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SPECIAL FEATURE: REPORT

Biodiversity and Ecosystem Services: Importance of Cities for post 2010 perspective

Biodiversity and ecosystem services in urban areas for smart adaptation to climate change: "Do you Kyoto"?

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Abstract Kyoto is an old city blessed with beautiful natural and cultural landscapes. With the long history of the various events and responses to them, Kyoto is expected to offer some insight into how to create a sustainable city with resilience relevant to its historical inheritances and biodiversity. In this paper, we attempt to describe some concepts of developments and responses that could mitigate the negative impact of urbanization on its biodiversity and ecosystem services. (1) Modern city planning considering natural amenities as well as old Feng-shui geomancy theory could conserve the surrounding mountains. Down-zoning and vistaed view preservation are examples. (2) Inside the city areas, the theory of island biogeography is applicable for biodiversity planning, and the size of the isolated greenery is the most important factor for species richness of all taxonomic groups. However, a single large patch is not always sufficient to conserve as many species as possible. Moreover, the heterogeneity of the environment, which is formed by its design and management, plays an important role in species richness. Japanese gardens and the created wildlife habitat park are good solutions for biodiversity. (3) The nature of rivers and wetland systems has been severely degraded in the urbanization process. However, the excellent Katsura detached palace garden and Oguraike wetland system, which were one-time national monuments with high biodiversity, suggest a smart adaptation to the increasing risk of flooding by climate change: "Do you Kyoto"?

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Introduction: why Kyoto?

The local government of Kyoto, the city where the Kyoto Protocol was adopted, proposed to work toward becoming a low-carbon society by asking people: "Do you Kyoto"? (Kyoto city 2009). However, beyond reducing carbon dioxide emissions, more attention must be paid to the biodiversity that has been the basis of this sustainable city that celebrates ecosystem services. To obtain an ecosystem-dependent design solution, biodiversity is an essential natural capital that must be reassessed from the viewpoint of smart adaptation to climate change. I was involved in discussions regarding the 21st Century Environment Nation Strategy (Japanese Government 2007), the official statement of the Japanese government that pointed out the importance of comprehensive measures to integrate the three aspects of a sustainable society: a Low Carbon Society, a Sound Material-Cycle Society, and a Society in Harmony with Nature.

Since 794, Kyoto has been celebrated as an ancient capital, but the significance is that Kyoto has so far maintained its status as a major metropolis with features unique within Japan. It has been blessed with natural beauty, which expressed as *Sanshi-Suimei*, or blue mountains and clean water, according to Sanyo Rai, a famous Confucianist from the Edo period several hundred years ago. However, we must note that Kyoto has several times experienced severe destructive events, such as civil wars and massive fires. Despite this, Kyoto has been a place where innovative ideas have been implemented, such as the reconstruction by Hideyoshi, the chief adviser to the emperor in the sixteenth century, or the cutting-edge modernization taking advantage

of the natural environment of Kyoto in the Meiji era. This includes the construction of the Sosui Canal from Lake Biwa, Japan's largest lake, and its use as the first commercial water-generated power station in Japan to power the first street cars, which also allowed the development of excellent villas and provided high-quality Japanese gardens with water. These events took place at the end of the nineteenth century but have become quite important elements of the historic amenities of Kyoto today.

As a result, Kyoto is expected to offer some insight into how to create a sustainable city with resilience relevant to its historical inheritances and biodiversity. Cities need to more or less alter the original wildlife habitats into areas for human use. This process inevitably results in some sort of degradation of natural ecosystems. This paper tries to elucidate the reality of the degradation of nature in the urbanization process and discuss some concepts, responses, or good practices that could mitigate the negative impact of urbanization in relation to its biodiversity, ecosystems, and ecosystem services. Urbanization impacts on the natural environment in the Kyoto city area will be categorized and discussed as follows: (1) Historical responses to urban sprawl or city planning against expanding urban areas into the surrounding mountains;. (2) The reality of and response to the fragmentation and isolation of natural habitats beyond the island biogeography. (3) Dealing with flooding or seeking an alternative to mitigate tradeoffs of ecosystem services.

Historical responses to urban sprawl

City planning considering natural amenities

The original city of Kyoto, the ancient capital Heian-Kyo, was constructed more than 1,200 years ago. The main structure is modeled after the ancient cities of China, and it is said that Feng-shui geomancy played an important role (Honda and Huang 1994; Huang 1996) in the city planning. Feng-shui is a theory for site selection and setting up facilities thinking of qi, or the flow of vital energies such as wind and water. The theory gives us some tips for sustainable city planning. In his famous publication *Land Mosaics* (Forman 1995), Dr. Forman mentioned the Feng-shui concept for sustainable land use considering urban forest ecosystems, which are key resources of biodiversity in the scale of urban planning.

