-Layered,
Resilience => Sustainability



Historical city: Kyoto

京都市の概要 「歴史都市・京都」



Homepage of Kyoto City

Forman: Land mosaics

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(I) Feng-shui geomancy to modern city planning 都市の風水から近代都市計画へ

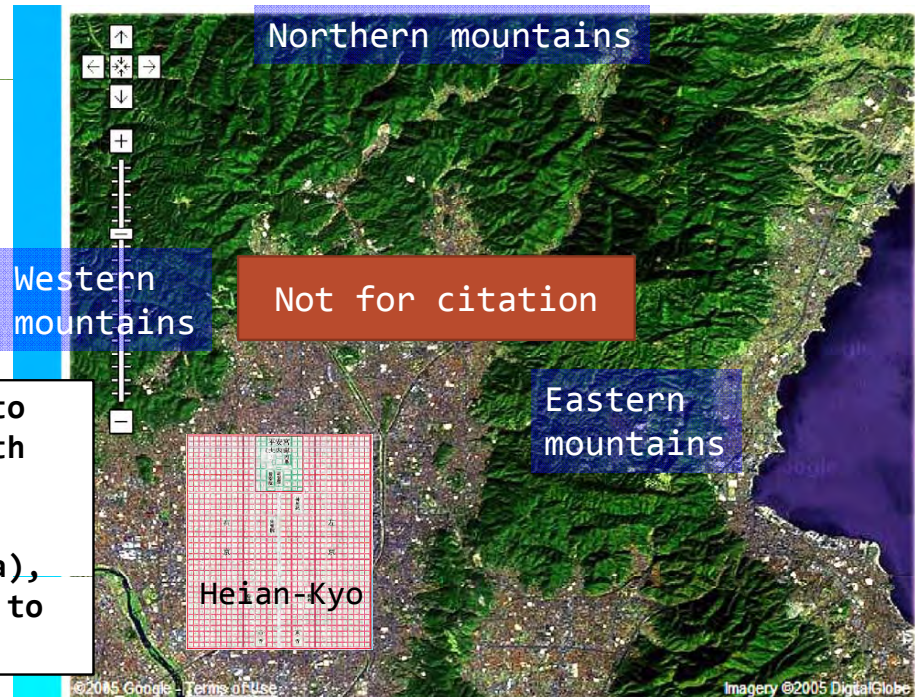
- Feng-shui: City area is the basin enclosed to the east, west and north by mountains
- Natural amenity oriented against sprawling city
- New landscape ordinance.

盆地ランドスケープと山地開発抑制=>借景としての緑の保全

Kyoto city

- Matured, Less disturbed greenery
- Shrine forests, Japanese gardens
- Nearly steady state in dynamics.....

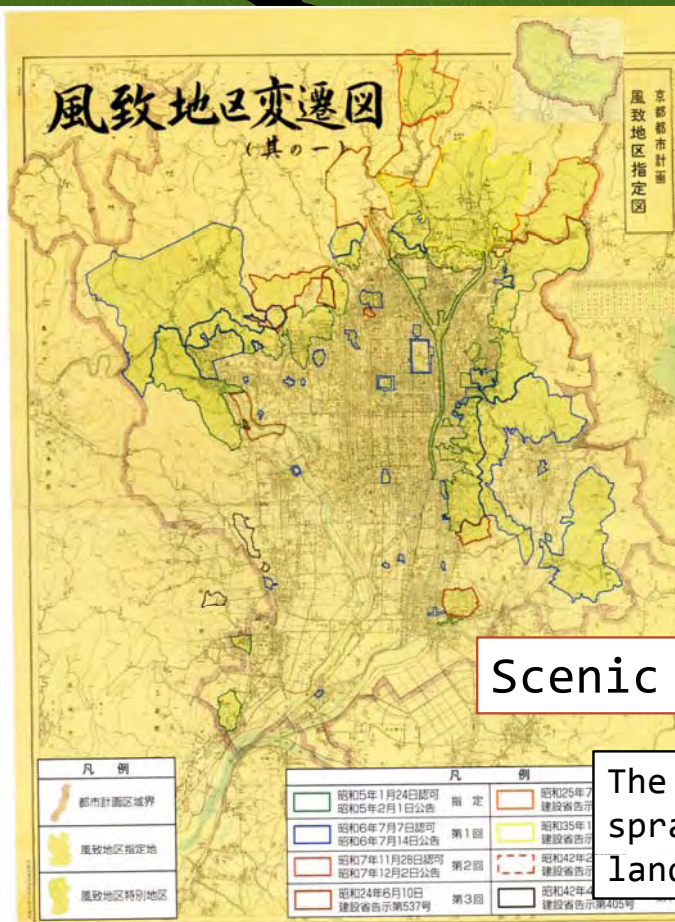
The terrain of Kyoto City is a basin with mountains of three sides (Higashiyama, Nishiyama, Kitayama), and rivers flowing to the south.



Tab. 1. Selected landscape policies related to Kyoto city's biodiversity

Year	Policies	Type*
1930	Scenic Landscape Districts designated (3,400ha → 17,938ha at present) 風致地区	A
1935	First park by town planning "Funaokayama Park" opened 都市公園	AB
1969	Special preservation areas designated under the Ancient Capital Cities Preservation Law (117ha → 2,861ha at present) 古都保存特別地区	B
1971	"One-million-tree-planting Initiative" started 百万本植樹運動開始	C
1972	City Ordinances on Urban Landscape established (nation's first) 市街地景観条例	a
1981	Accomplishment Not for citation 百万本植樹達成	C
1991,2	Report for Kyoto Town Development on Land Use and Landscape Measures 基本計画	D
1995	City Ordinances on the Betterment of Urban Landscape 市街地景観整備条例	a
1995	City Ordinance on Preservation Areas for Natural Scenery (25,780ha) 自然風景保全地区	b
2006	Interim Report on the Landscape of Kyoto by the special council (Down zoning) 時を超え光り輝く京都の景観作り審議会	D
2007	Final Report on the Landscape of Kyoto by the special council 眺望景観保全地域	D
2007	City Ordinance to Preserve Vistaed Views (38 targets)	a
2010	New Master Plan for Parks and Open Spaces established 緑の基本計画	D

*A: Nature friendly development, a:Amenity oriented development, B:Strict preservation of bio-cultural environment, b:Conservation of natural environment, C:Greening, D: Comprehensive policy



Kyoto City

1930:
風致地区 (日本初)

Scenic Landscape Districts

The first response against sprawling. Guiding toward landscape-conscious development.

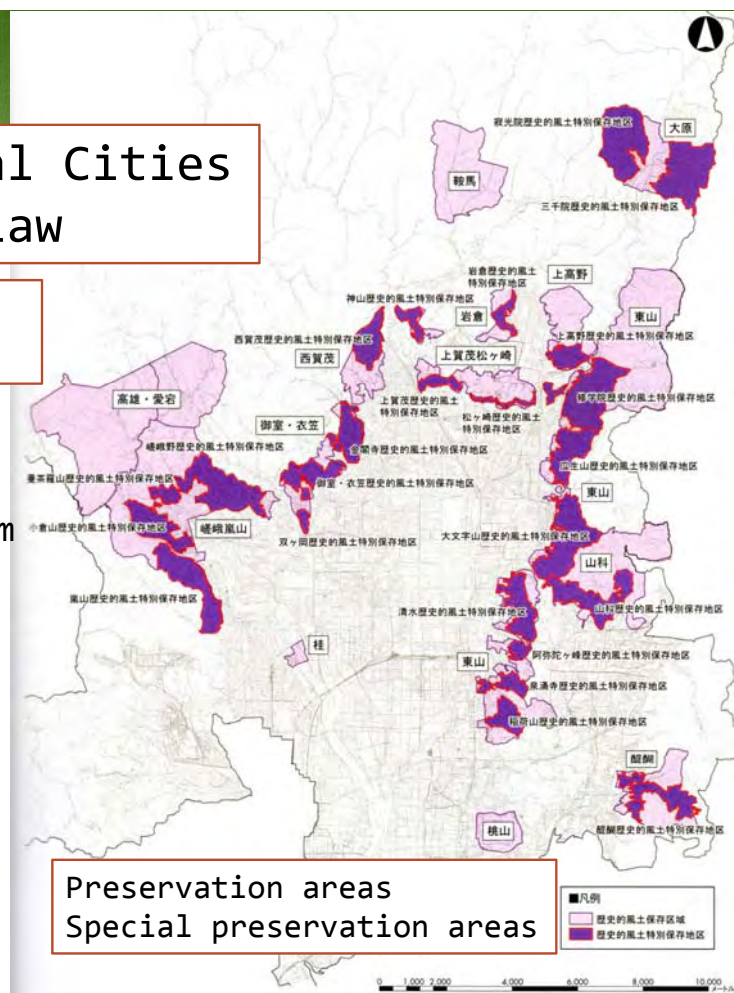
Ancient Capital Cities Preservation Law

1969:
古都保存地区

Strict preservation by buying-out system



Kyoto City



Preservation areas
Special preservation areas

“時を超え光り輝く京都の景観づくり審議会”2006,2007

Conserving Vistaed Views and Borrowed Landscapes

— City ordinances are established to preserve vistaed views—

Kyoto claims many magnificent views – Japan's assets that are unique to Kyoto, admired even in ancient poems. In 2007, Kyoto was the first city to establish a Vistaed View Creation Ordinance to conserve 38 magnificent vistaed views and borrowed landscapes.

