

COMPARATIVE ANALYSIS OF METHODOLOGIES FOR LANDSCAPE ECOLOGICAL AESTHETICS IN URBAN PLANNING

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Abstract. Areas with high level of urbanisation provoke frequent conflicts between nature and people. There is a lack of cooperation between planners and nature scientists in urban studies and planning process. Landscapes usually are studied using the ecological and aesthetical approaches separately. However, the future of urban planning depends on integration of these two approaches. This research study looks into different methods of landscape ecological aesthetics and presents a combined method for urban areas. The methods of landscape visual aesthetical assessment, biotope structure analysis, landscape ecology evaluation and multi-disciplinary expert level are compared in the article. A comparison of obtained values is summarized by making a comparative matrix. As a result, a multi-stage model for landscape ecological aesthetics evaluation in urban territories is presented. This ecological aesthetics model can be successfully used for development of urban territories.

Keywords: landscape aesthetics, landscape ecology, urban areas, assessment methods, evaluation criteria.

Introduction

The current situation in Latvia is as follows: citizens are moving from rural areas to towns, so the population of large towns increases. Ecological landscape planning in urban territories is an important and actual direction, which sometimes is overlooked in the planning process. The planning in accordance with nature is topical, especially in the areas with high level of urbanisation and anthropogenic load. These territories feature certain disharmony between processes of nature and human desire to influence them.

An attractive and pleasant landscape is most often associated with human transformed and modified landscape (Fig. 1). Natural-looking landscape is not always desirable in human environment. People are not aware of how to see ecological quality directly, so bio-diverse landscapes are perceived as messy and unkempt, while the landscape, in which human intervention is felt, most often is perceived as beautiful (Nassauer 1995).

Assessing the landscape ecological, aesthetical values and their interaction has to be taken into account. The trend of 'natural aesthetics' formed in the Great Britain starts with combination of ecological and aesthetical values. This idea represents that a landscape designed along ecological lines will always be the one which satisfies aesthetics (Thompson 2000). Landscapes created by this environmental – aesthetical design using only the aesthetic goals have been sustainable without involving science of ecology.



Fig. 1. Man-made landscape with low biodiversity and natural-looking landscape with high biodiversity. Examples from Latvia. Source: author's photos (2007, 2009)

However, the discipline of landscape ecology is very important for future landscape sustainability. Ecologists and landscape architects both need to collaborate and organize the urban planning process together. Urban planning for sustainable future depends on the combination of these two researchers in finding a compromise between the natural and man-made landscapes to satisfy the needs of both parties.

The main purpose of this study was to create a combined assessment method for ecological aesthetics in urban territories. The main tasks were to overview different methods used to assess landscape aesthetics, landscape ecology, describe multi-disciplinary expert methods and summarize these methods in a matrix.

Materials and Methods

General scientific qualitative research methods have been used in the study. To elaborate the new ecological aesthetics assessment method, as well as to interpret and compare different methods a monographic or descriptive method has been applied. It is based on the use of the existing concepts and theories. The method of synthesis has been used for the formulation of interface and combination of evaluation matrix.

Research methods have been divided into three groups to define the specifics of landscape ecological aesthetics assessment tools. The first group includes visual landscape assessment methods. The second group consists of ecological planning methods, and the last one is devoted to a multi-disciplinary expert interview based on the methods used to determine the best way for finding the point of view from different specialists.

Perception-based method is backed-up by people's psychology and philosophical approach in the evaluation of landscape aesthetics (Melluma, Leinerte 1992). Design objective method characterises landscape aesthetics by analysis of landscape visual structure, pattern, diversity, harmony etc., used in planning and composition (Ziemełniece 1998). The last landscape visual assessment method has been chosen for this study is K. Lynch's 'city image' method (Lynch 1960) of analysing districts, edges, nodes, landmarks and links in city plans.

One of the ecological planning methods is biotope structure analysis in which ecologically valuable biotopes, such as woodlands and grasslands with broadleaved deciduous forest trees, are identified (Lövenhaft *et al.* 2002). Method of landscape ecology principles (Forman 1995) includes concepts of patches created by landscape elements, corridors and landscape matrixes, natural network, connectivity, fragmentation of landscape to characterise the

structure of landscape. Method of sustainable landscape principles focuses on decreasing anthropological load, creating ecological linkage with the surrounding areas and introducing green areas (Kühn 2003).

