

# Greening the Horizon: Possibilities of Preserving Biodiversity During the Renovation of Apartment Buildings as Manifestation of Values of European Green Deal

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## Abstract

Biodiversity is often an afterthought in city planning and development; however, as cities densify or expand, the need to protect urban nature and enhance biodiversity becomes more urgent. Residential building renovation becomes increasingly important urban development sector in the context of reaching sustainability goals and implementing European Green Deal. Consequently, the relevance of biodiversity conservation during and after the building renovation process becomes increasingly high. The focus of this research is biodiversity in urban residential areas built up with Soviet modernistic apartment buildings and the possibilities of biodiversity conservation and enhancement in buildings renovation process considering ecological, social, and aesthetic aspects. The methods of research include literature analysis, observations on site and pilot sociological survey. The results of the research confirm the importance and potential of integrating biodiversity considerations into planning, renovation practices, and policies to create sustainable and livable neighborhoods. Pilot sociological survey revealed the positive attitudes of surveyed Kaunas residents towards urban biodiversity. The observation on site in Eiguliai, Gričiupis, and Dainava neighborhoods demonstrates positive improvements in terms of building aesthetics and signs of residents' interaction with nature; however, there were also areas that lacked sufficient public space amenities and showed limited diversity in plant species. The observations highlight the need for further attention to enhancing livability and biodiversity aspects in the neighborhoods, alongside the ongoing renovation projects.

**Key words:** *Biodiversity, biodiversity conservation, apartment buildings, renovation*

## Anotacija

Biologinė įvairovė dažnai yra nepakankamai įvertinama planuojant ir plėtojant miestus; tačiau miestams tankėjant ar plečiantis poreikis saugoti miesto gamtą ir didinti biologinę įvairovę tampa vis aktualesnis. Gyvenamųjų namų renovacija tampa itin reikšmingu miesto plėtros sektoriumi siekiant tvarumo tikslų ir įgyvendinant Europos Žaliojo kurso nuostatas. Taigi biologinės įvairovės išsaugojimas pastatų renovacijos proceso metu ir po jo tampa aktualiu klausimu. Šiame tyrime daugiausia dėmesio skiriama biologinei įvairovei miesto gyvenamuosiuose rajonuose, užstatytuose sovietinio modernizmo daugiabučiais gyvenamaisiais namais, ir biologinės įvairovės išsaugojimo bei didinimo galimybėms pastatų renovacijos procese, atsižvelgiant į ekologinius, socialinius ir estetinius aspektus. Tyrime taikyti metodai – literatūros analizė, tyrimai vietoje ir žvalgomoji sociologinė apklausa. Tyrimo rezultatai patvirtina, kad biologinės įvairovės aspektų integravimas į planavimą, renovacijos praktiką ir politiką yra svarbus ir potencialus siekiant sukurti tvarius ir gyvybingus gyvenamuosius rajonus. Žvalgomoji sociologinė apklausa atskleidė teigiamą apklaustų kauniečių požiūrį į miesto biologinę įvairovę. Stebėjimas vietoje Eigulių, Gričiupio ir Dainavos mikrorajonuose rodo pastatų estetikos pagerėjimą ir gyventojų sąveikos su gamta požymius, tačiau buvo ir tokių stebėtų teritorijų, kuriose trūko pakankamų viešųjų erdvių patogumų, o augalų rūšių įvairovė buvo ribota. Pastebėjimai rodo, kad greta vykdomų renovacijos projektų reikia ir toliau skirti dėmesio gyvenamosios aplinkos ir biologinės įvairovės aspektų gerinimui šiuose rajonuose.

**Reikšminiai žodžiai:** *biologinė įvairovė, biologinės įvairovės išsaugojimas, daugiabučiai gyvenamieji namai, renovacija.*

## Introduction

Cities and towns can contain high levels of biodiversity - the variety and extent of animal, plant and other species, including their genes and habitats, and of entire ecosystems - because they are often located on previously natural or rural areas or near water bodies, such as rivers, estuaries, or shorelines that support high levels of plant and vertebrate diversity. For example, Dewaelheyns et al. (2011) showed that gardens contain high biodiversity and can be richer than intensive agricultural land, although detailed comparisons are lacking. In addition, the moderate levels of disturbance that occur in cities, as well as the extreme diversity of habitats, can contribute to



increased biodiversity (Farinha-Marques et al., 2017). However, biodiversity is often an afterthought in city planning and development. As cities grow and densify, the need to protect urban nature and enhance biodiversity becomes more urgent.