38 Vistaed Views & Borrowed Landscapes

⇒ Selected from 597 literary and citizen opinion sources

⇒ As urban areas approach historical assets including World Heritage Sites, vistaed views and borrowed landscapes are in danger of being lost unless new regulations for height controls and design are formed

38 Locations selected by committee

⇒ City Ordinances on the Preservation of Vistaed Views

Building height controls and design regulations / suggestion system

- ① **Temple Views** 14 World Heritage Sites, Kyoto Imperial Palace Park, Shugakuin Imperial Villa, Katsura Imperial Villa
- ② **Street Views** Oike St., Shijo St., Gojo St., Sanneizaka, etc.
- ③ **Waterfront Views** Hori River, Uji River, Biwa Lake Sluice
- ④ **Background view of garden** Entsuji Temple, Shosei Garden
- ⑤ **Mountain Views** Higashiyama and Kitayama from Kamo River, Nishiyama from Katsura River banks
- ⑥ **Bonfire Character Views** Gozan no Okuribi as seen from Kamo River, Kitayama St., Funaokayama, etc.
- ⑦ **Lookout Views** Arashiyama range as seen from Togetsu Bridge downriver
- ⑧ **Bird's Eye Views** Cityscape seen from Daimonjiyama

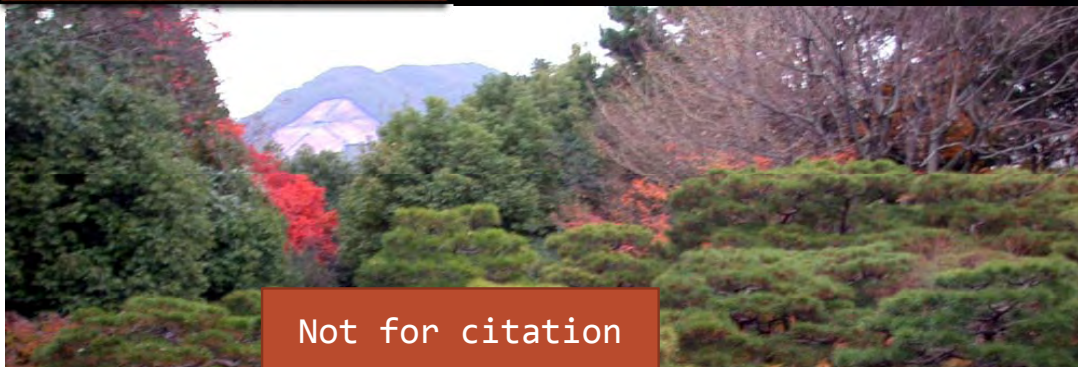


Vistaed view of Daimonji seen from Kamo River right bank

Kyoto City



Bon-fire



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背景の「森」は無秩序開発からは守られるようになった。
しかし、送り火に使うマツはマツ枯れで危機。

Background forests successfully protected, however,
Pine trees for torch fire are in the crisis of
massive die down by invasive species.



名勝・清風荘庭園
Seifu-So Garden,
National Scenic Beauty



URBIO 2010
May 19th 2010

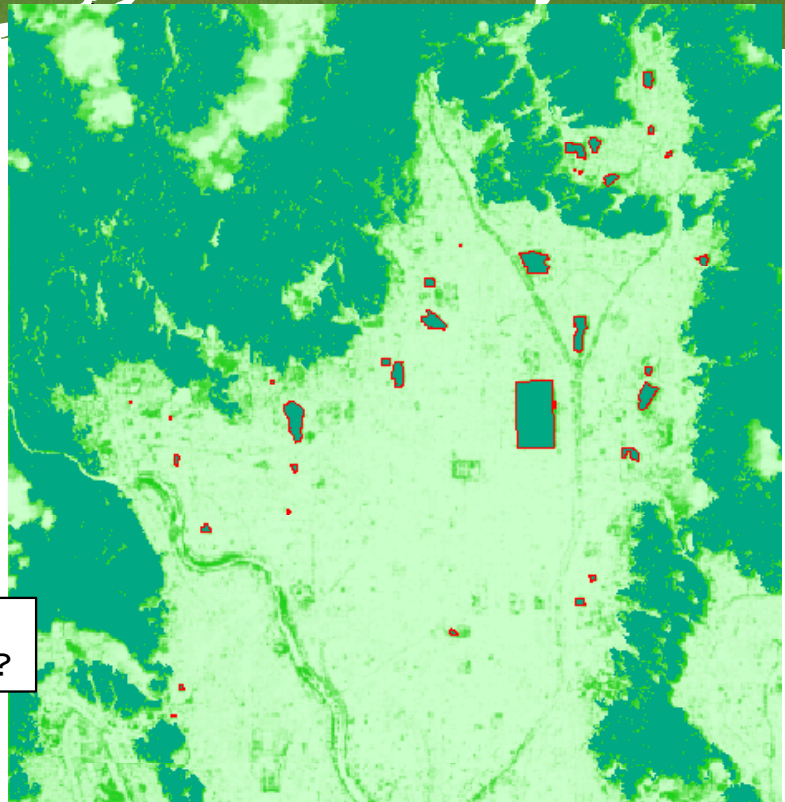
(2) Beyond Island Biogeography 市街地の緑と生物多様性

- Urban forests: historically nurtured
 - Beyond SLOSS: Management and Design
 - Creating a new island: Habitat park
- 町の森、細分化孤立化を超えて、新たな島

Island biogeography
has been a major
theory for urban
landscape ecological
analysis considering
build-up areas as
matrix like ocean and
forested areas as
patches of islands
for wildlife.
Kyoto : steady state?

島嶼生物地理学：都市の
孤立緑地は大洋に浮かんだ島？

isolated
woodlands
in urban matrix
of Kyoto



江戸時代に紹介された町の森 Urban forests as sight seeing spots of Kyoto in Edo period

卷第一：17の「森」

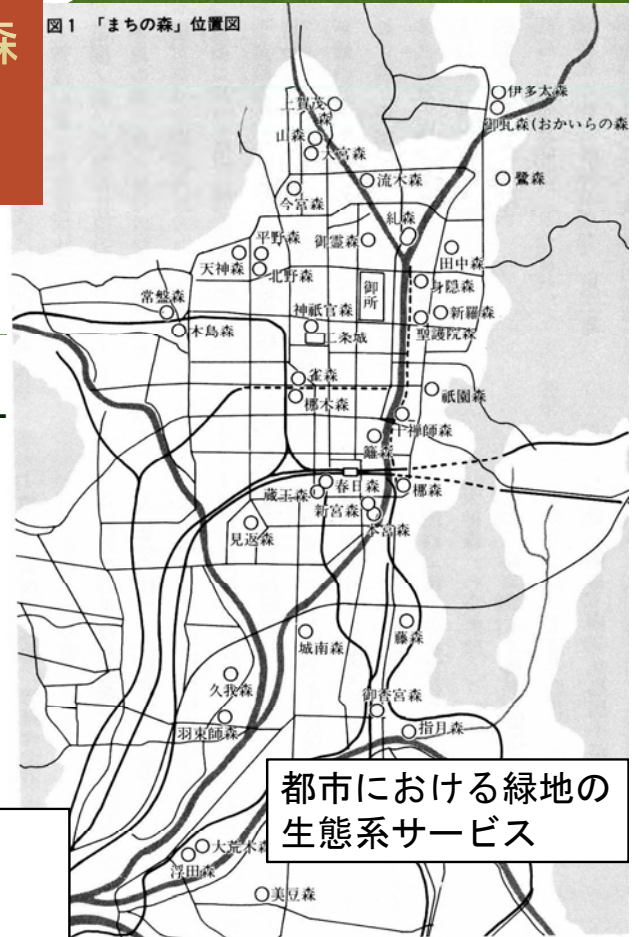
卷第四：26の「森」

雲、月、鶴

Miyako-Meisho-Zue

Cultural and regulating services or urban forests in Edo period

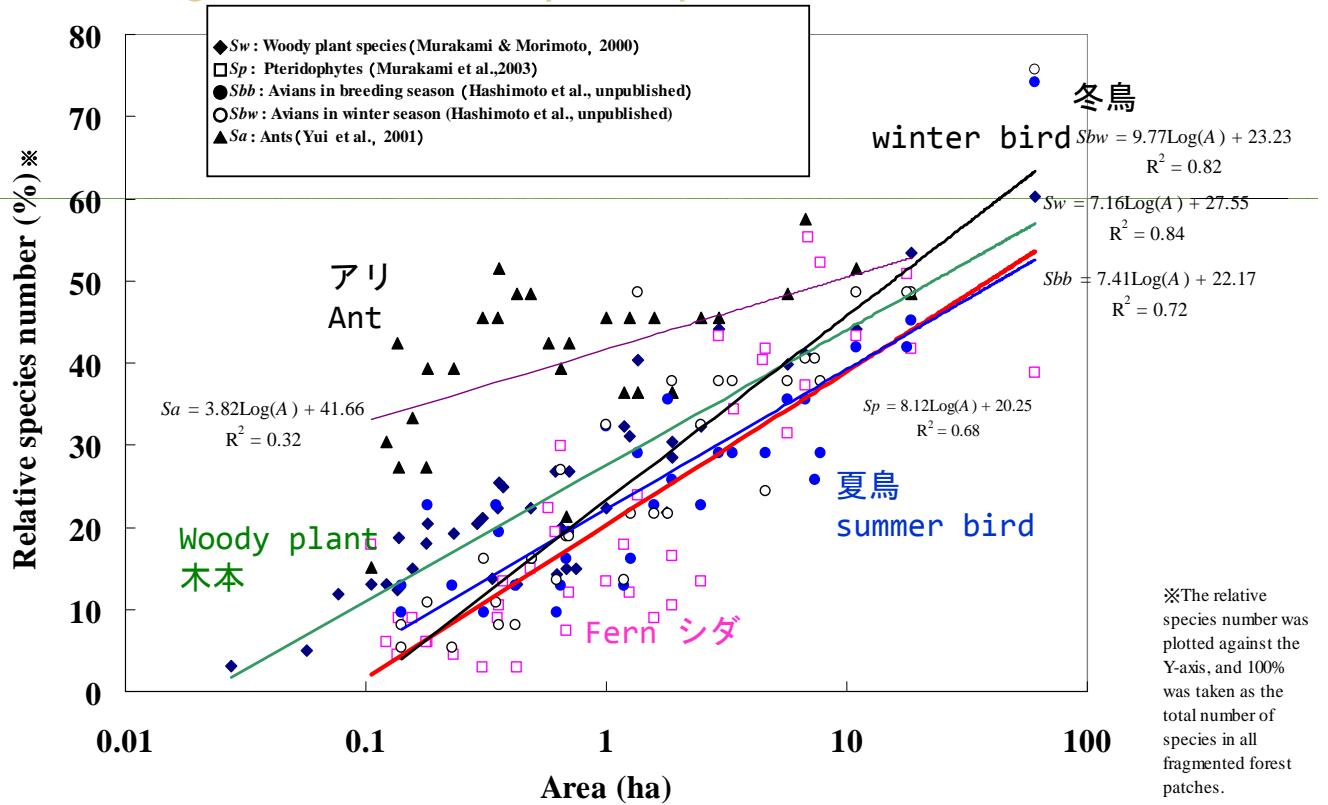
図1 「まちの森」位置図



都市における緑地の生態系サービス

- Island biogeography suggests the importance of
 - 1) patch size: area of the greenery
 - 2) distance from source patches
- However,
 - 1) Is it applicable in a similar way to every taxonomic group?
 - 2) Are small and isolated patches meaningless?
 - 3) Is there any advantages of isolation?