Recognizing that natural beauty is a basic component of the historical quality of the city, the local government of Kyoto has been a front runner in the city's landscape amenity governance (Morimoto 2009), beginning with the first city ordinance to control urban sprawl into the surrounding mountains, *Scenic Landscape Districts*, which was established in 1930. A person wanting to build a house in the designated area is required to consider the environment, including trees and shrubs. However, this ordinance only intended to create well-considered developments and was ineffective in conserving the natural environment in the face of rapid urbanization during the rapid economic growth after the 1960s. Citizens' earnest protests against the destruction of natural and historic environments in Kamakura, an ancient city like Kyoto, pushed the government to establish a powerful new law, the Special Law for the Preservation of Historical Features in Ancient Capitals, which enables land acquisition by local authorities. This buyout system to deal with rapid economic growth was an emergency procedure. The Special Preservation Areas of Historical Landscape ordained by this law and another powerful law that designated Preservation Areas of Green Spaces and Special Preservation Areas of Suburban Green Space succeeded in keeping the isolated and precious forested hills in the urban areas of Kyoto, Narabigaoka, and Yoshidayama, untouched (Table 1).

However, more discussion is required to ascertain whether compensation for landowners is necessary. The landscape area and the zoning code for urbanization constrain private rights, but the compensation is not prepared. It is very natural for people in the current generation to consider the excellent natural and historical amenities that have been nurtured by and inherited from our ancestors in order to make some decisions regarding land use. This zoning is limited to the core areas of amenities, such as shrines, temples, and the foothills of surrounding mountains.

Another city ordinance that intends to conserve the entire forested mountain scenery as the basic backdrop of Kyoto is the Preservation Areas for Natural Scenery, which was adopted as a response to illegal development and dumping. The designated area encompasses >25,000 ha, and it is recommended that regionally specific landscape and plant materials be considered during the conservation efforts. The ordinance stipulates not only punishment by fine but imprisonment for violators so as to ensure the effectiveness of the ordinance. Kyoto is likely to be conceived as a green city, but contrary to expectations, actual greenery coverage is rather low in the city. However, because of the green mountains in the surrounding area, citizens' level of satisfaction with the aspect of greenery is very high (Nagayama et al. 1992).

Down-zoning and vistaed-view preservation: new ordinance

Kyoto established several other townscape zoning systems within built-up areas in order to revitalize the areas while considering historic traditions. Moreover, for the purpose of keeping beautiful natural and historical vistaed views or

Table 1 Selected landscape policies related to Kyoto city's biodiversity

Year	Policies	Type
1930	Scenic landscape districts designated (3,400 ha → 17,938 ha at present)	A
1935	First park by town planning Funaokayama Park opened	AB
1969	Special preservation areas designated under the Ancient Capital Cities Preservation Law (117 ha → 2,861 ha at present)	B
1971	One-million-tree-planting initiative started	C
1972	City ordinances on urban landscape established (nation's first)	a
1981	Accomplishment of planting one million trees	C
1995	City ordinances on the betterment of urban landscape	a
1995	City ordinance on preservation areas for natural scenery (25,780 ha)	b
2006	Interim report on the landscape of Kyoto by the special council (Down-zoning)	D
2007	Final report on the landscape of Kyoto by the special council	D
2007	City ordinance to preserve vistaed views (38 targets)	a
2010	NewMaster plan for parks and open spaces established	D

A nature-friendly development, *a* amenity-oriented development, *B* strict preservation of biocultural environment, *b* conservation of natural environment, *C* greening, *D* comprehensive policy

borrowed scenery, down-zoning of building heights and design control systems were established based on the intensive discussion at the special council in which I participated. Thirty-eight vistaed views were designated for preservation, as follows:

1. On-site views: 14 World Heritage Sites, Kyoto Imperial Palace Park, Shugakuin Imperial Villa, Katsura Imperial Villa
2. Street Views: Oike St. etc.
3. Waterfront Views: Hori and Uji River, Lake Biwa Sosui Canal
4. Borrowed Views of Gardens: Entsuji Temple, Shosei Garden
5. Mountain Views: Higashiyama and Kitayama from the Kamo River, Nishiyama from the Katsura river banks
6. Bonfire Character Views: Daimonji Bonfire as seen from the Kamo River, etc.
7. Lookout Views: Arashiyama range as seen from Togetsu Bridge downriver
8. Bird's-Eye Views: Cityscape seen from Daimonji-yama.