Consequently, an increasing number of cities are including biodiversity considerations into their planning processes (Beatley, 2011), and more and more developers are incorporating features that support local wildlife into their projects. Urban biodiversity conservation can be seen as the practice of protecting and preserving the wealth and variety of species, habitats, ecosystems, and genetic diversity in urban areas. Renovation - the process of improving or modernizing outdated, damaged, or defective buildings or their components - becomes increasingly important sector in the context of reaching sustainability goals and implementing European Green Deal - the set of policy initiatives by the European Commission with the overarching aim of making Europe climate neutral in 2050 (The European Green Deal, 2024). Consequently, the relevance of biodiversity conservation during and after the building renovation process becomes increasingly high. The protection of biodiversity in urban residential areas built up-with apartment buildings is essential to the sustainable management of urban environmental resources and the maintenance of human well-being and biophilic connection to nature. The renovation of Soviet era modernistic apartment buildings is a very important issue in the Eastern European region. The implemented renovation works currently not only often do not meet the technical and aesthetic requirements, but also destroy the habitats of some valuable species of wildlife found in urban areas.

The aim of the research is to focus on the dimension of biodiversity in urban residential areas built up-with Soviet modernistic apartment buildings and to analyze the possibilities of biodiversity conservation and enhancement in buildings renovation process considering ecological, social, and aesthetic aspects.

## Methods

The methodology of the research includes the following methods: literature review and analysis, research on site (observation) in selected territories of Kaunas city, and pilot sociological survey. The review and analysis of literature was carried out in order to clarify the most important components of this study – residential buildings' renovation in urban areas, nature conservation and restoration in cities, and aesthetic aspects related with sustainable development of urban environment and implementation of European Green Deal policies – and their links. The sources included in literature analysis were recently published scientific papers and other publications retrieved from scientific literature databases, such as Web of Science, Scopus, Google Scholar. Observation on site in seven selected areas in Eiguliai, Gričiupis, and Dainava districts in Kaunas was carried out in order to understand better situation (biodiversity, social livability, and renovation) in areas with renovated and non-renovated apartment buildings. Pilot sociological survey of Kaunas residents was carried out in order to determine residents' attitudes towards urban nature, biodiversity and changes in the biodiversity and aesthetic qualities of neighborhoods as a result of the renovation of apartment buildings and development of areas. The results of literature analysis, observation and pilot sociological survey were analyzed and generalized, and the conclusions regarding the possibilities of preservation and enhancement of biodiversity during renovation of apartment buildings were formulated.

## Theory

The European Green Deal initiative to become the first climate-neutral continent by 2050 with other ambitious goals as at least 55% less net greenhouse gas emissions by 2030, compared to 1990 levels and 3 billion additional trees planted in the European Union (EU) by the same year are strongly related with residential buildings sector, nature conservation, and general lifestyle and attitude changes. The goals of this initiative among others include renovating buildings for greener lifestyles and working with nature to protect our planet and health (The European ..., 2023) that are



strongly related with the topic of this research. It is evident that such large-scale actions in the building sector and in other fields will have inevitable cultural impact. Moreover, the emotional impact of new ecological aesthetics as well inclusiveness and attractiveness of cultural initiatives can have positive impact on promotion environmentally friendly attitudes and lifestyles. The New European Bauhaus initiative, referred as “the soul of the European Green Deal” by Ursula von der Leyen, President of the European Commission, was created for this purpose. The New European Bauhaus encourages searching for aesthetical and meaningful ways to connect the European Green Deal to daily lives and living spaces of Europeans, and proclaims such values as sustainability, aesthetics, and inclusion. Aesthetics here is defined as quality of experience and style beyond functionality (New ..., 2023). Consequently, three aspects – renovation, restoring nature, and sustainability aesthetics - relevant to EU sustainability policies and urban development are analyzed in greater detail.

### ***Building renovation***

Building retrofitting, renovation, and rehabilitation are defined as subcategories of building refurbishment. The refurbishment of buildings is a process that seeks to restore and improve the functional, economic, and social aspects of a building (Hassan et al., 2017; Shahi et al., 2020). It is a process that can be applied to any type of building, although in this case the research is focused on apartment buildings. Traditionally the main objectives of the refurbishment of buildings are to improve the quality of life of the people who live or work in them, as well as to extend the useful life of the buildings (Hassan et al., 2017), although environmental and climate change objectives can be mentioned in the context of above-mentioned EU initiatives. Renovation can be defined as the process of replacing or repairing outdated components or remodeling the interior spatial layout of existing buildings, as well as the exterior part. Renovation addresses conditions that are no longer economical or energy-efficient, or do not satisfy the occupants or users while keeping the function of the building intact (Shahi et al., 2020). According to S. Shahi et al. (2020), building renovation can involve both structural and non-structural elements. According to the plans of the European Commission, the renovation rates must be at least doubled in the next ten years with resulting benefits, such as higher energy and resource efficiency, reduction of greenhouse gas emissions, improvement of reuse and recycling of materials, enhancing the quality of life for people living in and using the buildings etc. The European Green Deal initiative mentions such building renovation measures as installing insulation, replacing old windows or doors, upgrading heating systems, or installing solar panels (The European ..., 2023). However, the goals of renovation project also include the improvement of building’s architectural aspects and appearance for enhanced comfort levels and attractiveness (Ástmarsson et al., 2013; Jensen and Maslesa, 2015).