京都市の孤立緑地の野生生物種数 Species-Area curves of selected taxonomic groups in fragmented forests in Kyoto city

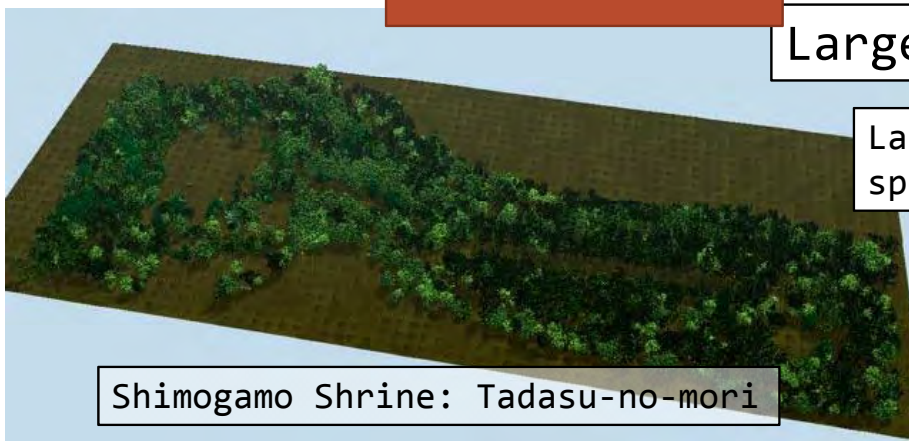


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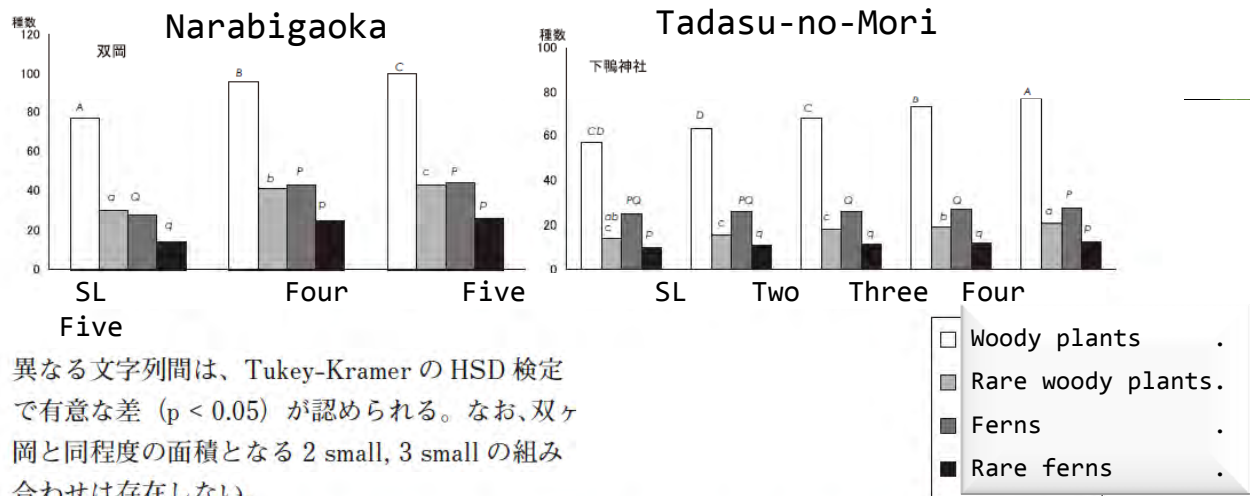
Large Patches

Large-patch-restricted species

Spiritual services



Single Large Or Several Small?

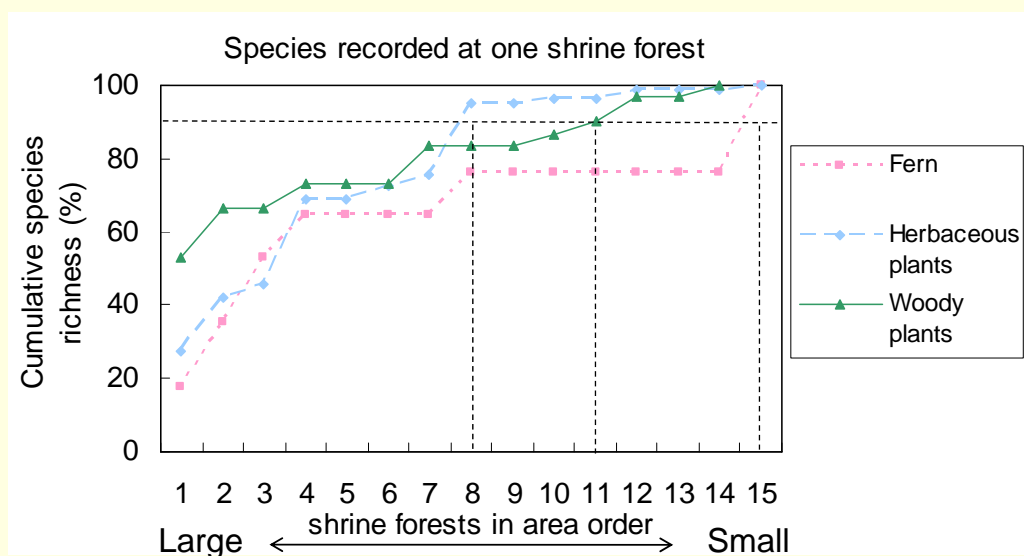


異なる文字列間は、Tukey-Kramer の HSD 検定で有意な差 ($p < 0.05$) が認められる。なお、双ヶ岡と同程度の面積となる 2 small, 3 small の組み合わせは存在しない。

図 2 大面積緑地の出現種数と合計で同程度の複数緑地の出現種数の比較 (村上ら 2005)

Several small patches are better for species richness.

Cumulative relative species richness curves (species recorded at one shrine forest)

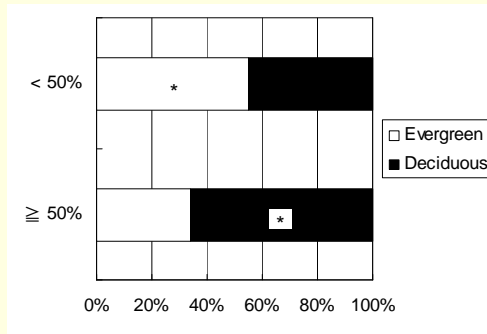


Imanishi A et al. 2007

小さい鎮守の森にも低頻度出現種が生育

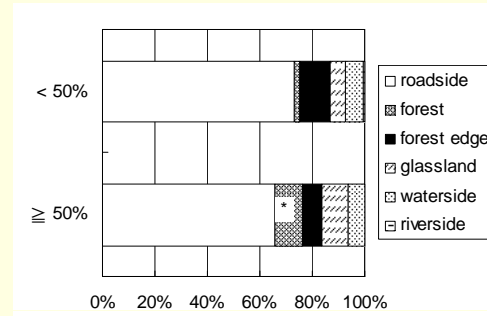
The species relatively departed from nested patterns

➤ Woody plants →
deciduous trees
(e.g. *Prunus grayana*, *P. jamasakura*, *Quercus serrata*)



*: Significantly high ($p < 0.05$)

➤ Herbaceous plants →
forest species
(e.g. *Boehmeria platanifolia*, *Lophatherum gracile*)

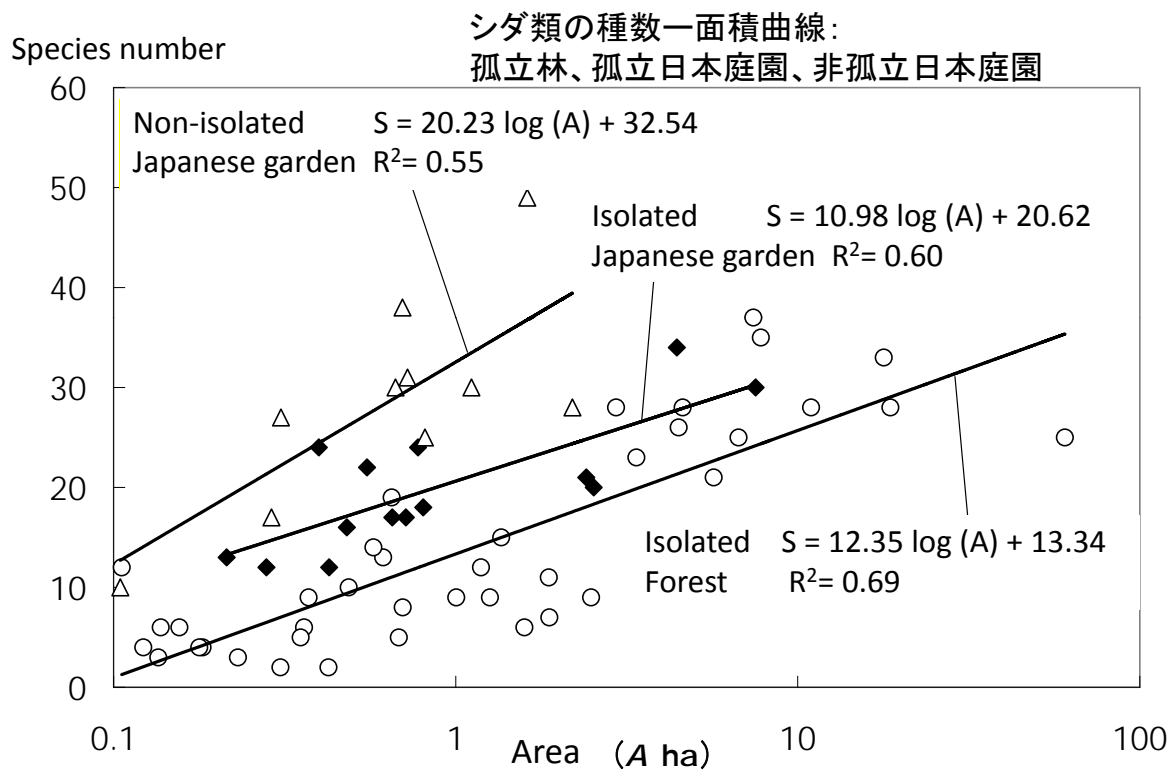


➤ Fern → There were no significant results.
(e.g. *Arachniodes standishii*, *Athyrium niponicum*, *Osmunda japonica*)