Despite the protest by residential developers, the fact that all political parties agreed to this innovative landscape ordinance clearly shows the socioeconomic value of cultural landscape with trees, vegetated mountains, and gardens. The price of condominiums is higher with a view of Daimonji Bonfire, one of the biocultural landscape elements of Kyoto. Using contingent valuation method (CVM) and the conjoint method, the benefit of the designation of Special Preservation Areas of Ancient Capitals is estimated at 2.4 billion yen, whereas the amount paid for acquisition to protect the scenery was much lower, at 1.1 billion yen (Aoyama et al. 2000). Thus, down-zoning and the vista preservation policy are expected to increase the asset value of Kyoto city, which could enjoy the ecosystem benefits of the surrounding mountains.

Beyond the theory of island biogeography

Fragmentation and isolation of habitats in Kyoto

Kyoto has had a unique structure of urban greenery since the Edo period, including shrine forests and trees in the traditional courtyards of town houses. Following is a summary of our survey on the reality of biodiversity in the fragmented greenery areas inside the city area of Kyoto. The application of island biogeography (MacArthur and Wilson 1969) has been a major theory for urban landscape ecological analysis, considering built-up areas as matrices like an ocean and forested areas as patches of islands for wildlife habitats. Species diversity in a remnant patch or a created park is expected to be determined by not only planting or species introduction but also by dynamics of natural colonization and extinction with a long history. Kyoto is a kind of mature city, with a considerable number of isolated forests, including shrine forests, that have been sustainably managed with trees and plants through traditional culture. Those mature greeneries could therefore be near the steady state of colonization/extinction dynamics.

Island biogeography suggests the importance of patch size, and distance from source patches; however, different types of responses were found in each taxonomic group. Woody plant species (Murakami and Morimoto 2000) respond most clearly to patch size. Species richness of ants has a considerably weak response to patch size and depends strongly on microhabitat diversity (Yui et al. 2001), features such as soil surface conditions and the

existence of fallen tree trunks. On the other hand, as pteridophyte species generally respond to microrelief, species diversity is also affected by microhabitat diversity. As forest patch size shrinkage in an urban area may result in a drier environment, causing an extreme environment for fern survival, the regression line slope for the species–area relationship is steeper and more widely scattered than that for woody plants. Smaller and more isolated patches seem to have more severe conditions for sperm fertilization of diploid ferns (Murakami et al. 2005), which are sensitive to urbanization. As a result, large patches could be the refuge of red-list species such as the orchid *Epipogium roseum*, the fern *Asplenium oligophlebium*, and the moss *Leskeella pusilla*. If one looks into the meaning of size in relation to an isolated patch, avifauna may be an appropriate example for characterization. Our research (Hashimoto et al. 2003, 2005a) suggests that the great tit, an insect-eating bird species, needs 1–3 ha, whereas the large beetle- and frog-eating brown hawk owl needs 3–10 ha. A pair of northern goshawks, which prey on crows, have successfully nested for 4 consecutive years in the Osaka EXPO '70 Park (about 100 ha of forested area) (Inoue et al. 2010).

However, small habitats are a matter to be reckoned with. When we tried to conserve all plant species found in the Kyoto shrine forests, we found that the largest forest has >50% of tree species; however, the ratio of herbaceous plants to fern species is only 20–30%. Moreover, red-list species are found in small patches (Imanishi et al. 2005a, b). Thus, the so-called single large or several small (SLOSS) issue is also an important topic for greenery planning (Morimoto 2004, 2007a). We examined the existing ecosystem in Kyoto and found both cases: a large forest on a hill of bedrock, Narabigaoka, and another on an alluvial fan, Tadasu-no-mori, showed that four or five small patches have much more woody and fern species, including rare species, than one large area (Murakami et al. 2005).

