BIODIVERSITY HOTSPOTS IN URBAN DESIGN: THE ROLE OF PERENNIAL MEADOWS IN REPLACING ORNAMENTAL TURF IN INSTITUTIONAL SETTINGS

HOTSPOTURI DE BIODIVERSITATE ÎN DESIGNUL URBAN: ROLUL PAJIȘTILOR PERENE ÎN ÎNLOCUIREA GAZONULUI ORNAMENTAL ÎN CADRUL INSTITUȚIONAL

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Abstract.
Recent studies in urban landscape design highlight the importance of green areas in cities, emphasizing their essential role in addressing the climate crisis and biodiversity decline. In recent years, creating urban meadows has been globally recognized as a practical solution for tackling these issues and bringing social benefits. In urban design, perennial meadows represent an ecological alternative to traditional ornamental lawns, often requiring considerable resources and contributing to biodiversity loss. Implementing perennial meadows in institutional spaces, such as university campuses or administrative complexes, can create biodiversity "hotspots", supporting local species and improving environmental quality. This paper proposes the development of a perennial meadow design to replace the existing lawn in the outdoor space of the Faculty of Biomedical Engineering at the "Grigore T. Popa" University of Medicine and Pharmacy in Iasi, evaluating the success of the initiative by analyzing three key factors: impact on biodiversity, improvement of local climate conditions, and benefits for the institution's users.
Key words: perennial meadows, urban biodiversity, institutional settings

Rezumat.
Studiile recente în peisagistica urbană subliniază importanța zonelor de vegetație din orașe, accentuând rolul esențial al acestora în combaterea crizei climatice și a declinului biodiversității. În ultimii ani, crearea de pajiști urbane a fost recunoscută global ca o soluție eficientă, având nu doar potențialul de a rezolva aceste probleme, dar și de a aduce beneficii sociale. În designul urban, pajiștile perene reprezintă o alternativă ecologică la gazonul ornamental tradițional, care adesea necesită resurse considerabile și contribuie la scăderea biodiversității. Implementarea pajiștilor perene în spații instituționale, precum campusuri universitare sau complexe administrative, poate crea „hotspoturi" de biodiversitate, sprijinind speciile locale și îmbunătățind calitatea mediului. Prin lucrarea dată se propune dezvoltarea unui design de pajiște perenă

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pentru a înlocui gazonul existent în cadrul spațiului exterior al Facultății de Bioinginerie Medicală din incinta Universității de Medicină și Farmacie "Grigore T.Popa" din Iași, evaluând succesul inițiativei prin analiza a trei factori cheie: impactul asupra biodiversității, ameliorarea condițiilor climatice locale și beneficiile pentru utilizatorii instituției.
Cuvinte cheie: pajiști perene, biodiversitate urbană, cadru instituțional

INTRODUCTION

Many environmental issues face humanity today, such as the imperative need to slow climate change, prevent biodiversity decline, and improve living standards. In response to these challenges, innovative approaches to landscape management, such as sequestering carbon, reducing greenhouse gas emissions, managing stormwater, and creating healthier urban environments, have emerged.

One of the current topics in contemporary landscape research is the process of rapid and uneven urbanization. This factor is a significant cause of species decline, driven by habitat destruction, fragmentation, and the spread of invasive plants [Kowarik, 2011]. In this context, biodiversity conservation and restoration research aims to increase the value of habitats for native species in urban areas, connecting biological diversity hotspots while mitigating urbanization's adverse effects [Miller and Hobbs, 2002]. In this context, research on biodiversity conservation and restoration suggests enhancing the value of urban habitats for native species, connecting fragmented biodiversity hotspots, and mitigating the adverse impacts of urbanization. Conserving and restoring native habitats in urban areas also brings social and educational benefits. Therefore, paying special attention to landscape design in residential and institutional areas is recommended. This concept is embodied in the EU's environmental policy, which focuses on preserving endangered species and their habitats while incorporating biodiversity into urban planning [COM, 2004].

Since 2002, Romania has registered a steady increase in the percentage of the urban population. According to World Bank statistics, in 2023, 55% of the population lived in urban areas, a considerably lower proportion than in other European countries. The lack of an appropriate urban structure and the rapid expansion of the built environment generate significant problems within the urban fabric. This situation worsens exponentially as built-up areas are increasingly dominated by turf.