Imanishi A et al. 2007

Not for citation

Shugakuin
imperial villa,
17th Century



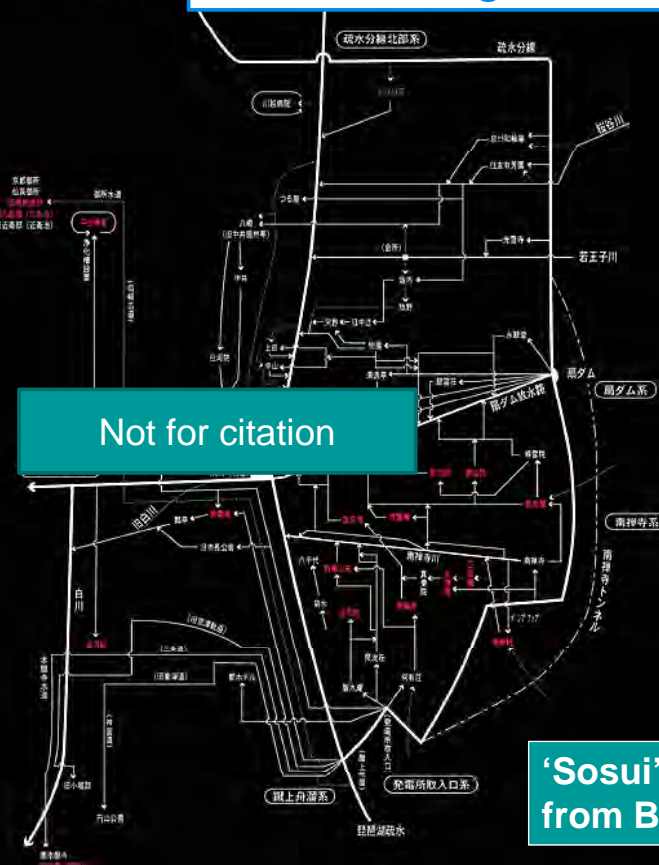
Species-area curves of ferns of isolated forests and Japanese gardens in Kyoto (Murakami & Morimoto 2004 modified)

水系系統図

Role of design and maintenance

Ueji, the most celebrated gardener in Meiji era, succeeded to construct refuges of wild fish from Biwa Lake in his Japanese gardens with water.

Not for citation



'Sosui', canal system from Biwa lake



01



05



09



13



02



06



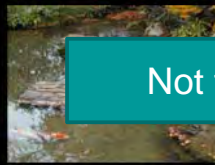
10



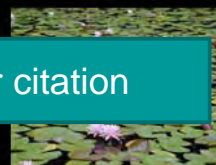
14



03



07



11



04



08



12

Not for citation

- 01: 泥
- 02: 砂
- 03: 細礫
- 04: 粗礫
- 05: 石積み護岸
- 06: 凹凸の大きな石積み護岸
- 07: 被覆構造物
- 08: 浅瀬
- 09: 深み
- 10: 抽水植物
- 11: 浮葉植物
- 12: 沈水植物
- 13: 水際の植物群落
- 14: 大型二枚貝

微小生息場所として設定した項目

Micro habitats of garden ponds

魚類相調査の結果

Not for citation

Fish fauna of garden ponds,
related to Biwa-lake

Ito and Morimoto 2003

ウナギ科 Anguillidae				
キョウリウオ科 Owstonidae				
コイ科 Cyprinidae	ダニョ科 Danioninae			
	カワトコ科 Cultrinae			
	モロコシ科 Belontiinae			
	ヒギョ科 Serranichthyidae			
	カマツカ科 Gobiomidae			
	コイ科 Cyprinidae			

織宝苑平面図



Shokuho-en
garden



Shokuho-en
garden

織宝苑の魚類相

【01】 ウナギ *Anguilla japonica*

【02】 カワムツA型 *Zacco* sp.

【03】 オイカワ *Zacco platypus*

【04】 ムギツク *Pungtungia herzi*

【05】 コイ *Cyprinus carpio*

【06】 ゲンゴロウブナ





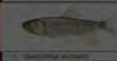

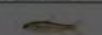
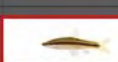
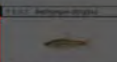
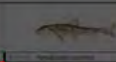
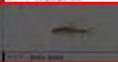
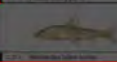




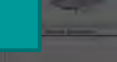
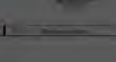

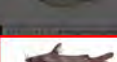

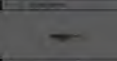




【07】 ギンブナ

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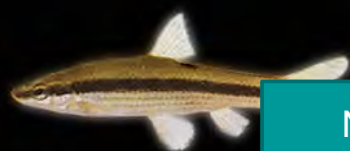
【08】 ギギ *Pseudobagrus fulvidraco*

【09】 スマチチブ *Tridentiger brevispinis*

Fish fauna of Shokuho-en garden pond

ウナギ科 Anguillidae				
キョウリウオ科 Oryziatidae				
コイ科 Cyprinidae	ギンブナ Cyprinus			
カワムツ科 Zacidae				
ギンブナ科 Cyprinidae				
ヒメミナコ科 Pseudocypripidae				
カワムツ科 Zacidae				
コイ科 Cyprinidae				
ギンブナ科 Cyprinidae				
ギギ科 Pseudobagridae				
スマチチブ科 Tridentigeridae				
ギンブナ科 Cyprinidae				
ギンブナ科 Cyprinidae				
ギンブナ科 Cyprinidae				
ギンブナ科 Cyprinidae				