There are experts that have to be involved in urban planning, for example architect, territorial planner, landscape architect, biologist, ecologist. Such multi-disciplinary approach helps to find out a viewpoint of different specialists. Expert interviews can be conducted using assessment of photographs, questionnaires or unstructured interview questions.

As a result, a matrix with two different axes was developed. Multi-disciplinary methods link certain ecological and aesthetic approaches.

Results and Discussion

Landscape Visual Assessment

Perception-based method is subjective and it depends on the observers characteristics and traits, for example age, previous experience, profession, place of residence and mood (Melluma, Leinerte 1992). Criteria of landscape perception are: landscape beauty, harmony, order, diversity, secrecy and safety (Table 1). After assessing the landscape, an observer makes his own interpretation of this perceived landscape. Subjective assessment uses different values: like - dislike, or descriptive values (silent, boring, pleasant etc.).

Table 1. Assessment matrix of the Perception-based Method

Landscape criteria	Assessment		
	1	2	3
Beauty	ugly	likely	beautiful
Diversity	simple	different	complex
Harmony	chaotic	balanced	harmonic
Order	messy	unsettled	orderly
Safety	unsafe	pleasant	safe

Source: the author

After calculating scores for different landscapes, the grade of landscape quality can be determined.

The design objective method simplifies, perceives and analyses landscape physical elements, such as relief, water, trees using their shape, lines, texture and colour (Zigmunde 2010). Landscape observer is a person who has professional skills – experience, cognition, talent. Assessing is divided in two stages:

- The analysis of a landscape pattern;
- the analysis of landscape scenery (Table 2).

Table 2. Assessment matrix of the Design Method

Landscape pattern	Qualities of landscape elements			
	shape	scale	colour	texture
Landscape element 1	round	small	grey	coarse
Landscape element 2	curved	large	colourful	plain
Landscape element 3	square	wide	vivid	scratchy
Scenery	Quality of landscape scenery			
	Accessibility	Visibility	Expressiveness	
Foreground	available	open	colourless	
Background	closed	limited	neutral	
Side-scenes	limited	partly	inexpressive	
Domain	limited	visible	expressive	

Source: the author

The third method is the Sensitive Landscape Assessment Method developed by Kevin Lynch especially for urban areas with intensive anthropogenic load (Fig. 2). This is a cartographic method, where important places of the city are marked, for example landmarks, high objects and connections (Lynch 1960).

However, this method is difficult to reconcile with ecological methods. Almost all objects that are evaluated in this method are man-made. Only rivers are natural objects that serve as barriers in the city, in the Jelgava's example. Pleasant views include natural territories – floodplain grasslands, meadows and water areas.

The first two methods are combinable with perception of ecological values and usable in urban planning situations. Difference between the two methods is the observer, whe-

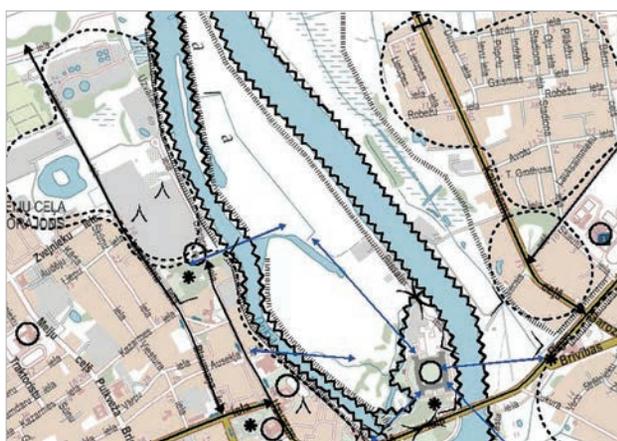


Fig. 2. Fragment of Jelgava 'City Image' analysis

↪ physical connection; ↪ visual connection; edges; * node; region; O landmark; gate; view; X tourniquet; high object; barrier.

Source: made by the author on the publishers 'Jāņa sēta' maps

reas the Design Method requires an expert to obtain values, and thus this method is more objective and reliable. Natural objects like trees, meadows, water objects bear the most of aesthetic values, therefore these landscape elements fit in the ecological assessment. Historical or modern neat architecture also has aesthetic values in urban areas.

Landscape Ecological Assessment

Landscape ecology studies nature's processes which make up the ecological background of nature. The most important part of landscape ecology is to maintain the biological diversity. In urban places landscape becomes uniform and fragmental.