Role of management

Therefore, is it enough if one large patch and several unique small patches are protected? The answer is no. As mentioned above, Kyoto has been a frontrunner in terms of landscape governance. However, the reason the Council for Kyoto Traditional Forest Culture was established, according to its charter (Yamaore 2007), is: "The background forest landscape has been gradually changed to create not a few environmental and ecological problems during recent years." Currently, the integrity of forest ecosystems in and around Kyoto is threatened by unusual mass dieback of pines and oaks, and the state of mosses in Japanese gardens is also part of the crisis. These phenomena might be examples of typical biodiversity crises in Japan (Japanese Government 2010). Moss withering mainly due to the urban heat-island phenomena (Iida et al. 2010) is an example of crisis 1: "habitat degradation due to excessive human activities." The background of oak wilt disease is crisis 2: "degradation due to an insufficient level of management." Pine wilt disease is crisis 3: "invasive alien species." Other examples of crisis 2 include drastic landscape changes and forest-floor vegetation dieback by succession to even-aged evergreen *Castanopsis* forest and abnormal population outbreaks of wildlife, such as Shika deer, wild boar, common raccoon, and monkey. These problems are detrimental to traditional cultural events, including the Daimonji Bonfire and Gion festival, the most important attraction festivals of Kyoto. The surrounding green mountains are suffering from metabolic syndrome, or accumulating materials without adequate use. The council has expert panels to discuss cultural ecosystem services, as well as forestry technology panels; however, adequate ecosystem management is only in the beginning stages of development.

Role of design: ferns and mosses

Another factor affecting the city's biodiversity is its nature-oriented design. Biodiversity is not only a resource of culture but also the result of culture. Characteristic biodiversity (Morimoto 2007a, b) nurtured by culture in Kyoto includes Japanese gardens, which play an important role in providing urban wildlife habitats for ferns and mosses. Our research (Murakami et al. 2004a, b; Ohishi and Morimoto 2003) clearly shows characteristics such as species richness of ferns, which is significantly greater than in other fragmented forests. Another characteristic is the high occurrence of forest-edge species. Japanese gardens are famous for their mossy landscape, and traditionally, the moss garden is one of the design styles of Japanese gardening. However, deliberately introduced fern and moss species are limited to several species only. Therefore, species richness in these taxonomic groups is the result of natural colonization and extinction, which are expected in the island biogeography theory, as well as by garden design and maintenance. Whereas the moss garden or Saiho-ji temple garden was originally a dried-up garden with sand and stones, the wet climate of Kyoto and the maintenance required—including clearing fallen leaves and pruning branches to keep the garden half shaded—created a refuge for moss (Morimoto 2007a). Well-maintained gardens are treasure houses of moss. An endangered (category VU (vulnerable), Ministry of Environment) species, *Monosolenium tenerum*, was confirmed at three imperial gardens in Kyoto city. This species was once recorded at the moss garden but is listed as most threatened by Kyoto Prefecture because it was not found during the red-list species survey

(Kyoto Prefecture 2002). We also found *Riccia fluitans* (category CR (critically endangered) + EN (endangered)) at the same places, and *Taxiphyllum alternans* (listed as endangered by Kyoto Pref.) was found in some imperial gardens, including the Katsura detached palace garden.

Role of design: fish fauna

A garden pond is not always just a water body or a carp haven. For example, one species of cyprinid fish, *Acanthorhodeus cyanostigma* (red-list category CR) (Ministry of the Environment 2004), inhabit the sacred garden pond of the Heian Shrine that was constructed about a 100 years ago. The fish lay eggs into large bivalves, and the bivalve larva need small fish to parasitize. Therefore, there exists a small but well-organized ecosystem. The above-mentioned Sosui Canal is regarded as an ecological network that connects Lake Biwa and the gardens in Kyoto. We completed a research project (Ito and Morimoto 2003) on the garden ponds designed by Ueji, an excellent gardener, using the water of the canal from Lake Biwa, about 100 years after its construction, sufficient time to analyze the time-proven relationship between fish fauna and design. We clarified parameters such as microhabitat diversity, depth, area, shape complexity, and water turnover rate, which strongly affect fish fauna. For example, a different fish composition of diverse species was found in the Shokuhoen Garden pond, where greater water turnover rate was recorded, including eel, the nesting fish *Pelteobagrus nudiceps* and *Tridentiger brevispinis*, and the brood parasite *Pungtungia herz*. Thus, garden ponds are now a refuge for these species because some species became quite rare at the site of their original habitat of Lake Biwa (Morimoto and Natuhara 2005).

Of course, the purpose of these Japanese gardens is not simply to grow fish or moss; the design effort to realize the sense of nature at the foot of the Higashiyama Mountains may have led to the development of the garden as an ecologically sustainable and well -organized environment in terms of an ecosystem. The reason we feel these Japanese gardens are important amenities is that they provide wonderful examples of biodiversity nurtured by the environment as well as by skilled maintenance.