織宝苑に生息する特異種



ムギツク
Pungtungia herzi

Not for citation



ギギ
Pseudobagrus fulvidraco



スマチチブ
Tridentiger brevispinis

Noteworthy fish
in Shokuho-en

ムギツクの托卵／営巣魚類との共生

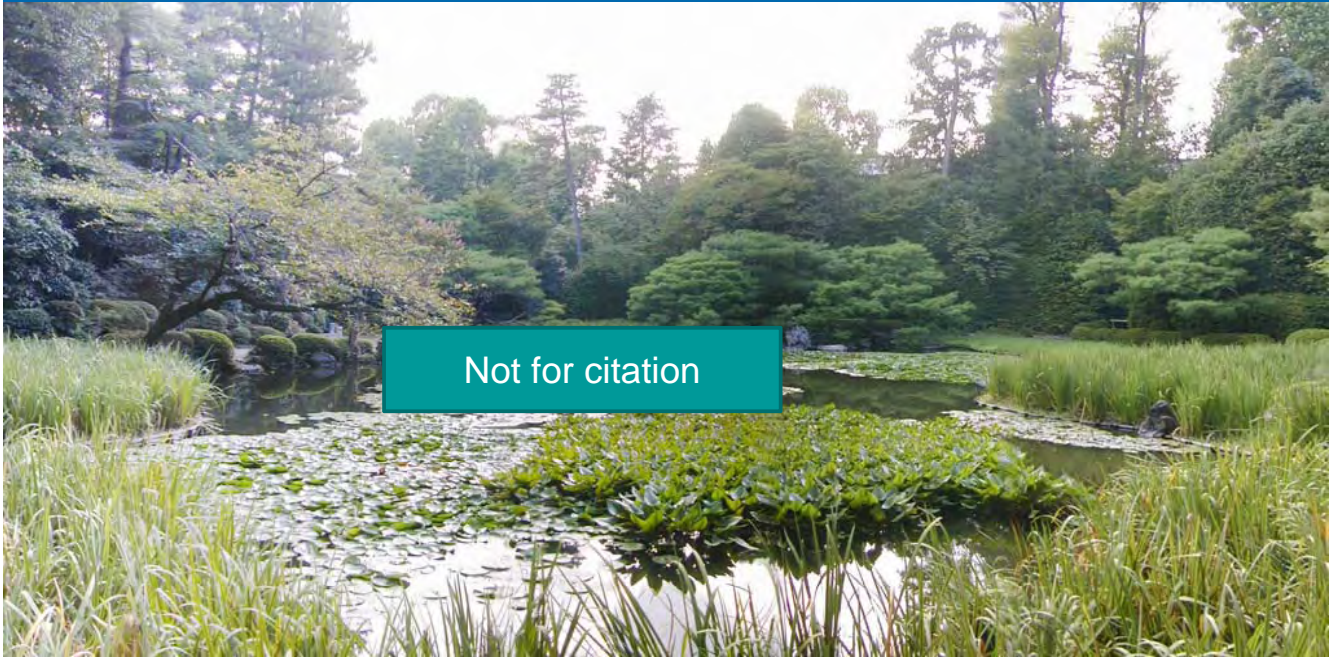
brood parasite

Not for citation

平安神宮平面図

Not for citation

Heian jingu
shrine



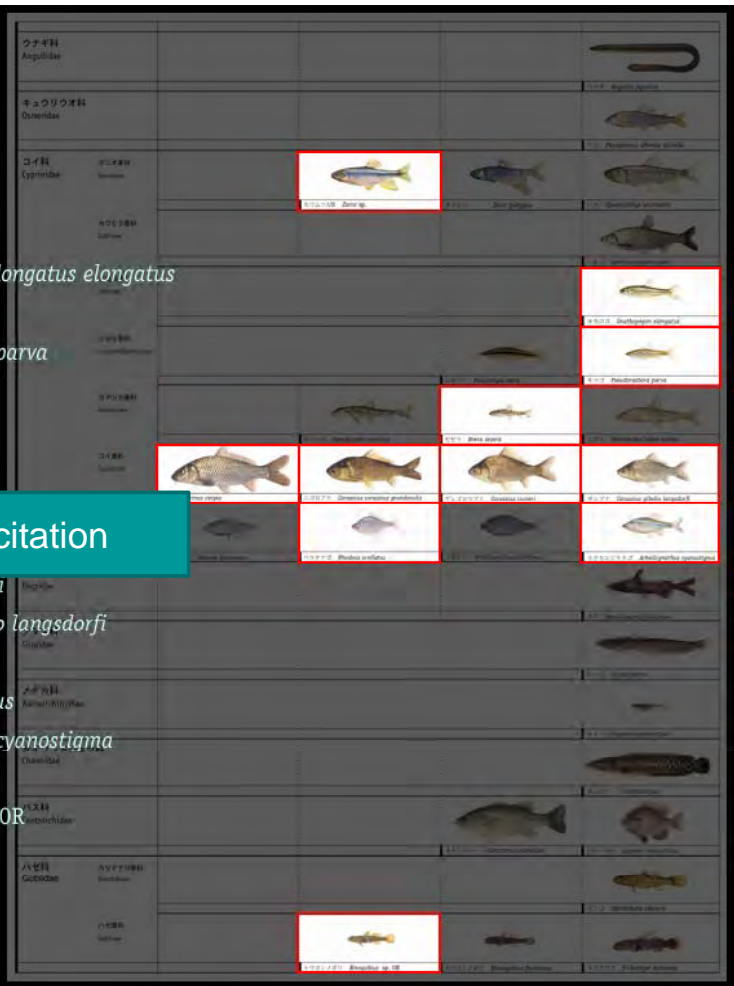
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平安神宮の魚類相

- 【01】 カワムツA型 *Zacco* sp.
- 【02】 タモロコ *Gnathopogon elongatus elongatus*
- 【03】 モツゴ *Pseudorasbora parva*
- 【04】 セゼラ *Biwia zezera*
- 【05】 コイ
- 【06】 ニゴロブナ
- 【07】 ゲンゴロウブナ *Carassius cuvieri*
- 【08】 ギンブナ *Carassius gibelio langsdorfi*
- 【09】 バラタナゴ *Rhodeus ocellatus*
- 【10】 イチモンジタナゴ *Acheilognathus cyanostigma*
- 【11】 トウヨシノボリ *Rhinogobius* sp. OR

Not for citation

Heian jingu
shrine



タナゴ類・二枚貝・小魚の3者間に見られる共生関係

Not for citation

Coexistence;
brood parasitism, Larva parasitism.

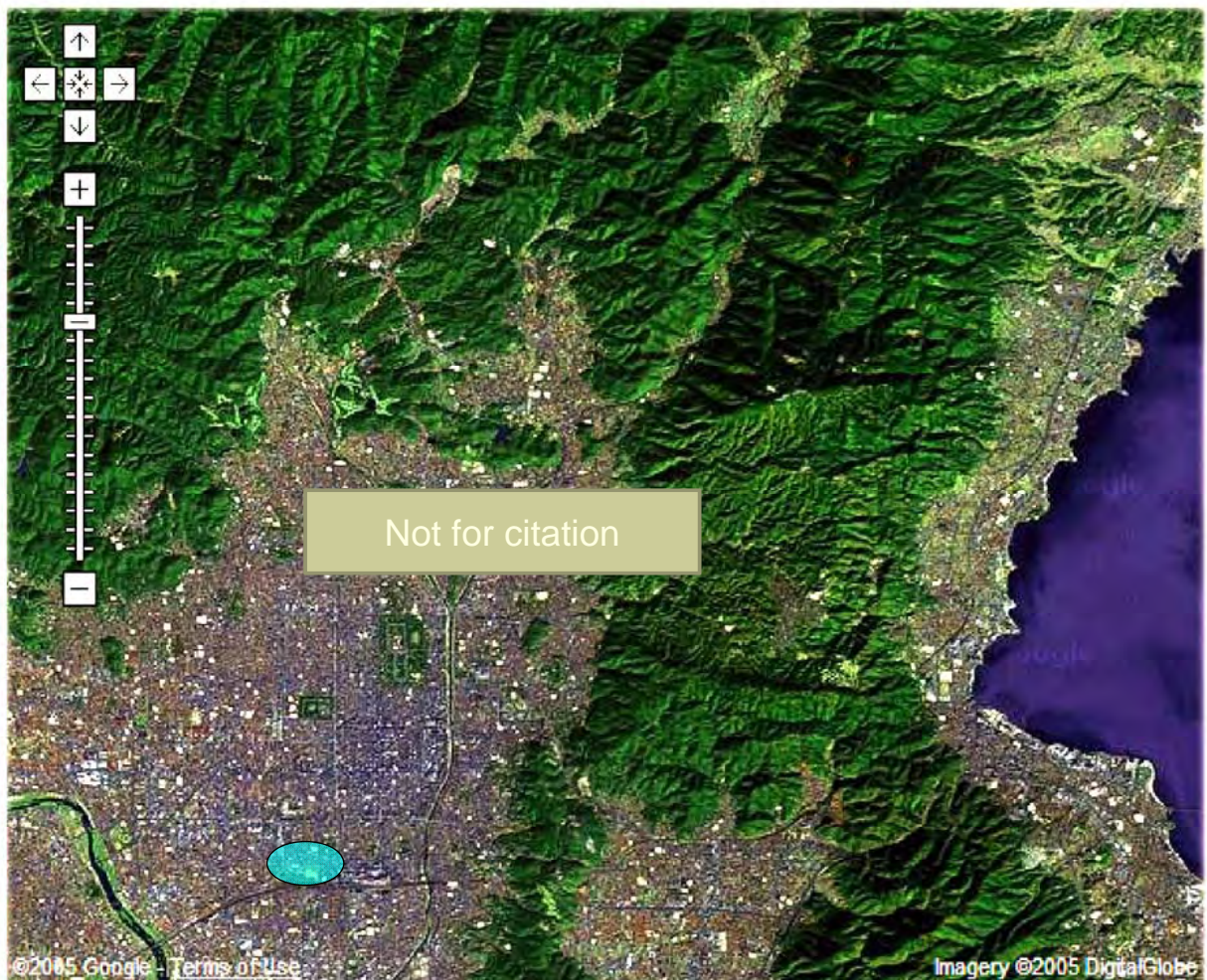
A small but well organized ecosystem has been sustained in
the isolated refuge.

いのちの森 Inochi-no-Mori before 1990

Not for citation

都心につくる新たな島:野生のハビタット

Creating a new island, habitat park INOCHI-NO-MORI



目標は山城原野

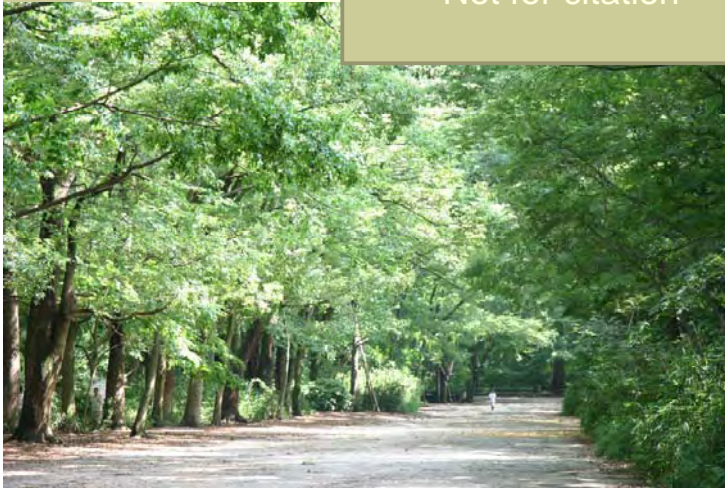
1 ha 程度のオープンスペースにおいて、

- できるだけ多様性が豊かで、
 - できるだけ発展的ないし持続的で、
 - できるだけ「京都」に関わりが深く、
 - できるだけ多くの人に親しまれる、
 - または親しまれるであろう種を含み
 - できれば多様性を損なう種は
 個体群の密度が低い、
 - 生物相を持つ生態系を育成する
- Diversity
 - Sustainability
 - Indigenous species
 - Symbolic species
 of Kyoto
 - Invasive species
 control
 - Adaptive management

Goal : Original forests before urbanization



Not for citation



Tadasu-no-mori, World heritage

朱雀の庭・いのちの森

朱雀の庭は長年にわたって京都が培ってきた造園技術を駆使し、さらには日本庭園で使われないような洋花を積極的にとり入れるなど、伝統と創生が見事に調和したデザインの池泉回遊式庭園(9,000㎡)です。現在の生活様式にもマッチする新しい試みを随所に取り入れたこの庭園は、建都1200年を記念する新しい市民の憩いの場となりました。



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狭い面積と短期間で
多様な野生動植物と共存する工夫
Limited area
Limited time
How to maintain sufficient diversity

●紅葉溪(もみじだに)

●水鏡(みづかがみ)

●野筋(のすじ)

岩場と溪流、紅葉からなる溪谷をイメージしました。

京都近郊から産出した山石で石組みの間を流るだけでなく、1部は緑の館2階ホールから1階エントランスガーデンへ、また1階レストランの中へと流れ込みます。

インド原産の黒御影石を敷き詰め、その上にわずか1cmの水をはった鏡のような池。昼は周囲の景色を、夜は月やかがり火を水面に映します。

緩やかな曲線を描き、草地の中を走る幾筋もの小さな流れ。流れのほとりには、ナデシコ、サワギキョウ等、季節を彩る草花が咲き誇ります。

樹冠回廊Canopy walk
流れと多様な池water bodies
大径木Big trees
表土移植
Soil seed-bank introduction
倒木導入
LWD introduction
etc.

