Mapping Biotope and Sociotope for Green Infrastructure Planning in Urban Areas

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1 ABSTRACT

Urban green spaces contribute to the quality of human life, whilst providing significant value to biodiversity (Hough, 2004; Sundseth and Raeymaekers, 2006). However, the recreation activities of people often inevitably conflict with habitat conservation, and achieving maximum benefits is difficult in practice. Green infrastructure concepts claim to embed multiple functions in green space systems and might provide a framework to integrate these differing aims in the built environment. By planning a multifunctional green infrastructure, combining social and ecological functions within urban green spaces, both the quality of environment for people and wildlife could be improved.

Traditionally, approaches on green space planning to date tend to discuss social issues and ecological issues separately and an interdisciplinary method integrating ecological and social factors in the planning process has not yet been developed. To address this need a framework incorporating both biotope mapping, a conventional approach to map ecological value, and sociotope mapping, an emerging approach to map social value, might provide a possibility to reflect natural and social characteristics respectively during green infrastructure planning.

This research aims to integrate literature on the concepts of green infrastructure with biotope and sociotope mapping, and to formulate a conceptual framework based on this new understanding. A bio-sociotope concept can assign and map differing values of the various users of each green space across a city. In so doing, the considerations of recreation provision and habitat conservation could both be taken into account during green space planning. This process enables the differing functions and values of green space to be identified and assessed and provides an opportunity for more appropriate and integrated strategic planning strategies to be proposed.

2 INTRODUCTION

Urban green spaces play multiple roles in benefiting environment and society alike. Functions including environmental, ecological, social and economic aspects exist individually or jointly in all green structures so as to contribute to quality life of citizens and urban biodiversity. However, the conservation of green spaces in urban areas has all too often conflicted with the interests of land development and therefore tends to be sacrificed under the economic pressure. As the result, green spaces are rapid decreasing in many metropolitan areas and have given rise to environment deterioration. In this circumstance, not only do the population and the diversity of wildlife decrease, but also environmental amenity for human beings decline.

In response to this environmental declination, planning strategies regarding habitat conservation and green space provision to date have respectively conserved valuable habitats for wildlife and created leisure spaces for citizens. However, although they have protected green spaces from the other land utilising to a certain extent, either of them has inherent demerits in terms of comprehensively countering haphazard development. As being pointed out by many researches, the former strategy looking at individual space and preserving land parcel-by-parcel is unable to efficiently prevent habitats from the encroachment of development; while the latter focusing on quantity provision, such as park hierarchy, and size distance standard, tends to neglect surrounding natural fabrics as well as multiple innate functions. Therefore, a planning approach conciliating land conservation and land development and reflecting specific surroundings and internal characteristics has attracted a wealth of attentions.

2.1 Green Infrastructure

To this end, green infrastructure proposes an ecological framework for urban growth. Rooting in the concept of green networks, it claims to interconnect green spaces, including natural, semi-natural and artificial areas, at various scales as networks that conserve natural ecosystem values and functions so as to provide

associated benefits to human populations (Benedict and McMahon, 2003). One of the principles that distinguishes green infrastructure from other planning strategies to balance conservation and development is the primary objective to identify various value of spaces. Accordingly spaces recognised as ecological valuable places are designated to be conserved, while spaces recognised as no value could be assigned to develop. This process therefore ensures that important natural systems are not fragmented by urbanization and provides a framework to locate new development.

However, what green infrastructure concept emphasizes to pre-identify is the value relating to ecosystem services, social value in relation to recreational service is failed to be addressed in the proposition. Recreation is one of the most significant functions a green space in urban areas provides and to some extents increase or decreases the other functions. Recreation with regard to human activities has very often conflicted with the ecological role of green spaces. The absence of identifying recreational value might result in a bias that neglect the demand of people and their coexistence with ecological function while determining the location of new green spaces and the following strategies of management. Hence, this research claims to evaluate not only ecological value but also recreational value for providing a foundation to assist in green infrastructure planning.