One of the most prominent features of contemporary urban landscapes is the lawn. According to the Oxford Companion to the Garden, published in 2006, the modern concept of a lawn as an area of closely mown turf, originated in the early 18th century from the French term "pelouse, defined as a community of plants, especially grasses from the *Poaceae* family, artificially created for ornamental purposes [Taylor, 2006]. Over time, the lawn became one of the most cherished features of English gardens, thanks to the region's moist maritime climate, which was especially conducive to its cultivation. From there, the lawn has spread

globally, becoming in the 21st century the most common element of urban green spaces and a symbol of the modern lifestyle.

Because of the general public's view of lawns' aesthetic value and easy maintenance and management, lawns are frequently incorporated into urban landscape designs [Ignatieva *et al.*, 2015]. However, observing in detail the evolution of an ornamental lawn over a year, it becomes evident that its maintenance involves intensive management. It includes monthly mowing, irrigating, fertilizing, and frequent application of herbicides, all generating high financial and ecological costs. An alternative for these lawn spaces, especially in the institutional environment, where the lawn has a predominantly ornamental and not recreational role, is to replace the lawn monoculture with a greater diversity of perennial species.

MATERIAL AND METHOD

This study aims to propose a design for a perennial plant meadow to replace the 129 square meters of space in front of the “Prof. Univ. Dr. Cristian Dragomir” Simulation Center, which is part of the Faculty of Biomedical Engineering within the “Grigore T. Popa” University of Medicine and Pharmacy (figure 1 and figure 2).

Fig. 1. “Prof. Univ. Dr. Cristian Dragomir” Simulation Center, front view

The research area was divided into three plots: P1, P2, and P3 (Figure 3). The planting design was created using AutoCAD software, and the visualizations were generated through Lumion.

Tables 1, 2, and 3 show the plant material used to design the future meadow, which included ornamental grasses (Table 1), spring-blooming bulbs (Table 2), and perennial plants with decorative value in spring, summer, and autumn (Table 3). All plants were chosen to best adapt to the existing site conditions and provide staggered visual interest from March to October, with ornamental grasses adding aesthetic value even during the winter.

Fig. 2. "Prof. Univ. Dr. Cristian Dragomir" Simulation Center, existing lawn

Table 1

The ornamental grasses proposed in the design

Scientific Name
Calamagrostis x *acutiflora* `Overdam`
Carex oshimensis `Everlime`
Deschampsia caespitosa `Goldtau`
Hakonechloa macra
Ophiopogon planiscapus `Nigrescens`
*Pennisetum alopecuroide*s `Little Bunny`
Sesleria autumnalis
Stipa tenuissima `Ponytails`

Table 2

The spring-blooming bulbs proposed in the design

Scientific Name	Period of decor
Allium aflatunense `Purple Sensation`	Apr-Iun(Jul-Nov)
Crocus tommasinianus	Febr-Mart
Muscari armeniacum	Mart-May
Narcissus poeticus	Mar-Apr

Table 3

The perennial plants proposed in the design

Scientific Name	Period of decor
Achillea millefolium `Milly Rock Red`	May-Sept
Achillea filipendulina `Cloth of Gold`	May-Sept (Sept-Febr)
Actaea simplex atropurpurea	May-Oct (Nov-Dec)
Ajuga reptans `Chocolate Chip`	Jan-Dec
Alchemilla mollis	Apr-Oct
Aster x *frikartii* `Monch`	Jun-Nov
Bergenia cordifolia `Rotblum`	Jan-Dec
Brunnera macrophylla `Jack Frost	Apr-Oct
Echinacea purpurea	Apr- Sept (Oct- Dec)

Echinops ritro	Apr- Sept (Oct- Dec)
Eremurus stenophyllus	May- Aug (Sept- Dec)
Eupatorium maculatum	May-Sept (Oct-Dec)
Euphorbia amygdaloides subsp. *robbiae*	Jan-Dec
Gaura lindheimeri	Apr-Nov
Geranium sanguineum	Apr-Oct
Hemerocallis sp.	Apr-Oct
Heucherra sp.	Jan-Dec
Iris germanica	Apr-Oct
Nepeta x *faassenii* `Purrsian Blue`	Apr-Oct
Perovskia atriplicifolia `Blue Spire`	May-Oct (Nov-Mar)
Salvia nemorosa `Caradonna`	Apr-Oct
Spiraea japonica `Goldflame`	Apr-Oct
Rudbeckia fulgida var. *sullivantii* `Goldsturm`	Apr-Oct (Nov-Dec)

RESULTS AND DISCUSSIONS

For ease of study management and design proposal execution, the land has been divided into planting plots: P1, P2, and P3 (Figure 3). Additionally, each of the respective plots has a different level of sunlight exposure, with P1 having the highest level of shading and P2 the lowest. This aspect was important in selecting the quantities of plants that were more or less tolerant/resistant to shade or sunlight for each plot. Regarding the design, the main goal was to ensure decoration for the longest possible period.