Creating a new island: Inochi-no-mori, urban wildlife habitat

A drastic change in the transportation system in Japan is the basic reason Umekoji Park (with a significant space of 12 ha) was established near Kyoto Station. The former freight-train yard was transformed into a park as part of Heian-Kyo's 1,200th anniversary celebrations. A portion of the park (0.6 ha) was designed as an urban wildlife habitat, Inochi-no-mori, where human use is restricted. The project team, in which I am involved, discussed making the area a wilderness refuge, such as that found in Kyoto before urbanization. Although it is a very limited area and there is limited connectivity from the nearest natural core areas (2 km from the Kamo River and 3 km from the Higashiyama Mountains), we attempted to create a miniature Kyoto Basin, including shrine forests and aquatic environments. During the Edo period, sightseeing guidebooks for Kyoto, such as *Miyako-meisho-zue* and *Kyo-habutae,* introduced about 40 urban forests (Shidei 1993). It is expected that the project will create a new landmark, or green island, inside Kyoto city.

By monitoring the process of species colonization and extinction for 14 years, from construction to now, we have analyzed the characteristics of each taxonomic group (Morimoto and Natuhara 2005; Murakami et al. 2004a, b; Hashimoto et al. 2005a, b; Imanishi et al. 2007, Kyoto Research Group of Biotopes 2010). Following is a brief summary of our ongoing research:

In general, the initial several years were quite astonishing in terms of recording new species, and the maximum or plateau value of the number of species was detected in most taxonomic groups. In the second year, an impressive 14 species of dragonfly was recorded; however, aquatic insects were almost completely replaced by invasive alien species, such as the American bullfrog and red swamp crawfish. The peak of species richness of herbaceous species was during the fourth year and gradually declined. The same trends were observed in woody plant species, but their peaks and declines were slower and less severe than those of herbaceous species. The number of seedlings taller than 0.5 m continues to increase, and *Celtis sinensis* var. *japonica* is most dominant, as expected, because of the site's natural quality of being a floodplain, like Tadasu-no-mori. However, *Ligustrum lucidum* (listed as a suspicious invasive alien by Ministry of Environment) is increasing even in shade conditions. Fern species richness increased gradually but seems to be already at its peak. Avifauna recorded over a year is almost steady at 30–34 species after the third year. There are still limited nesting species; however, a pair of *Alcedo atthis*, a beautiful fish-eating species, has become an attractive target for nature watching. The peak of mushroom diversity was observed in the fifth year, in relation to the decay process of woods introduced at the first stage. However, mycorrhiza species are gradually increasing. In general, however, growing trees, homogenization of the forest floor light environment, plant succession, and invasive alien species are considered negative factors for species diversity. Global warming might be another threat in relation to invasive alien species (Murakami et al. 2007; Murakami and Morimoto 2008; Horikawa et al. 2008; Ooishi et al. 2008). Despite these limitations, species richness of the above taxonomic groups

Table 2 Three properties of nature and the concepts for a biodiversity-conscious city, modified from Morimoto and Natuhara (2005)

Properties	Elements (flora, fauna, geology, topography…)	Pattern (patch, corridor, matrix, landscape)	Process (wind, water flow, sediment transportation, species colonization)
Primeval nature	Original flora and fauna	Original shifting mosaics, continuum ecosystems: mountain–river–floodplain–sea	Sun fleck; diurnal and seasonal change; yearly fluctuation; catastrophes by typhoon, earthquake
Biodiversity-conscious city	Land use without species extinction, close to nature	Optimized greeneries with core habitats and scattered significant small habitats, land use considering original ecological conditions	Disaster management with risk assessment considering disturbance-dependent ecosystems, win–win design, risk and ecosystem service communication
Deteriorated nature	Species extinction in the wild, predominant invasive alien species	Fragmented and isolated greenery, disappearing ecotones	Excessive control by dams and banks; extinction of disturbance-dependent species

in this wildlife habitat park is still significantly higher than the standard species–area curve derived from isolated greenery in the Kyoto Basin. This site became a unique site in the heart of the city, where nature observation and education projects are undertaken frequently.