2.2 Biotope Mapping

Biotope mapping, a conventional method used to map ecological value of green spaces in urban areas, can offer an informative biological reference to underpin conservation planning. Biotope refers to a distinct space, which is endowed with specific environmental conditions and suitable for particular flora and fauna (Hong et al., 2005). As Sukopp and Weiler (1988) indicated, the prerequisite for successful nature conservation strategies is knowledge of the individual biotope, their ecological characteristics, location and distribution in the city and the composition of their plant and animal communities. Generally, three main steps are comprised in the process, namely field survey, categorisation of biotopes, and evaluation. In this process, relevant condition of environments, such as soil, vegetation, fauna, and land-use, is evaluated and graded by various ecological values on the map. The result then offers an evidence based foundation to assist in the decision making of where to conserve.

2.3 Sociotop Mapping

Inspired from the concept of ‘biotope’, which is ecological defined environment, Stahle (2005) developed ‘sociotope’ concept as the counterpart. Sociotope is defined as the commonly experienced and used place of a specific culture. The approach collects public meanings of using experiences and preferences regarding both qualitative and quantitative content of spaces from a specific community. In the case of Stockholm, sociotope is generated by means of collecting opinions from professionals and public with interview and questionnaire. The result is then transferred into spatial dimension and graded as biotope mapping approach. However, as it is an emerging approach, the content of what to investigate has not yet been fully discussed. Generally factors relating to attractiveness and accessibility of a green space are the major concern while doing user survey, which gives a chance to reflect demographic characteristics and take public value of spaces into account in the earlier stage of planning. With sociotope map, places suffered from the insufficiency of quantity and quality provision can be identified.

3 CONCEPTUAL FRAMEWORK

Obviously the approach of biotope mapping, which evaluates ecological functions, and sociotope mapping, which evaluates recreational functions, can be used as complements to fulfil the objective of green infrastructure, which claims to pre-identify the value of green spaces. Bio-sociotope map ensures the multifunctionality of each green space can be illustrated for assisting in decision making of network connection in the earlier stage of planning. This research therefore presents a conceptual framework with an articulate sequence by integrating bio-sociotope approach into the processes of green infrastructure planning. In addition, the framework is designed a space-time planning tool. It links each step in the planning process with spatial methods, which then give a better visual reference to planners (figure 1; figure 2). It is also designed as a join-up approach to green space provision and management. Four steps are encompassed in this conceptual framework (figure 1):

Step 1: Identify Green Resources

The identification of green resources is the priority of the framework. In order to undertake a comprehensive green space planning, all kinds of green spaces with different naturalness should be taken into account. Conventionally land use map, which tends to neglect green spaces other than parks, is unable to provide a proper foundation. Therefore there is a need to identify land cover which better reflects all green resources of a city.

Step 2: Identify Current Values

After a citywide identification of green resources and their distribution, investigations into their ecological and social characteristics are suggested to conduct by documentary review, site survey, elite interview, or questionnaire. These data are then transferred into spatial dimension with biotope and sociotope approaches. Accordingly functions with regard to ecological value and recreational value of each parcel of spaces can be identified and graded.

Step 3: Generate Green Networks

On the basis of bio-sociotope map, green structure is evaluated in accordance with the space and distance criteria derived from biological and social evidence, which is then used to generate an ideal multifunctional green network as well. By comparing the ideal green network with current green structure, location subjects to quantity or quality deficency can be specified. As the result, each green parcel would be marked with current value and ideal value so as to assist in further strategy proposition.

Step 4: Propose Strategies

According to the result derived from step three, strategies in relation to both planning and management are presented. Three major strategies are suggested: adjustment, creation, and development. Adjustment refers to the strategies applied to existent green spaces, such as enhancing connectivity, enlarging habitats, changing vegetation composition, changing maintaining methods, and improving facilities; creation refers to create new green spaces, including habitats, corridors, and stepping stones for wildlife and leisure green spaces for people, in the areas suffered from green space insufficiency; and development is the strategy applied to the place recognised as non-value.