Biotope structure analysis identifies and classifies different ecologically valuable biotopes in urban landscapes (Lövenhaft *et al.* 2002), for example deciduous forest, grassland, swamp, water area and developed land (Fig. 3). Four types of planning categories can be identified – core areas, connectivity zones, buffer zones and green development areas.

There are solitary deciduous trees and dead wood stems marked on the larger scale maps. Example of Jelgava shows ecologically valuable biotopes in the centre of the city. Core area with significant ecological values is Pils Island centre area, connectivity zones are river shores, swamp and park near Jelgava palace. Buffer zones surround the core and connectivity zones, for example small private residential areas. Green development areas with high ecological potential are found within the core areas. These are floodplain meadows on the Pils Island.



Fig. 3. Fragment of Jelgava Biotope Map

forest with old-growth trees; grasslands and meadows; swamp; water; developed land with dense vegetation cover; developed land without/sparse vegetation cover.

Source: made by the author on the publishers 'Jāņa sēta' maps

All biotopes can be also summarized in a matrix.

Method of Landscape Ecology Principles could be referred also as a cartographic method (Fig. 4). Main elements that have to be identified on a map are:

- patches, green wedges (territories with high ecological potential – woods, grasslands);
- bio-corridors (alleys and routes which link green wedges);
- greenways (large green belts that form next to watercourses and forest edges); and
- matrix (space between patches and corridors – farmlands and urban areas).

These three elements create the green network of the city, which describes how the spatial structure of landscape influences the migration of species among the patches (Zigmunde 2010). If these territories are not connected, it may cause landscape fragmentation.

Method of Sustainable Landscape can be used in territorial planning. It analyzes sustainable techniques usable in urban territories:

- increasing the proportion of green areas (maintenance of the existing and development of new parks, re-use of public space infrastructure for parks);
- creating green built structures (roofs, walls, bridges, tunnels);
- planning the environmental friendly transport structure;
- use of renewable resources (solar, wind, wave and tidal energy);
- use of environment-friendly materials;
- recycling; and
- planning intensive and extensive wetlands near the city.

This method is good for planning process in the already green cities which have long-term and strong background of living in accordance with nature. This is not the case of Latvia. Ecological thinking here is in an early stage, thus we have to begin with the identification of the ecological problems. The Method of Sustainable Landscape will be advisable after identifying landscape ecological aesthetics in urban territories for further process of sustainable development in Latvian towns.

The first two ecological methods are similar; they only differ by the scale. After identifying bio-corridors and patches, an analysis of separate biotopes and species in them should be made.

Multi-disciplinary Level Assessment

Landscape ecological aesthetics is an interdisciplinary research area which involves professionals from landscape architecture, ecology, geography, history etc. All these experts should participate in urban environment studies.

Methods of the multi-disciplinary study level differ significantly. First of all, unstructured interview with similar and different questions is presented for all specialists. In this case, expected responses would be different and difficult to analyze. The data obtained would be qualitative only when encrypted. Data processing would be complicated.

Easier method is a multiple-choice questionnaire with 2–3 given answers that expert has to select while assessing given landscapes (Table 3). Questions cover different levels of landscape, such as land use, green territories, vegetation etc. This method is simple for data processing because every answer has its score and the data obtained are quantitative.

Even easier method is the use of photos. This method was first applied in suburban project, the USA. Residents of Minneapolis – St. Paul metropolitan area rated images

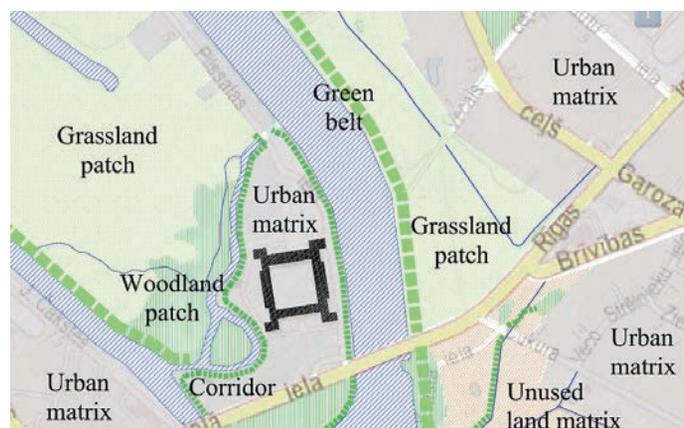


Fig. 4. Patch – corridor – matrix connectivity.
Source: made by the author on the publishers 'Jāņa sēta' maps