Secondly, the aim was to avoid monotony by using plants of varying heights to create a dynamic interplay across different structural levels. Repeating the same plant groups provides a specific rhythm to the design, unifying all the plots into a cohesive whole. Regarding the plant species, only six *Spiraea japonica* `Goldflame` specimens were used from the shrub category to create focal points that will serve as the framework and anchor points for the future meadow. Apart from these, only herbaceous perennial species were proposed.

Fig. 3. Planting plot distribution

Considering the site's location and the predominant period of use for the institutional university space is from autumn to spring - while summer, when many plant species reach their peak ornamental value, is less utilized - the aim was to create decorative accents throughout each season.

In March - April (Column A), the decorative effect is predominantly supported by bulbous plant species such as *Crocus* and *Narcissus*, set against the backdrop of emerging green foliage from species like *Alchemilla mollis* and *Brunnera macrophylla*, which by late April begin to delight the eye with their yellow and blue inflorescences, respectively. Among the bulbous plants in May (Column B), *Allium aflatunens*e stands out with its striking presence alongside *Iris germanica* (Figure 4).

Of course, the peak months for decoration are those from June to September (Columns C & D) (Figure 4). Most proposed species contribute to the display through foliage and flowers during this period. However, the diversity of plant material allows for staggered blooming, with each species providing a visual spectacle during its peak period, most producing new inflorescences every one to two weeks.

Fig. 4. The decorative effect from March to May.

During the colder months of the year, from October to February (Column E & F) (Figure 5), the main decoration will be provided by the ornamental grasses used in the design, as well as the dry structural inflorescences or the decorative branches of plants such as *Rudbeckia fulgida, Echinacea purpurea, Echinops ritro, Perovskia atriplicifolia, Eupatorium maculatum*, and *Actaea simplex.*

Fig. 5. The decorative effect from June to September.

In addition to their decorative properties, these plants are also used as food sources for birds, thus supporting and enhancing biodiversity.

The project's first stage, the design implementation, took place in October 2024, with plots 2 and 3 planted (Figure 6), while plot 1 is scheduled to be planted in the spring of 2025. A new approach to implementation involved planting the vegetation directly into the existing lawn without processing the soil layer through traditional operations such as plowing, harrowing, or aerating.

Fig. 6. The decorative effect from October to February.

Regarding removing the lawn, the method used was covering it with pieces of cardboard (Figure 7), placed individually around each plant. This procedure has been successfully used in other studies, simplifying weed removal operations, such as the lawn, thus reducing implementation costs.

Fig. 7. The implementation of the design.

At the same time, it contributes to an effective and sustainable method of soil processing without disrupting it through repetitive mechanical work (Goncalves et al., 2021). To contribute to the decomposition of the cellulose layer, the cardboard was covered with a layer of soil (Figure 8).

Fig. 8. The placement of the cardboard and covering it with soil.

CONCLUSIONS

The presented work represents the first phase of a larger study. In this stage, the goal was to develop a dynamic design that successfully combines various species of perennials and ornamental grasses, providing decoration throughout as much of the year as possible, which has been achieved.

The implementation in multiple stages allows for adapting the design to any difficulties or issues that may arise along the way. Additionally, the rooting progress of the planted plants can already be observed before completing all the plots.

The design and the list of selected plants demonstrate the goal of supporting local biodiversity by providing aesthetic decoration and fostering a healthy ecosystem.

Covering with cardboard reduced the time required for lawn removal, promoting an ecological process that is friendly to the soil ecosystem while also being a more financially optimal solution.

The study's following stages aim to monitor the evolution of the selected perennial species, assess their impact on urban biodiversity, and highlight the aesthetic and comfort benefits they provide to the academic community and space users.

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