

vehicles. This means that the government should add NOx emission standards and assessment criteria for diesels with implementing the OBD monitoring test and the I/M test.

SMG, on the other hand, needs to adopt a differentiated management plan for each excess emission level, while encouraging vehicle owners to reduce auto emissions by paying them financial incentives. At the moment, the SMG subsidizes the cleaning cost. Taking a step further, it should foster and support social organizations advocating environmental protection. SMG needs to consider financially supporting car owners with emission test by connecting the test with the vehicle eco-mileage program.

Meanwhile, Seoul citizens should participate in improving the city's air quality by making necessary improvements to the emission performance of their cars. They need to engage in the vehicle eco-mileage program.

Lastly, auto manufacturers should provide services for the emission diagnosis of vehicles, as well as for old component exchange and repair. This way, they can take their parts in discarding decrepit vehicles spewing an excess of pollutants.

Environmentally friendly Urban Management Using Biotope Maps

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Summary

The Seoul Metropolitan Government (SMG) should adopt quantitative and systematic biotope assessment criteria to better evaluate the conditions of each ecological space, while making necessary improvements to related guidelines. The biotope assessment criteria should be utilized in the government's ecological urban management.

1. Introduction

The environment-friendly management of urban spaces has become increasingly important as land planning is carried out in tandem with environmental planning

In recent years, the national government has conducted national land planning with considering environmental aspect. This is to develop an environment-friendly plan for land management. As a result, the need to collect and manage information on environmental matters has grown. In this regard, the SMG has produced a biotope map containing information on ecological spaces in Seoul. SMG has been utilizing the map in various areas of urban management, such as in setting the development permission criteria, Environment Impact Assessment (EIA), and environmental review of urban planning. A biotope refers to an area of certain environmental conditions that provides a specific assemblage of plants and animals with a living space. It is a biotic habitat clearly distinguished from other areas in the region. In the field of urban management, a biotope is regarded as a spatial unit with the least possible condition to maintain the natural ecosystem for the survival of living organisms.

According to their conditions, biotopes are classified into five types, each assigned with a level from one to five: Level one is given to a biotope whose entire area must be preserved at all cost; Level two goes to a biotope of which the whole area should be preserved with priority; Level three is given to a biotope of which some areas need to be preserved with priority, while the rest are subject to land use restriction; Level four goes to a biotope with some area subject to land use restriction; Level five is given to a biotope where improvements should be made in some areas.

Since 2000 when SMG first introduced the biotope map of Seoul, it has widely been used in the urban management. For instance, the SMG has availed itself of the biotope map for preserving Seoul's natural ecology, land sustainability assessment, and EIA. To secure reliability of the information, the map is updated with new data every five years. Yet its main usage is currently limited to a means of directly regulating or managing biotopes with respect to their biotope levels. In other words, the potential of biotope map is not fully realized in the city's environment-friendly urban planning and management.

In addition, the development standards applied to level-one-type biotopes, which have been used in the SMG's environmentally friendly urban management, are different to the current environmental planning standards. Consequently, it is difficult and inappropriate to use them together. Moreover, the SMG's urban management plan does not provide specific evaluation methods and necessary criteria for constructing a biotope. In recognition of these issues, this research draws up a plan as to what approaches the SMG should take to more effectively use the biotope map in tandem with the current urban management system. Furthermore, it provides information requisite to lay the foundation for ensuring the practicability of the existing urban management system, and developing a more effective ecological plan in the future.

2. Main Findings

This study presents herewith the findings from the evaluation of current urban management systems, including the environmental review of urban planning, the Environmental Impact Assessment (EIA), and Green Building Certification systems

SMG has implemented various urban management systems by making reference to the biotope map for the sake of the city's sustainability. Among them include the environmental review of urban planning, EIA, and Green Building Certification systems. Urban planning mandated and implemented by the law may impinge on environment, climate pattern and urban ecosystem, while affecting the public health and energy consumption. The environmental review of urban planning is conducted in anticipating these influences on the lives of Seoul citizens. This is essential to develop a solution for the eradication or restoration of such damage. Through these efforts, the SMG aims to create an environmentally healthy and sustainable city. The review criteria include items for biotope assessment. Within the SMG, ideas should be collected from departments responsible for each segment of biotope assessment, and then reported to the division, which is in charge of environmental review of urban planning.