### ***Biodiversity in cities***

There are several reasons for the high level of biodiversity in urban areas. Urban landscape is composed of an assortment of patches of artificial, semi-natural, or even almost natural habitats, with some unique types that are rare in any other environments, e.g., areas dominated by constructed elements (Young et al. 2009). Besides green areas, there are various types of artificial and built structures, commonly only found in cities (Farinha-Marques, 2017). Even these habitats are inhabited by some species of fauna and flora, as they replicate some physical features and functions of natural environments. Such habitats may therefore be analogs to natural habitats (Young et al. 2009). Given the intensification of urbanization, the high density of buildings, and urban sprawl, the remaining green areas have become essential refuges for native biodiversity (Goddard et al. 2010). They also fulfill important environmental services, by improving air quality, microclimatic conditions, rainwater drainage, and the turnover of organic matter (Bolund and Hunhammar 1999). In current climate change context urban green areas help to absorb and store carbon and mitigate the impact of increasingly violent natural disasters such as floods, and heat



waves (The European ..., 2023). Moreover, it is widely acknowledged that urban nature has numerous human health and well-being benefits (Beatley, 2011).

Biodiversity is under threat from numerous human activities, including habitat destruction, overexploitation, pollution, and climate change and is especially vulnerable in urban areas. Recent studies have drawn attention to the conservation of biodiversity in urban areas. An important first step towards better management of urban environments is a systematic approach in order to understand better the interactions between landscape and local factors that affect urban biodiversity. Many cities have a network of habitat fragments or “urban greenways” that include areas of semi-natural habitat, secondary successional habitats, ruderal and pioneer environments, and open spaces. These habitats can be important for biodiversity, both as stable habitats and as transitional habitats (Angold et al., 2006). The systematic approach of natural framework applied in territorial planning in Lithuania (Skorupskas, 2022) is also aimed at protection and enhancement of urban biodiversity. To complement these systematic approaches, there are several steps that individuals and communities can take to increase biodiversity in cities (Henriques, 2019): plant native species, which are adapted to the local climate and soil, and provide food and shelter for native wildlife; create habitat by providing places for wildlife to live, such as nesting boxes, log piles, and ponds; connect habitat by creating corridors of habitat that link different green spaces, so that wildlife can move around freely; reduce the use of harmful chemicals and dispose of waste properly, so that it does not pollute the environment. Another way to protect the biodiversity of urban areas is to promote the use of sustainable practices. This means using resources in a way that does not damage or destroy the environment. For example, using recycled materials, or using energy-efficient methods of transportation.

#### ***Impact of building renovation on environment and biodiversity***

The impact of building renovation on the environment and biodiversity can be both positive and negative. On the positive side, renovation can lead to increased energy efficiency in buildings, which can save resources and reduce emissions. It can also encourage the use of recycled materials, which reduces the demand for new resources and generation of waste. On the negative side, renovation can generate a significant amount of waste, which can end up in landfills. In addition, the use of certain chemicals and materials during renovation can release pollutants into the air, water, and soil (Environmental Pollution Centers, 2023). During the renovation, there is a potential for environmental pollution if hazardous materials are not handled properly. If lead paint is present, for example, improper removal can result in lead contamination of the air, soil, and water. Asbestos and other hazardous materials may also be present in older homes and should be removed by trained professionals to avoid pollution (Environmental Protection Agency, 2014). In cases when renovation involves demolishing a part of the building, this could create dust and noise pollution. If new materials are brought in for the renovation, this could also impact the environment, depending on how they are transported and what they are made of. There are a few ways to reduce pollution during the renovation process: use low-emitting paints, adhesives, and finishes; use environmentally friendly cleaning products; use recycled or recyclable materials to minimize waste; avoid using harmful chemicals; use energy-efficient lighting and appliances; properly seal off the work area to prevent dust and other particles from escaping; use a HEPA filter to remove contaminants from the air (Environmental Protection Agency, 2014).