Getting along with flooding

Alteration of natural water ecosystems

As part of the process of modernization, Kyoto is no exception to the trend of loss of natural water ecosystems, including small rivers inside the city area and wetlands. From 1931 to 1976, 24% of the total length of rivers was lost (Yoshimura et al. 2006). Almost all small rivers became concrete-covered. The major rivers, the Kamo and the Takano, had their cross sections improved to lower the level of the water table. As a result, the small ponds and rivers in Tadasu-no-mori, the largest shrine forest in Kyoto, lost water, along with Futabaaoi, or *Asarum caulescens*, the symbol herb of this shrine (Shidei 1993). Natural springs stopped, and a well was drilled to pump water up for a shrine purification ceremony—the Mitarashi ritual, a popular traditional event. An endemic fish species, *Pungitius kaibarae*, also became extinct from Japan. The most serious impact for biodiversity and ecosystem services could be the reclamation of the Ogura-ike pond wetland system (800 ha in 1910), which had been the symbol of the southern side of Heian-Kyo. Notwithstanding that the wetland was designated as a national monument of the habitat of a rare aquatic plant species—the largest inland marsh with the largest wetland biodiversity in western Japan, which had aquatic production and was a famous place for lotus watching—Ogura-ike was reclaimed for rice production. Ninety-one aquatic plant species, including endemic species, were lost (Hatcho et al. 2007; Matsumoto et al. 2009).

These changes in biodiversity and ecosystem services should be reconsidered from the viewpoint of smart adaptation to climate change. Biodiversity contains critical natural capital, which is not renewable and is essential for sustainability. Species extinction in the wild is an indicator of this issue. Ecosystem services issues should be studied as tradeoffs, benefits, and sharing. The main tradeoff of provisioning service in the reclamation process of Ogura-ike is between rice production of about 4,000 t a year and fish production of about 160 t a year. However, attention must also be paid to the cultural function of Ogura-ike as a famous lotus-watching site, as in travel writing by Watsuiji (1951), the famous philosopher, before reclamation in 1926. Moreover, Ogura-ike's regulating service as a flood-control basin is a fundamental tradeoff with dams and levees (Okuma 2007; Miyamoto 2007), which maintain the trend of waterside ecosystems toward deterioration.

There must be more discussion about long-term adaptation scenarios considering the increasing risk of flooding (Hamada et al. 2008). Ideal land use, including flood basins with optimized greenery planning and design, are expected to contribute to disaster management considering ecosystem services from the viewpoint of smart adaptation to climate change. As the Millennium Ecosystem Assessment (2005) and the report by the Washitani et al. (2007) suggested, one of the most endangered habitats is the wetland of floodplains.

Biodiversity-conscious solutions

The above discussion is summarized for biodiversity-conscious urban design, as shown in the middle row of Table 2. Biodiversity is essential for human land use as well as an indicator for resource and land use sustainability. Urban design without extinction of species that originally inhabit an area could be the goal for a sustainable city. I propose this concept for a bioculturally diverse city because biological sustainability will not be guaranteed without cultural sustainability.

At the scale of site planning and design, Japanese gardens suggest good solutions for land use, taking advantage of the environment. Katsura detached palace, one of the excellent examples of architecture with a garden introduced to the Western world by Taut (1936), suggests a harmonious coexistence between culture and nature. Most materials for its construction, such as wood and stones, are common in and around Kyoto, but the composition and design are unique. It was constructed at the alluvial plane just along the Katsura River, which gave it the advantage of bringing water from the river for attractive garden ponds but also created the risk of flooding. The solution for this tradeoff was to give the main building a high floor. Several signs of floodwater levels may be seen on the posts under the floor (Okuma 2007). Moreover, the unique design of bamboo fences in the garden and the bamboo grove along the riverbank may have played an important role in mitigating flood damage by filtering garbage so it was not deposited in the garden. Its 400-year history shows the significance of smart adaptation that allowed the garden to live in harmony with nature, providing both positive ecosystem requirements as well as natural hazards. Considering that the waterside ecotone is one of the key habitats for species threatened by urbanization (Washitani et al. 2007), and considering that there is an increasing risk of extraordinarily heavy rainfall in the urban climate (Mikami 2005), we need to seek an alternative system of design and planning to mitigate tradeoffs of ecosystem requirements and biodiversity. There are still many attractive landscapes being nurtured as part of the long history of land use and landscape design and management (Murakami and Morimoto 2008). Considering the multilevel mosaic city of Kyoto, I suggest that "Do you Kyoto"? should ask everyone to engage in not only ethical behavior, such as *mottainai*, but also innovative design with nature for a society with biocultural diversity.

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