EIA, on the other hand, assesses the impact of urban development projects on the environment nearby the designated project sites. Total 26 projects in 11 fields such as housing site development projects (occupying land in the total size of 90,000-300,000m²), are subject to EIA. The assessment criteria comprise 20 items spanning over 6 areas, including ones assessing impacts on air quality and the lives of animals and plants. The assessment report is reviewed by the Seoul Institute or other expert bodies, and then deliberated by the Environmental Impact Review Deliberation Committee. SMG also carries out a regular investigation twice a year, checking whether deliberations are properly carried out.

Lastly, the Green Building Certification system evaluates the environment-friendliness

of buildings. If it is up to the standard, the system can certify green buildings. With the system, the SMG aims to create a healthy environment by reducing environmental burdens produced in the course of construction. They include the excessive consumption of energy and pollutant emission that may occur in building design, construction, maintenance, and waste discard. SMG applies different certification criteria to different structures with varied purposes, such as apartment buildings, multiplex buildings and accommodations. SMG carries out the Green Building Certification System in pursuit of creating green spaces and habitats such as a biotope within the construction site. It is to create an environment for living organisms, and securing the ecological function of spaces outside the building.

As of 2015, the total size of level-one biotopes was 9,829ha, occupying 16 percent of total Seoul area

In detail, green belt zones have the most level-one-type biotopes (approximately 85 percent), and residential areas have 15 percent. It should be checked whether level-one biotopes are present in a project site before permitting development activity. Recognizing the need to thoroughly investigate the condition of each biotope and growing requests from the citizens to adjust the level of biotopes in their neighborhoods, SMG has revised the relevant guidelines. And a system has been established for regular maintenance of biotopes.

The environmental review of urban planning covers biotope assessment, yet the assessment criteria are mostly non-specific. There are also no guidelines for post management of biotopes upon the completion of urban development projects

Environmental review reports of 51 urban development projects carried out in 2013 and 2014 have been analyzed. They comprise 13 reconstruction projects, 12

district unit development projects, and 26 urban planning facility construction projects. The environmental review with biotope assessment was carried out in 43 projects. However, the environmental review without the biotope assessment was conducted in 5 projects. The rest had neither environmental review nor biotope assessment. The biotope assessment criteria in the environmental review are too general at present: It merely states the level of a biotope and describe its condition upon the completion of development project as “no need to alter the current level-type,” “only minimal damage is made” or “improvement is likely to be made upon the initiation of future development project.” The criteria do not assess the specific condition of biotopes. Therefore it is difficult to derive any solutions for improvements.

All the 51 urban development projects subject to the environmental review reportedly have biotopes in their designated project sites: 9 have the level-one-types; 15 have the level-two-types; 14 have the level-three-types; 13 have the level-four-types; and 21 have the level-five-types. Some of them have more than one biotopes.

[Table 1] Number of Urban Development Projects (Subject to the Environmental Review) with Biotopes

Biotope Level-Type	Level 1	Level 2	Level 3	Level 4	Level 5
No. of Projects	9	15	14	13	21

Note: Only included projects where the biotope assessment was conducted with the environmental review

The current EIA does not give directions as to how biotopes that have been damaged in the course of urban development should be restored

In general, urban development projects subject to the SMG’s EIA are required by the EIA deliberation committee to build terrestrial and aquatic biotopes within their project sites. This process ensures the biodiversity in the areas. In case there exists a level-one or level-two biotope close to the project site, the project planner should

consider connecting them with green spaces. When the designated development site contains a level-one biotope that should be preserved, but are likely to be damaged in the course of development, alternative green space must be set aside. It is the EIA's mandate that the size of alternative green space to be larger than the size of damaged biotopes. Yet the EIA gives no standards regarding to what should be done to restore damaged biotopes.