Table 3. Example of the expert questionnaire

Statement	Answer 1	Answer 2	Answer 3
Native species used in greenery	Less than 60% of greenery	60–80% of greenery	More than 80% of greenery
Species diversity observed in greenery	Less than 60% of greenery	60–80% of greenery	More than 80% of greenery
Plants selected according to their growth requirements	No	Yes	–

Source: made by the author

of seven landscapes, based on five dimensions: attractiveness, care, neatness, naturalness and need for maintenance (Nassaurer 1993). In order to adapt this method for experts, there should be different landscapes to form case studies. Photos from multi-storey residential areas, small garden residential areas, public parks, industrial areas and nature pavement territories in urban environment should be used. Such data obtained from assessment of landscapes would be quantitative and easily processed.

Multi-disciplinary Experts' Interview Methods are usable to reinforce the data obtained in the landscape survey.

Assessment Matrix of Landscape Ecological Aesthetics

There are many relationships between ecological and aesthetic values that exhibit specific landscape. If there are ecological natural factors, landscape will be perceived as aesthetic. If there will be visible human intention and care of landscape, it will be perceived more aesthetic than landscape without that.

A combined matrix has opposite and similar values of landscape ecological aesthetics (Table 4). Landscape values have been selected from examined scientific literature.

Landscapes are evaluated according to 1–10 score system; 1 point goes to low quality, 10 points to – the highest quality. Leaving natural form of plants has high aesthetic potential, not only ecological one. The highest landscape values for ecology and aesthetics coincide. There is a framework for values of different properties in a matrix. Evaluation criteria have the principle of gradualness. The elements of landscape which are considered ecological could be changed by those that are corresponding with aesthetics. This assessment matrix should be processed using cluster analysis (K-means cluster). Territories under evaluation can be divided into four clusters – groups of landscapes with similar ecological aesthetic values. Obtained data are represented in a graph, where x axis

Table 4. Combined assessment matrix with ecological and aesthetic values

Types of landscape Values	Traditional small gardens	Squares, central piazza	Multi-storey residential areas	French formal gardens	English landscape parks	Wildflower garden	Woodland	Overgrown meadow	Untouched waterbed	Degraded abandoned sites	Industrial areas	Approach
Order, regularity	8	8	4	10	5	5	4	1	1	1	2	Aesthetics
Quality of man-made elements	9	10	8	9	5	6	1	1	1	1	8	
Visible human intention	10	9	6	10	7	8	3	1	1	1	4	
Particularity	7	8	4	10	9	10	6	1	3	1	4	
Use of outlandish species	9	4	4	10	6	5	1	1	1	1	2	
Use of natural forms	6	4	4	3	10	10	10	10	10	5	3	
Accordance with architecture	7	8	4	10	9	10	–	–	–	–	4	
Biodiversity	5	3	3	2	7	9	9	10	9	2	2	Ecology
Accordance with landscape type	8	7	5	8	9	9	10	9	9	1	4	
Native species	5	3	4	4	7	9	10	10	9	3	2	
Natural elements	7	3	3	3	8	10	10	10	10	2	2	
Carelessness	1	1	3	1	4	8	9	10	10	7	1	
Wildlife	4	2	2	2	7	9	10	10	10	2	1	
Unaffected nature processes	1	1	1	1	5	7	8	10	10	3	1	