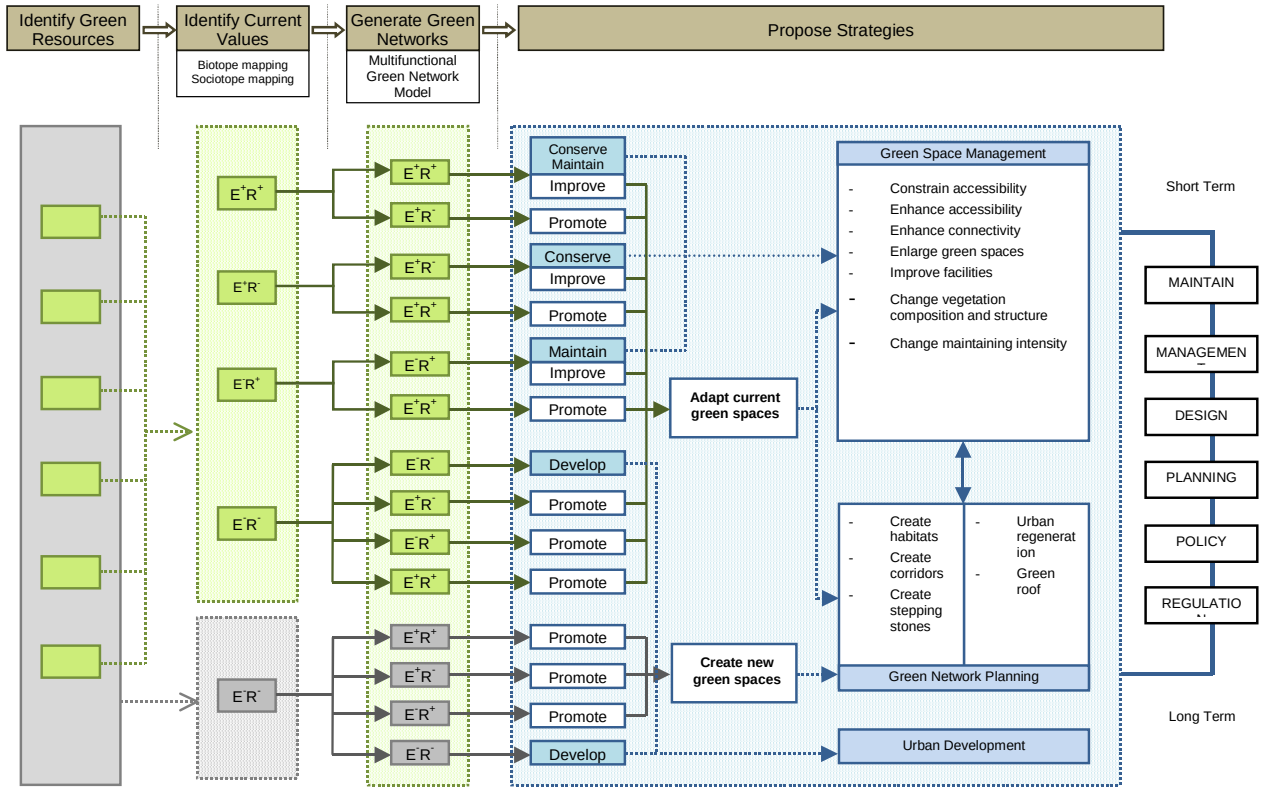

Fig. 1: Conceptual framework at a time dimension

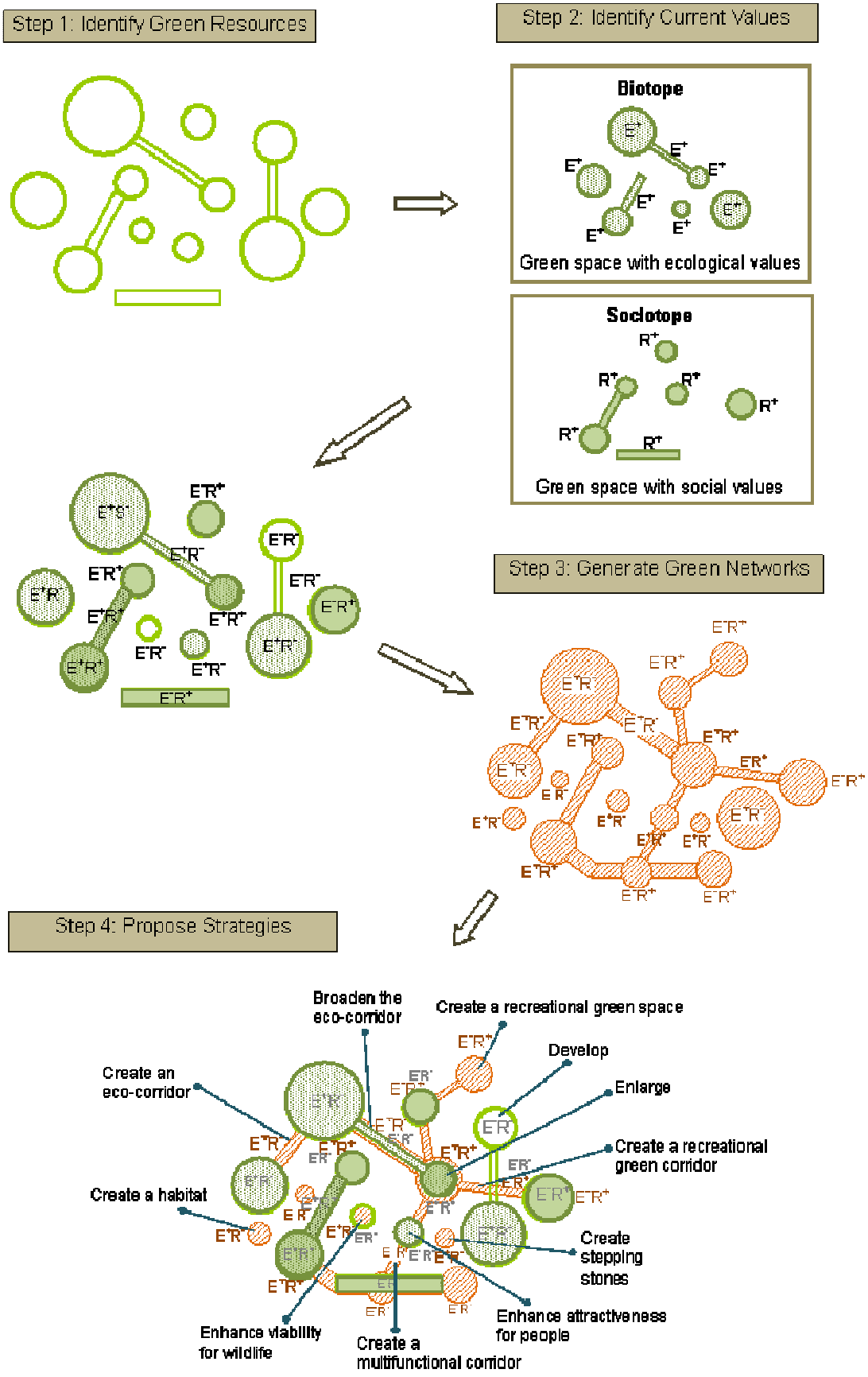

Fig. 2: Conceptual framework at a spatial dimension

4 CONCLUSION

As green infrastructure planning is becoming a prominent concept in urban green spaces to confront haphazard development and enhance urban biodiversity, so it is significant to further develop its method.

This research finds the approach of biotope mapping and sociotope mapping can strengthen green infrastructure method by identifying multiple functions of a green structure with scientific evidence prior to the stage of network generation. Built upon previous concept as well as methods, this research seeks to present a comprehensive planning framework that integrates the process from green resource identification, green value identification, green network generation to strategy proposition.

In order to promote the adaptation and the resilience for a wider application, the framework is designed to be an evidence-based framework, which the criteria is underpinned by a series of site investigation; a dynamic and flexible framework, which the standard could be changed in accordance with the natural and social context in different cities; a space-time planning framework that provides not only a sequence of green network planning, but also a spatial planning strategies across different gradient of a city; and a join-up approach to green space provision and management that integrate management into planning process. Eventually this conceptual framework might fulfil the aim of green infrastructure by assisting decision makers to determine the place to conserve, to adjust, and to develop in an urban context.

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