Initial status, 1996



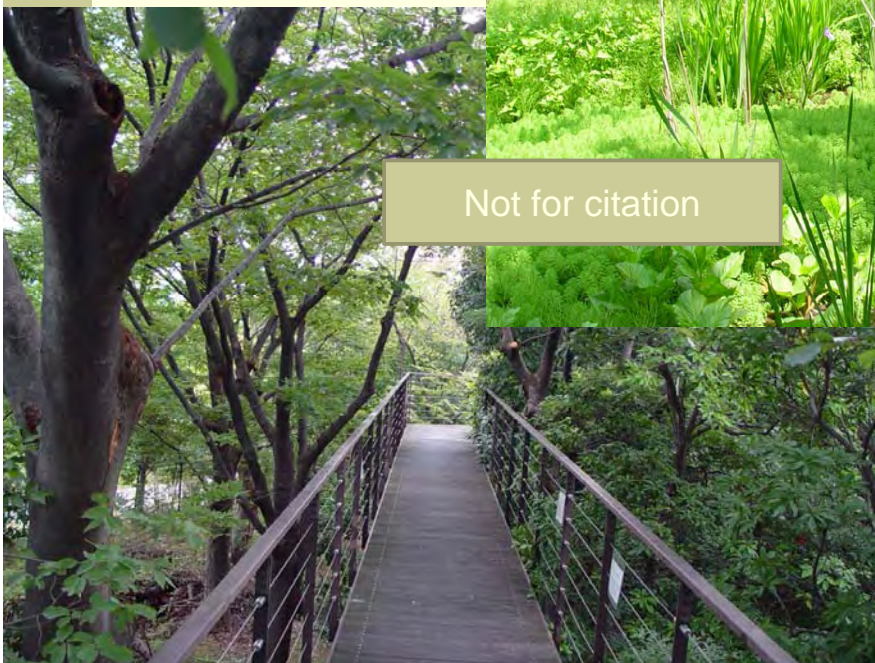
Not for citation

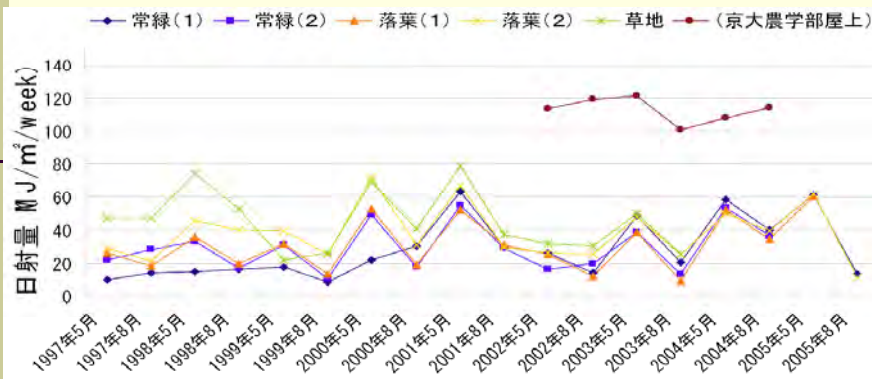


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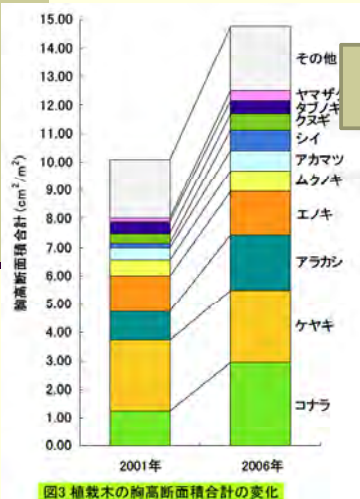


2003.May





Loosing
heterogeneity
of light
intensity



Not for citation

Quercus laevis
Castanopsis spp.
Pinus densiflora
Aphananthe aspera
Celtis sinensis var.
japonica
Quercus glauca
Zelcova serrata
Quercus serrata

Growth of planted trees

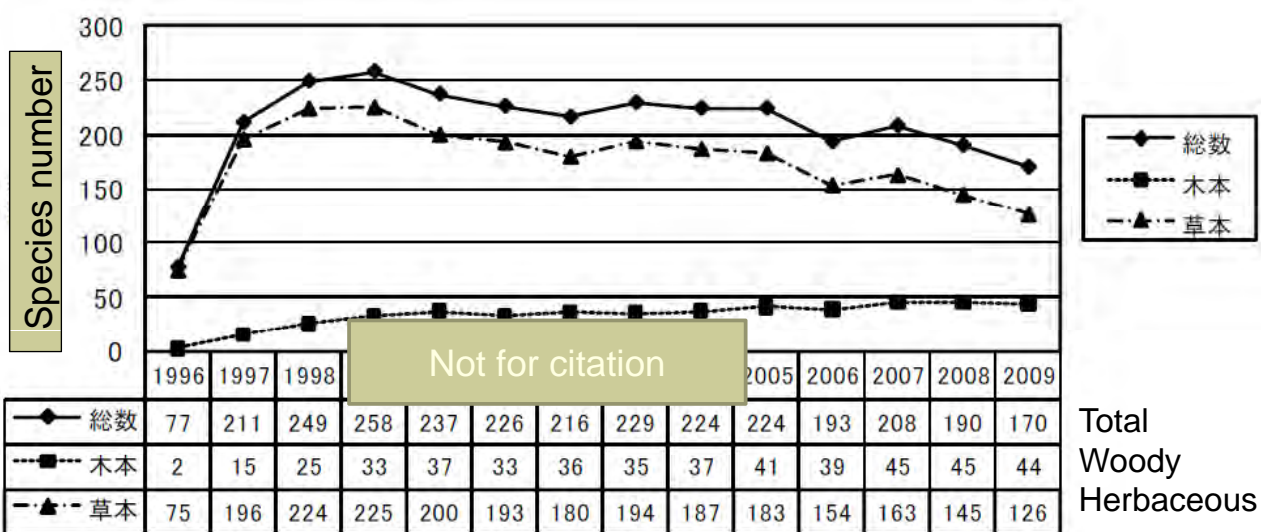
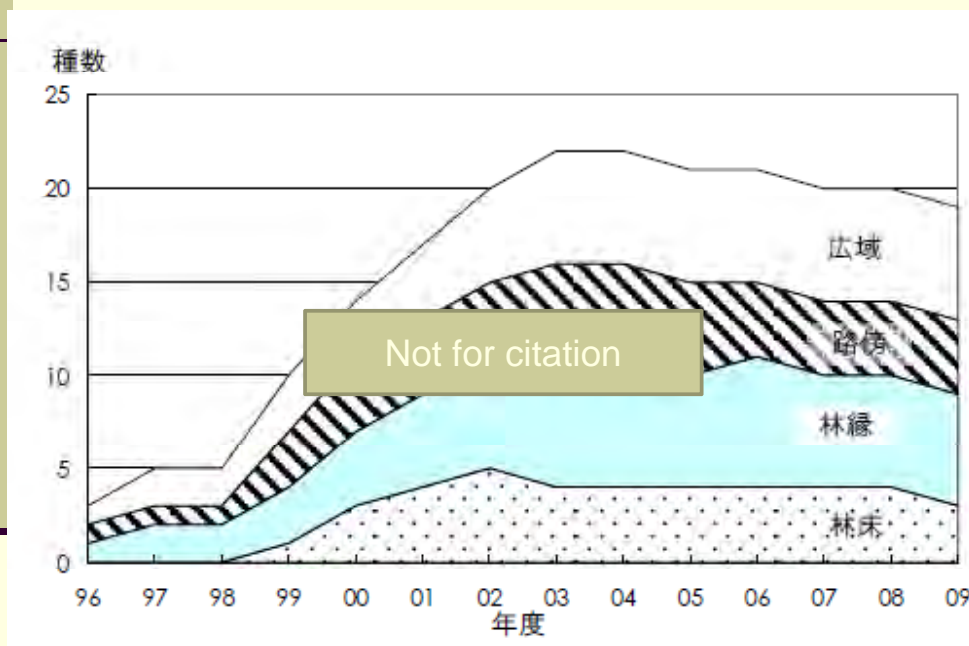