Source: made by the author

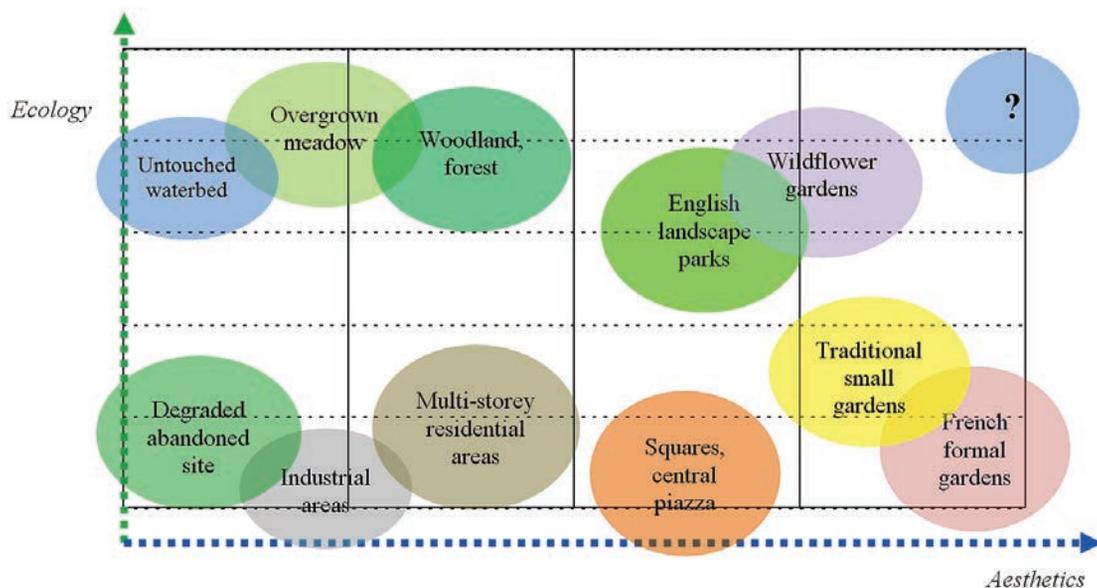


Fig. 5. Graphical connection between landscape ecology and aesthetics. *Source: made by the author*

shows aesthetical values and y axis - ecological values (Fig. 5). The graph characterises interaction between ecology and aesthetics in different landscapes.

Landscapes with the low dimension of both aspects are abandoned sites, industrial areas and multi-storey residential areas. Overgrown meadows, untouched waterbeds and woodlands have high ecological quality and lower aesthetical quality. Man-made transformed landscapes, such as French formal gardens have low ecological quality, but high aesthetical quality. Landscapes with high quality of both aspects are English landscape parks and wildflower gardens. Ideal situation with maximum of both values is marked with a question mark for further research.

Conclusions

1. The main purpose of the research has been achieved within the framework of developed assessment matrix for identification method of landscape ecological aesthetics in urban situation.
2. Visual landscape assessment methods (perception-based and design method) are combinable with ecology assessment methods (landscape ecology principles, biotope structure). Landscapes with high aesthetical values often have a potential for ecological value.
3. The problem with multidisciplinary experts' evaluations is the difficulty of qualitative data processing. It may be simplified by providing the qualitative data with numerical values.

4. It is possible to classify the landscapes under evaluation by their acquired ecological aesthetics, if data are inserted into the assessment matrix. Further research should be made on landscapes with maximum values of ecological aesthetics. The use of this method is suitable for identifying and assessing ecological and aesthetical qualities in different landscapes.

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KRAŠTOVAIZDŽIO EKOLOGINĒS ESTETINĒS URBANISTINIO PLANAVIMO METODOLOGIJOS PALYGINAMOJI ANALIZĒ

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Santrauka

Aukštas teritorinēs urbanizācijas lygis skatina dažnā gamtos ir žmogaus konfliktā. Urbanistinio planavimo studijų procesuose trūksta bendradarbiavimo tarp urbanistinių teritorijų planavimo ir gamtos mokslo srityse dirbančių mokslininkų. Kraštovaizdis dažnai tyrinėjamas atskirai, taikant ekologinius ir estetinius metodus. Tačiau miestų planavimo ateitis priklauso nuo šių dviejų metodų integracijos. Šio tyrimo metu nagrinėjami skirtingi kraštovaizdžio ekologinės estetikos metodai ir pateikiamas apibendrintas urbanizuotoms teritorijoms skirtas sprendimas. Palyginti kraštovaizdžio vizualinio estetinio vertinimo, biotopų struktūros analizės, kraštovaizdžio ekologijos vertinimo metodai ir įvairių sričių ekspertų išvados. Gauti rezultatai suvesti į palyginamąją matricą. Viso to rezultatas – urbanistinių teritorijų daugiapakopis kraštovaizdžio ekologinės estetikos vertinimo modelis. Šis ekologinės estetikos modelis gali būti sėkmingai taikomas urbanistinių teritorijų plėtrai.

Reikšminiai žodžiai: kraštovaizdžio estetika, kraštovaizdžio ekologija, urbanizuotos teritorijos, vertinimo metodai, vertinimo kriterijai.