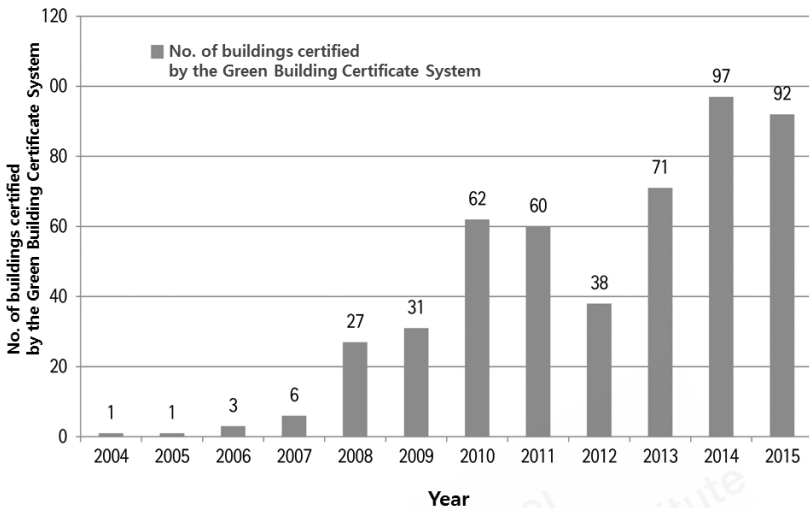
For this research, the alternative green space plan of 5 urban development projects with accessible EIA data have been investigated. It has been found that every designated project site has enough space to build alternative green area. The size of spare area is, on average, over twice larger than the size of damaged biotopes; in some cases, a difference between the two is over three to one. However, it has been found that such space is not entirely spared for alternative green. For example, Oksu 13 and Bugahyeon 3 development sites have the largest space (relative to the size of damaged biotopes) available for alternative green space among other urban development project sites. Yet the given space is not reserved specifically for alternative green: The area spared for alternative green comprises just a small part of a large space previously reserved for park. Excluding such cases, spare spaces available for greenery within the project sites is approximately 1.7 times larger than the size of damaged biotopes. In the case of Godeok Jugong Apartment Complex 2 development sites, the SMG has changed the location of an alternative green space, considering ongoing road and trail construction and the location of a nearby green space (Bangjuk Park). With the change, the government aims to create wider alternative green space adjacent to well-preserved biotopes at the development site, while connecting with other biotopes near the site. In addition, the SMG plans to transplant every 120 damaged tree in level-one biotope (1,085m²) to the alternative green space.

[Table 2] Damaged Biotopes and Alternative Green Spaces at Each Designated Project Site

Project site	Site size (m ²)	Biotope size (m ²) (Level-one -type)	Damaged biotope size (m ²)	Alternative green space size (m ²)	Alternative green space size relative to damaged biotope size (%)
Cheonwang 2	278,887	72,895	18,168	18,213	100
Oksu 13	124,465	5,451	5,451	19,404	356
Bugahyeon 3	263,101	3,888	3,888	11,398	293
Godeok Jugong Apt. Complex 2	246,210	3,783	1,086	3,005	277
Seoul Samsung Hospital	157,005 (actual development site size 48,727)	1,389	1,389	1,714	123

The Green Building Certification system encourages building owners to adopt energy conservative and environment-friendly practices in building construction and maintenance, offering various kinds of incentives

SMG makes it compulsory for apartment buildings with more than 500 residential units to acquire the Green Building Certificate. Other types of building structures may apply for the certificate voluntarily. The Green Building Certification system provides various incentives. They include property tax exemptions, support for obtaining the Green Building Certificate, environmental improvement charge discount, and relaxed regulations regarding the floor area ratio, building height, and the size of landscape area. Between 2004 and the third quarter of 2015, total 489 structures were certified as green buildings by the SMG's Green Building Certification system: 12.9 percent were rated with the "Excellent" ; 70.1 percent received the "Good" ; 11.9 percent obtained the "Fair" ; and 5.1 percent were given the "Ordinary". The amount of incentives is different across the rate of certificates.



[Figure 1] Number of Buildings Certified by the SMG's Green Building Certification System (2004-2015)

The condition of urban development site should be carefully weighed when establishing a biotope management plan

To come up with an effective biotope management plan for environment-friendly urban management, development sites subject to the environmental planning review and the EIA, and structures that must be certified by the Green Building Certification system have been examined. This report categorizes urban development project sites subject to the environmental planning review into three types: reconstruction sites, district unit development sites and urban planning facility construction sites. Among them, it specifically looks at the sites with level-one and level-two biotopes. In regard to development sites subject to the EIA, this study examines ones in which level-one biotopes have been damaged or new biotopes have been built in the course of development. Lastly, building structures that have biotopes within their building sites or received outstanding grades in the certification have been studied.