図-1 植栽以外の植物種数の変化

Colonized species

Number of Species: peaked out



Habitat

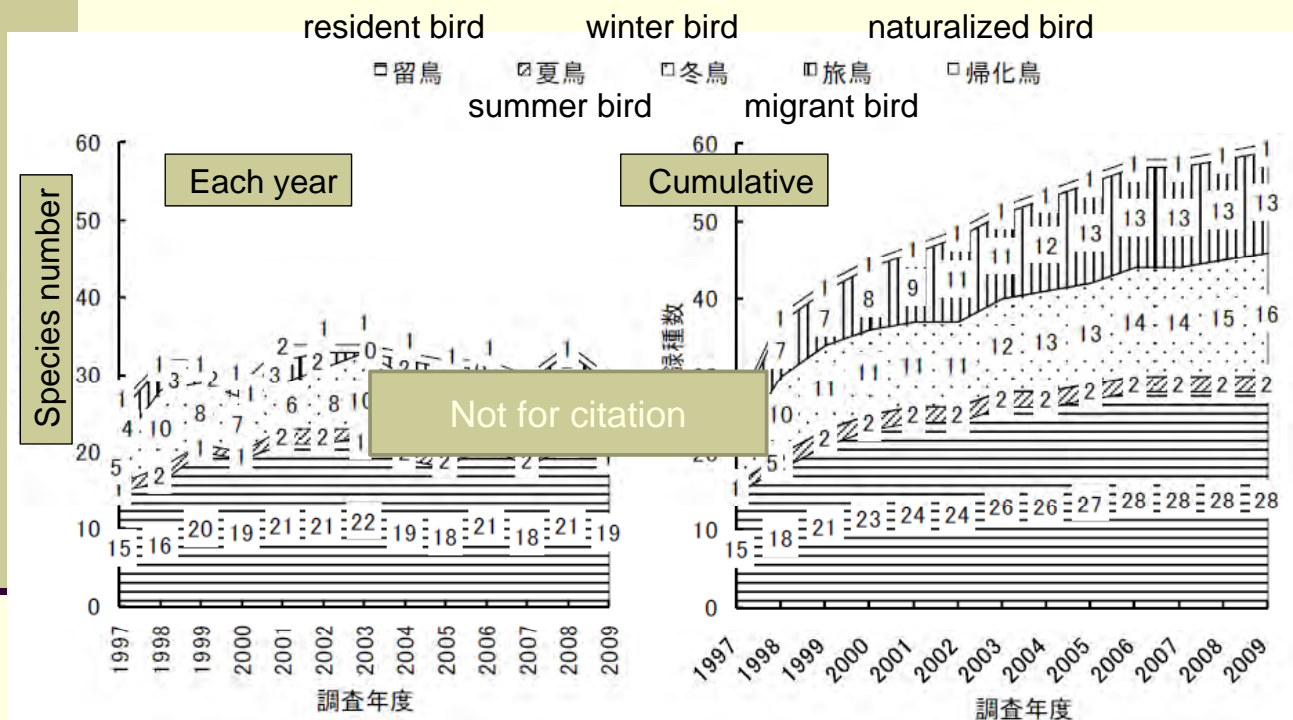
Cosmopolitan

Roadside

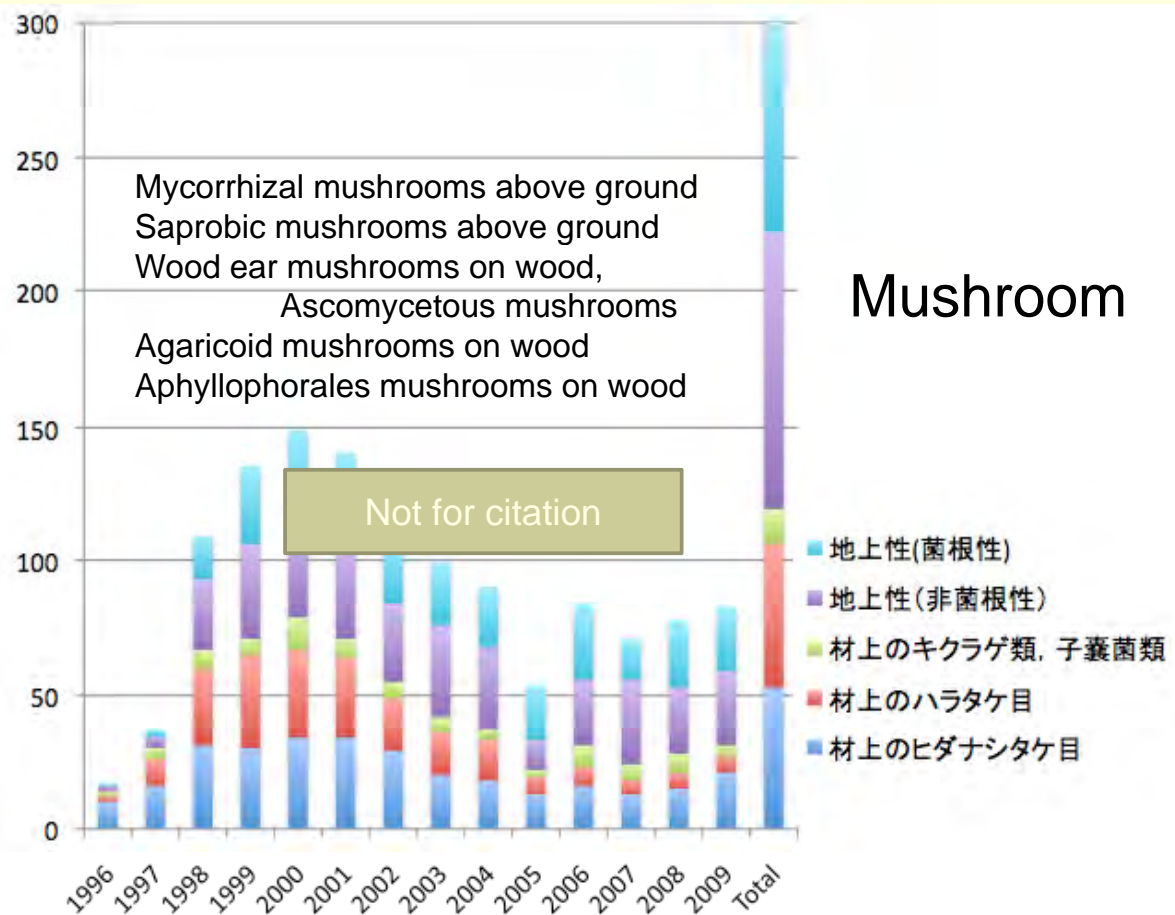
Forest edge

Forest floor

Fern species

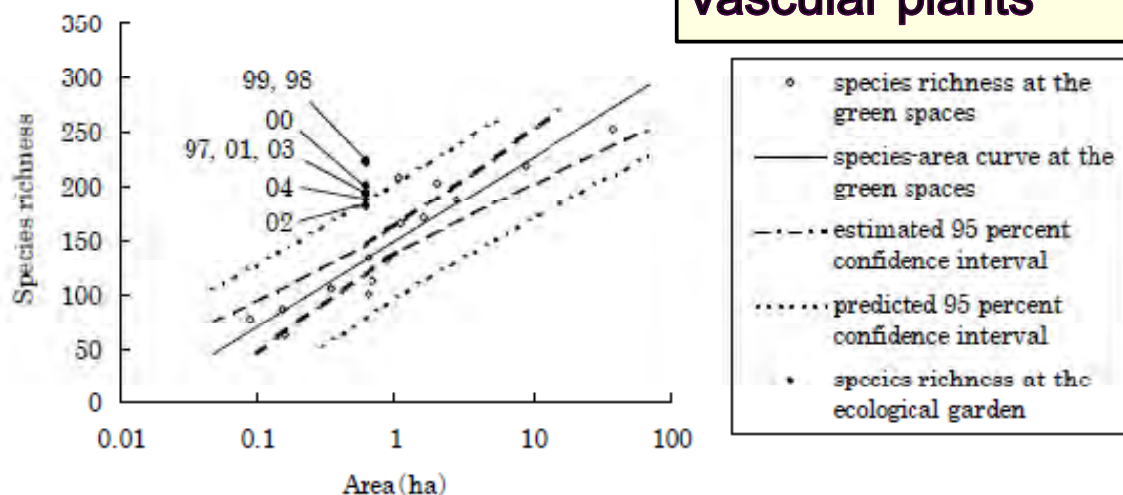


Avi-fauna




社寺林の種数－面積曲線と、ビオトープいのちの森の位置

vascular plants




Species-area relationship of the 15 shrine forests, and the position of wildlife habitat park for each year.



URBIO 2010
May 19th 2010

(2) Beyond Island Biogeography **市街地の緑と生物多様性**

**Patch size is important, but design
and maintenance are also very
important.**



URBIO 2010
May 19th 2010

(3) Smart adaptation to climate change with biodiversity: restoring waterside eco-tone **水辺エコトーン再生と賢い適応**

- Design/Management of
Japanese garden
- Getting along with flooding
増大する洪水リスクへの生態系依存
型適応

Consequences of the river improvement

Traditional festival, "Mitarashi-festival" with pumped-up water

Dried-up Tadasu-pond

Not for citation

Endangered Symbol plant, "Futaba-Aoi"

桂離宮 Katsura detached palace

CG by Morimoto (1993)

世界に誇る日本庭園の傑作 (17th C)
A masterpiece of Japanese garden art

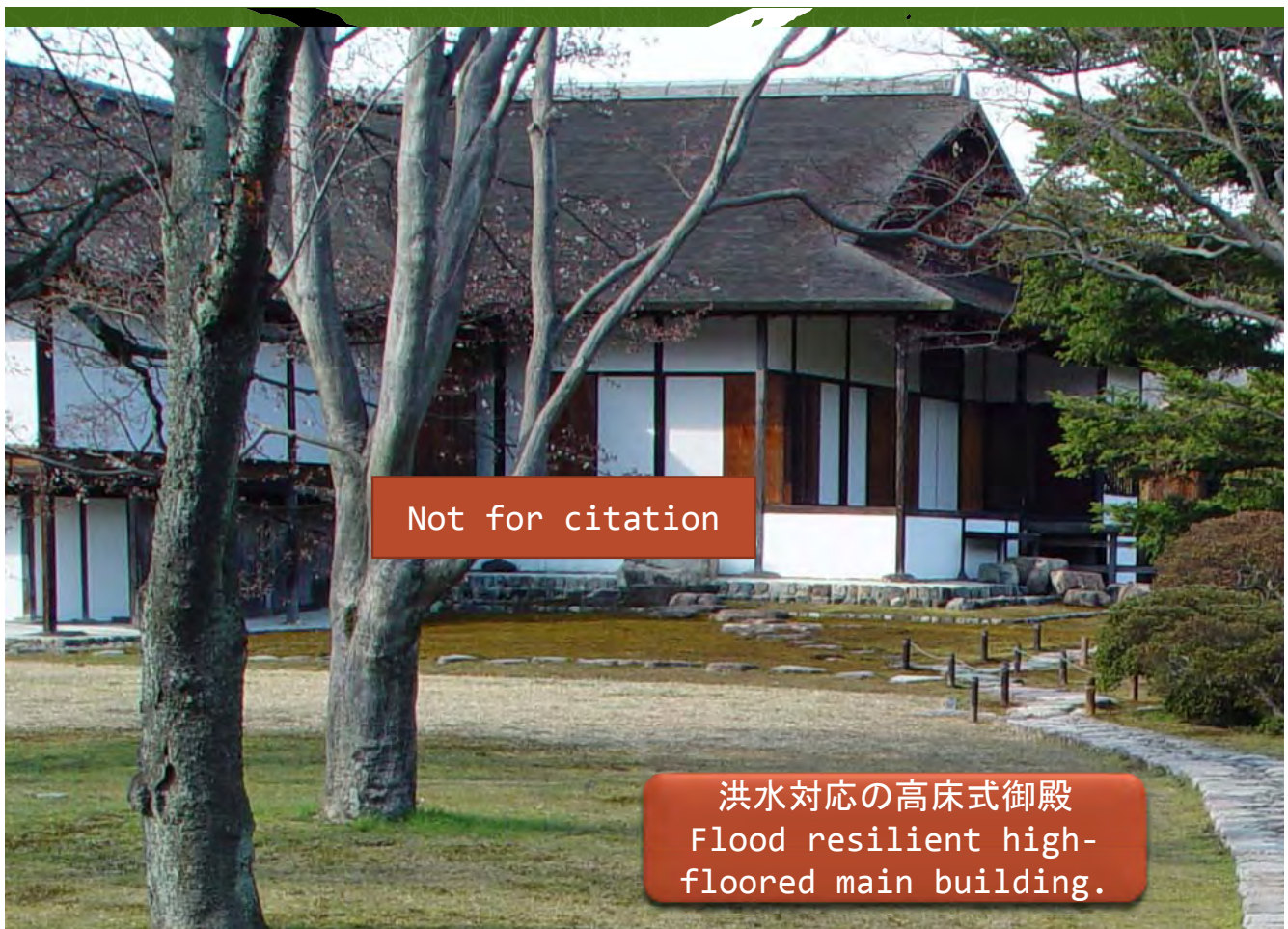


Not for citation

Katsura
Detached
Palace along
the river
桂川ぞいの桂離宮

Image © 2008 DigitalGlobe
© 2008 Europa Technologies
© 2008 ZENRIN
Image © 2008 TerraMetrics