This report explains how to distinguish a biotope “nearby” the designated development site from one “adjacent” to the site. The former refers to the biotopes that are situated in close distance from the project site, yet separated from it by a paved road running between the two areas. In the case of the latter, there is no such paved road. This study confirms the necessity of not only restoring damaged biotopes, but also improving the condition of undamaged biotopes. Moreover, we delineate factors that should be considered in the biotope assessment, such as what is required for an area to be accepted for alternative green space. This research also explains what details must be included in the environmental review report prepared upon the project execution. Lastly, it supports the idea that a well-organized management system should encompass a plan for post management.

Eighty eight percent of experts claim that not only biotopes within the development site, but ones located nearby the site should be taken into consideration for preservation

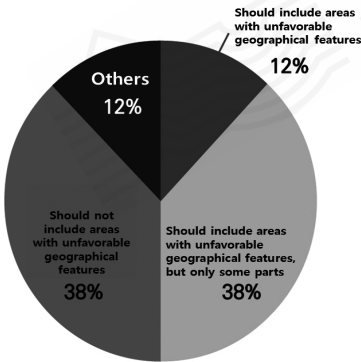
The survey of experts has been conducted on the issues regarding the preservation and restoration of biotopes, and the construction of alternative green spaces. It serves the following two purposes: One is to organize the biotope assessment methods and criteria by making reference to the results of the research and field study. Another is to secure additional objectivity in contents that may impose burdens to project managers.

To the question whether biotopes nearby development sites should be considered for preservation along with those located within the site, the large majority of experts answered in the affirmative: “Absolutely yes (42 percent)” and “Yes (46 percent).” The rest responded “Maybe (8 percent)” and “No (4 percent).”

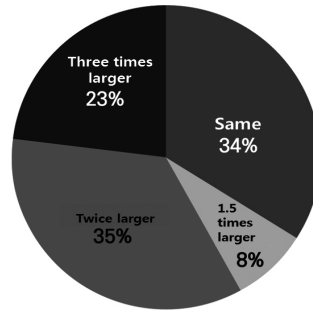
If biotopes near development sites are to be considered for preservation, there should be made a clear distinction between ones “nearby” the site and others “adjacent” to the site, said 84 percent of respondents. To the question as to what is

the appropriate range of nearby biotopes, the largest number of respondents (40 percent) answered “Biotopes located within 50m from the project site.”

Regarding the construction of alternative green spaces, the field study has found that, in many cases, such spaces are created in areas with unfavorable geographical features, such as steep slopes and rocky lands. Recognizing this trend, the survey asked experts whether they consider if it is appropriate to include such kinds of areas in the list of desirable sites for alternative green space. 38 percent responded that it would be appropriate to count only some part of such areas, whereas the same proportion of respondents answered that it would be inappropriate to consider such areas at all. To the question concerning the size of alternative green space, the biggest number of respondents (35 percent) answered that it should be twice larger than the size of damaged biotopes. Slightly less number of experts (34 percent) said that it should be the same size as that of damaged biotopes. The rest responded “three times larger (23 percent)” and “1.5 times larger (8 percent).”



[Figure 2] Responses Regarding to the Location of Alternative Green Space



[Figure 3] Responses Regarding to the Size of Alternative Green Space (relative to the size of damaged biotopes)

Biotope assessment methods and criteria regarding the location, size, type, and planting of alternative greenery should be developed and implemented

We propose herewith a revised version of biotope assessment methods and criteria as [Table 2] below. Based on the analysis of both research and field study, this the first draft of such methods and criteria was first drawn. Next, they have been modified through the expert survey and consultation.

[Table 3] Revised Biotope Assessment Methods and Criteria

Criteria	Details
Location	<ul style="list-style-type: none"> • Create a biotope in the place where monitoring is convenient, while human interventions are minimal and various kinds of environmental pollutants and noise sources (e.g. vehicles, bicycles) are distant • Aquatic biotopes are to be created in the place with no risk of soil loss by rapids in the time of heavy rain • Terrestrial biotopes are to be constructed in an open space and connected to nearby green areas • Alternative green spaces: <ul style="list-style-type: none"> - Select a desirable site near the biotopes damaged in the course of urban development project for alternative green space construction - Only count some part (maximum 30%) of the areas featured by undesirable geographical characteristics (e.g. slopes, rocky lands) for alternative green space construction - The spatial scope of alternative green space is better be within a close range of designated project site (e.g. a destructed forest adjacent to the site) - Allow alternative green space created in the area obtained through contributed acceptance (i.e. a land contributed to the government by the private owner)
Size	<ul style="list-style-type: none"> • An aquatic biotope: minimum 90m² • A terrestrial biotope: 180m² (at least 3% of the total size of development site) for the minimum size of construction site, 3m for the minimum width • In case if an alternative green space need be created, propose its size to be at least 1.5 times larger than the size of damaged biotopes • The size of aquatic biotopes, terrestrial biotopes, and alternative green spaces may be included as part of an green area
Type	<ul style="list-style-type: none"> • Provided that every other condition is the same, build a round-shape biotope instead of long, narrow one (the former is more effective) • Aquatic biotopes: <ul style="list-style-type: none"> - A pond-shaped biotope does not have be created in a single form, yet should have various curves. It is necessary to ensure the diversity of aquatic ecosystem - If it is difficult to secure a large area within the development site, small ponds should be created in large quantities and they need all be connected with one another to enhance the biodiversity

[Table 3 continues] Revised Biotope Assessment Methods and Criteria

Network building	<ul style="list-style-type: none"> • Build a green network by connecting green spaces and biotopes created within and outside the project site and existing natural habitats nearby the site to each other. It would help ensure the stability of local ecosystems that may be damaged in the course of urban development
Planting	<ul style="list-style-type: none"> • Draw a planting plan by identifying the species of living creatures inhabiting a biotope. The plan should be prepared for planting local plants in a multi-layered structure • Select a plant species that can contribute to maintaining and enhancing the ecological function of a biotope. Focus on species that inhabit or used to inhabit the development site or places nearby the site • Need to construct vegetation zones on the periphery of a biotope as a buffer from external influences • In case if the vegetation of a level-one-type biotope has to be transplanted to other area due to its low density and dearth of plants, regard the area as an alternative green space • Transplant a certain number of damaged trees to a new designated area and if they successfully adapt to the new ecosystem, increase the planting volume of such a tree species. When additional trees (or other types of plants) need be planted, avoid ornamental tree species as much as possible • Plant shrubs or creeping plants as well as high trees to provide target animal inhabitants with food sources • Planting tree species do not have to be equal to ones inhabiting the biotope, yet do not plant naturalized plants (e.g. Acacia trees) or foreign plants. Select appropriate ones from the Seoul's native plants, and plant them in harmony with other plants in the biotope
Inhabitants	<ul style="list-style-type: none"> • Aquatic biotopes: Construct perches on which birds and insects can rest • Terrestrial biotopes: <ul style="list-style-type: none"> - Construct nests, feed buckets, water sources, etc - Build animal burrows (e.g. a mound of stones, a pile of logs) • Alternative green spaces: <ul style="list-style-type: none"> - In principle, select a single species of living organism as a target species - Choose a target animal and plant species after carrying out the research and field study of natural habitats damaged by urban development, surveying the residents nearby the project site, and consulting experts

[Table 3 continues] Revised Biotope Assessment Methods and Criteria

External influence	<ul style="list-style-type: none"> • Use various means (e.g. building fences, growing hedging plants) to minimize external influence
Maintenance	<ul style="list-style-type: none"> • Regularly check and improve the condition of biotopes and alternative green spaces with the consideration of the ecological characteristics of target living organism species. Block the light of street lamps, noise of cars, etc • Write an annual report on the post management of biotopes and alternative green spaces. Make reference to the findings when carrying out the post management in the following year • Construct direction (sign) boards <ul style="list-style-type: none"> - Inform guidelines regarding to biotopes - Inform guidelines regarding to the biotope management - Inform guidelines regarding to the code of conducts and precautions that should be taken by managers, residents, etc