©2008 Google



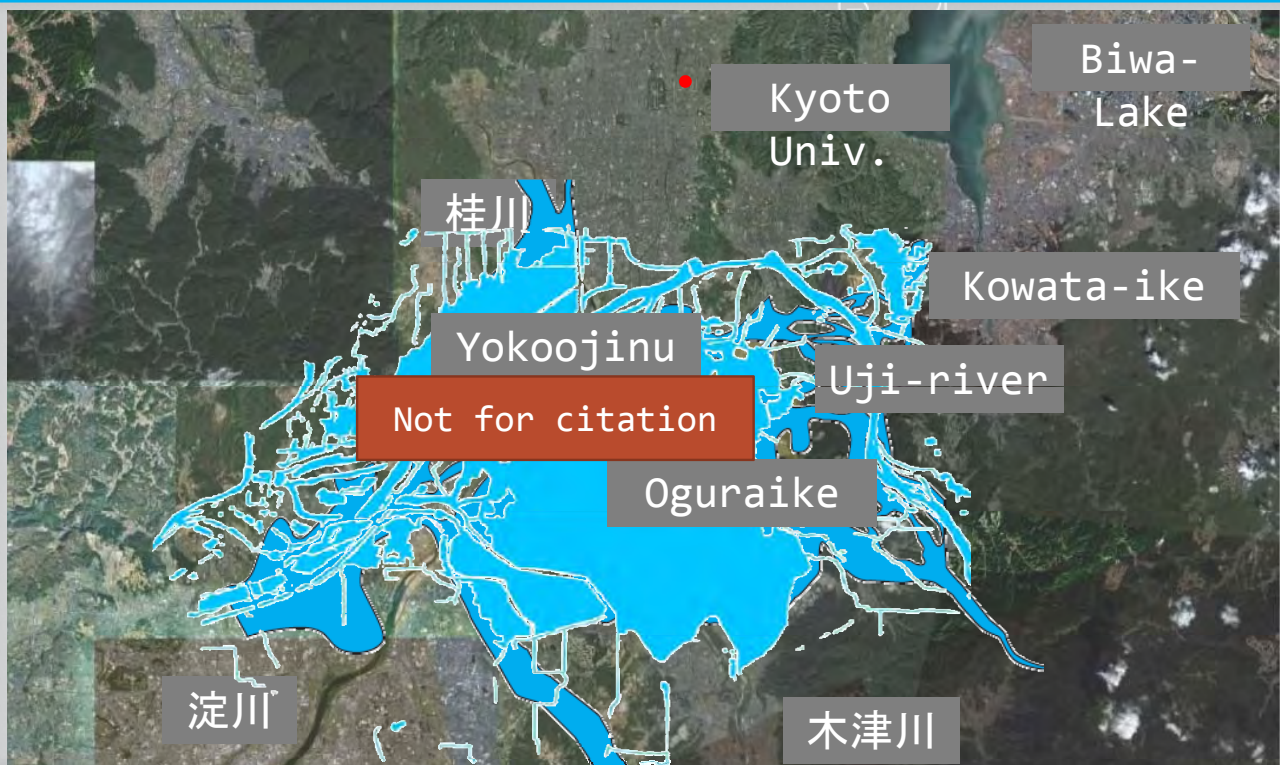
Not for citation

洪水対応の高床式御殿
Flood resilient high-
floored main building.

桂垣 ハチクの生垣 Living Bamboo Fence,



“Katsura-Gaki” and the bamboo grove along the riverbank could have played a good role in mitigating the flooding damage by filtering garbage so it could not get into the garden.





Lotus watching: travel writing by Watsuji, famous philosopher



Before reclamation

The most important flooding pond in the western Japan with high biodiversity, National monument

「巨椋の 入江響むなり射目人の 伏見が田井に 雁渡るらし」万葉集
Man-yo-shu, celebrated poems in Nara era.



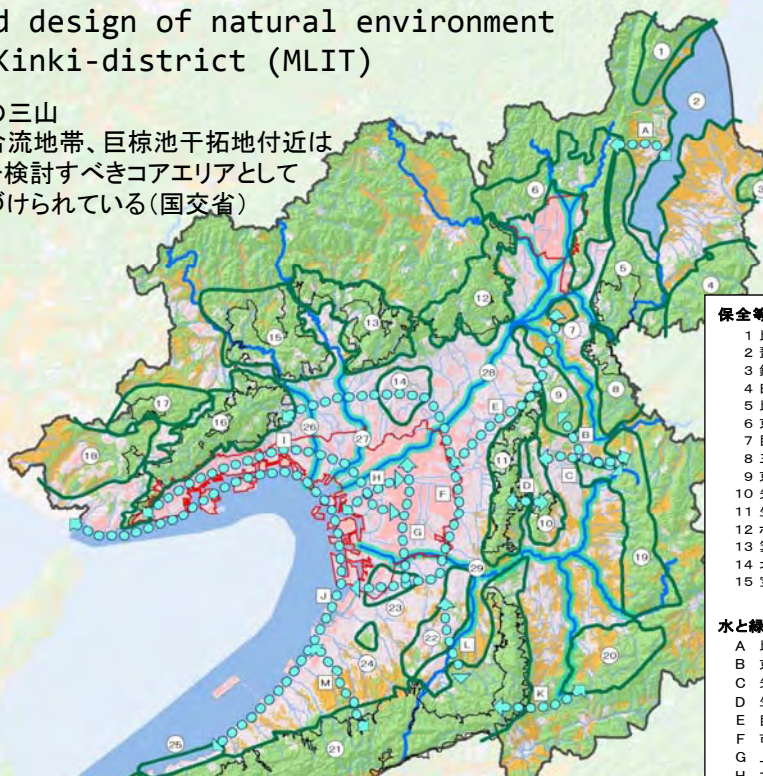
Not for citation



MIKI, Shigeru (1927)

近畿圏の自然環境インフラ将来像図 Grand design of natural environment for Kinki-district (MLIT)

京都の三山
三川合流地帯、巨椋池干拓地付近は
保全を検討すべきコアエリアとして
位置づけられている(国交省)



- 保全等を検討すべき地域
- ゾーン
 - 河川
 - 水と緑の基本軸
 - 水と緑の重点形成軸
- (参考)
- 自然とのふれあいが求められる地域
 - 土地利用
 - 樹林地
 - 農地・草地
 - 市街地
 - 河川
 - 既成都市区域
 - 近郊緑地保全区域

保全等を検討すべき地域

- | | |
|------------|------------------|
| 1 比良山地 | 16 六甲山地 |
| 2 琵琶湖 | 17 帝釈山地 |
| 3 鏡山周辺 | 18 西神丘陵 |
| 4 田上信楽山地 | 19 大和青垣 |
| 5 比叡山から音羽山 | 20 飛鳥 |
| 6 京都市街地周辺 | 21 金剛山地・和泉山脈 |
| 7 巨椋干拓地 | 22 南大阪丘陵地 |
| 8 三上山周辺 | 23 堺市北部 |
| 9 京阪奈丘陵 | 24 信太山 |
| 10 矢田丘陵 | 25 貝掛・箱作・長松・小島海浜 |
| 11 生駒山地 | 26 武庫川 |
| 12 ポンポン山周辺 | 27 猪名川 |
| 13 箕面山・妙見山 | 28 淀川・木津川・桂川・宇治川 |
| 14 北大阪丘陵地 | 29 大和川 |
| 15 宝塚市周辺 | |

水と緑の重点形成軸

- A 比良山地から比叡山地域と琵琶湖をつなぐ軸
- B 京阪奈丘陵と大和青垣をつなぐ軸
- C 矢田丘陵と大和青垣をつなぐ軸
- D 生駒山地と矢田丘陵をつなぐ軸
- E 巨椋干拓地から京阪奈丘陵、大阪市街地をつなぐ軸
- F 市街地を環状につなぐ軸
- G 上町台地を中心とした軸(堺北部地域と淀川をつなぐ軸)
- H 大阪湾沿岸と大阪市街地をつなぐ軸
- I 六甲山麓から神戸・大阪市街地をつなぐ軸
- J 大阪湾沿岸をつなぐ軸
- K 金剛山地・和泉山脈と飛鳥地域をつなぐ軸
- L 南大阪丘陵と金剛山地・和泉山脈をつなぐ軸
- M 大阪湾沿岸と金剛山地・和泉山脈をつなぐ軸

A result of a comprehensive study on ecosystem and ecosystem services.

Conclusion

- (1) 借景保全は大きな意義があったが、里山の危機への対応が必要。

Borrowed scenery strategy was effective to sprawling city. Needs to take care the Process as well as the Pattern

- (2) 孤立緑地の大きさも重要だが、デザインと管理も大きな意味。

Large patches are important, however, design and management are also important.

- (3) 増大する洪水リスクへの賢い適応は氾濫原の再生も視野に。

Ecosystem dependent design/management for smart adaptation to increasing risk of flooding is needed.

Japanese gardens suggest an alternative design and planning to mitigate tradeoffs of ecosystems services and biodiversity.