3. Conclusions & Policy Recommendations

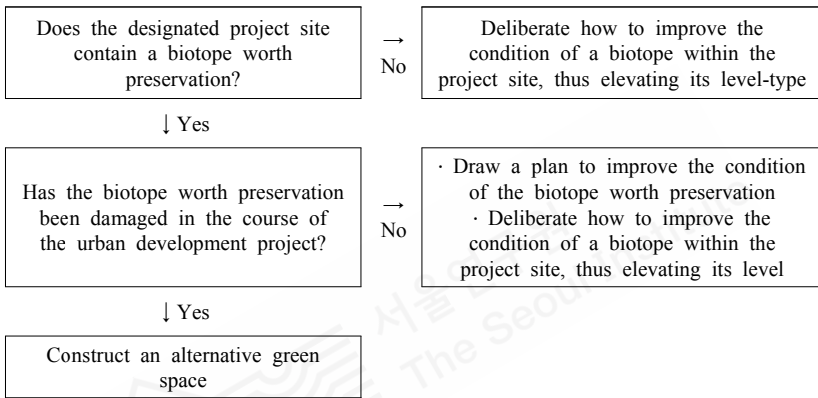
The revised biotope assessment methods and criteria suggested in this report are expected to enhance the practicability of the existing biotope assessment system and be usefully utilized in establishing the city's ecological urban management plan

We proposed a revised version of the biotope assessment methods and criteria for the environmental planning review, the EIA and the Green Building Certification system. The following is the summary of the biotope assessment system improvement.

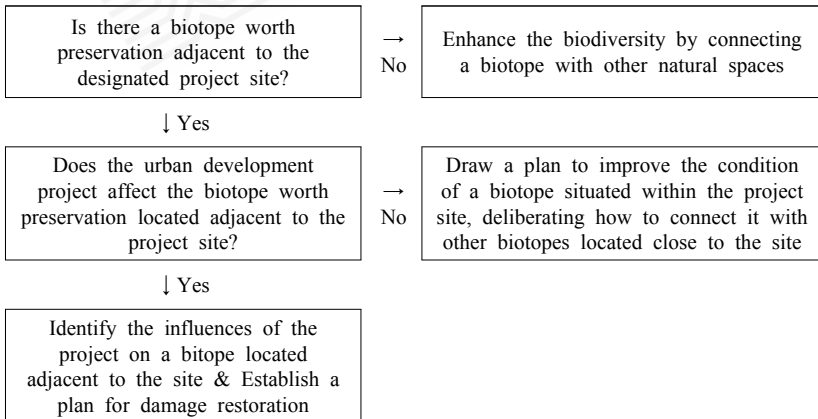
For the environmental planning review, the biotope assessment methods and criteria should be objectified so the results can be quantified. If there exists a biotope worth preserving within or close to the designated urban development site, the project manager should examine the condition of biotope in the project plan. If the biotope that should be preserved is damaged in the course of development, the manager is bound to prepare a plan for restoring damaged biotope or creating alternative green space by complying with the biotope assessment methods and criteria. This plan should be submitted to the relevant department within the SMG for revision. In regard to the biotope assessment method, two different improvement

plans should be drawn separately for biotopes located within the project site and those found outside the area. The diagnosis on biotope conditions is to be prepared to identify the current biotope conditions and develop solutions for improvement, if necessary. This report would be able to assist reviewers who make reference to the report to better comprehend it, thus supporting their decision making.

Biotope Assessment Method (for biotopes situated within the project site)



Biotope Assessment Method (for biotopes situated outside the project site)



The size of alternative green space should be defined and included in the SMG's EIA standards. Tree planting methods should be specified as well. For instance, plants of various heights and sizes need to be planted together, while plants should be selected from native and indigenous species. It is strongly recommended to create vegetation zones nearby the designated project site as a buffer from external interventions. In regard to the biotope maintenance, specific methods for managing its location, size, type, inhabitants, external influence, and maintenance have been described in this research.

It is expected that a newly improved biotope assessment scheme will ensure the practicability of the existing environment-friendly urban planning and management system. The scheme combined with other environmentally friendly urban planning systems, such as a biotope area ratio application system, would also serve as the foundation for carrying out ecological planning in the future.