There are many cases when apartment buildings are being renovated to be more sustainable and to take care of biodiversity. This is often done by adding green roofs, brown roofs, rain gardens, pollinator gardens etc. Green roofs are a type of roofing that is covered in vegetation. They help to insulate the building, reduce stormwater runoff, and create habitat for birds and insects. Rain gardens are planted areas that collect and filter rainwater. They also help to reduce stormwater runoff and can complement the aesthetics of the building (Henriques, 2019). In addition to the renovation of individual buildings, the renovation of residential areas also includes landscaping, the



recovery of water resources and solid waste, as well as the improvement of basic support functions such as secure facilities, streetlights, etc. These renovation measures have a significant impact on the carbon emissions (Luo, 2022) of residential areas and provide opportunities for habitat creation and biodiversity enhancement.

### *Aesthetics*

The aesthetic aspects of sustainability are gaining increasing interest in research, although the understanding and definition of sustainability aesthetics remain very general and abstract. S. Kagan (2010, 2011) had formulated the definition of sustainability aesthetics based on works of G. Bateson (1972) as a response to connecting patterns. According to S. Kagan (2010, 2011), sustainability aesthetics can be characterized by complexity, open design, and possibilities to reflect the complementarity of contradictions. The aesthetics of sustainability in architecture can be divided into numerous different trends – this is an extremely unexplored area, so it is widely interpreted. Although some interesting works are emerging in this area, for example, D. Gawryluk and D. A. Krawczyk (2021) and D. Gawryluk et al. (2022) had analyzed the impacts of photovoltaic panels and solar collectors on architectural expression and cityscape. In this study, three problematic aesthetics related aspects in the renovation of apartment buildings were distinguished: multidisciplinary perception; bad practice and its representation and the results it causes; the influence of artificial intelligence (AI). It is important to stress that today's apparatus of bureaucracy is particularly lacking the coherence of a philosophical, semantic approach on the subject of aesthetics. The integration of solar panels into various roof elements, landscaped roofs, green facades – this could be an excellent part of the EU biodiversity or climate change adaptation strategies, but the question may be asked: how will all this form a long-term approach – contribute to public education? It should be borne in mind that such a set of initiatives underlines the need for a holistic and cross-sectoral approach in which all relevant policies contribute to the ultimate climate-related objective. However, this is not only the installation of special elements, it is a question of education and multidisciplinary perception.

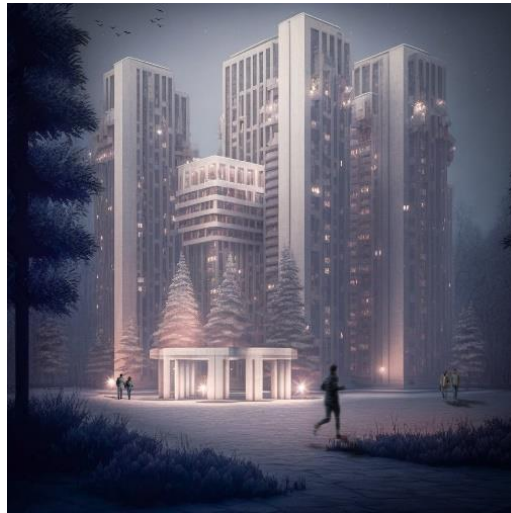
*Multidisciplinary perception.* For design specialists in various fields, when creating objects, teamwork is inevitably encountered. Most of the decisions in the design are influenced by the tastes, opinions of different team members, which is natural - the aesthetic perception of each person is different. It is not uncommon for disagreements to arise, which eventually become problems of the implemented project. Succinctly, education on the issue of harmonious architecture, and more specifically aesthetics, is not often observed, is not popular due to the complexity of the problem - here both the period of correction of such gaps and the systemic gaps affecting the management of other sectors, political will, economic issues influence. Typical Eastern European repair standard for apartment buildings is a self-evident and large enough decision to improve the quality of life. Although from the broader perspective, in the long run, such a renewal of the object does not solve the issues of quality of life – starting with the fact that it is an aesthetically unchanged building – architectural aesthetics, apart from the change in coloring, often remain unchanged, which does not form a new urban narrative that could shape a new architectural trend, or at least be more descriptive of a new architectural trend. The situation of both individual and apartment buildings, on the topic of harmonious aesthetics, is not surprising, since this is primarily a question of lack of education, which did not form a multidisciplinary understanding of specialists.

*Bad practice and the results it causes.* Deep problems lie in the media representations of sustainability and its aesthetics - even general information, for example, what is coherence in architecture, can be misleadingly presented in the media sources. In this way, another problem area is born - bad practice representation and the results it causes. Media sources informing about sustainable renovation of apartment buildings often do not even try to describe the topic in more detail – the level of quality of life is not just installed new balconies, or the windows of an apartment – the question of aesthetic perception of how an individual feels when walking towards



such an object, how such an apartment building describes the narrative of a quarter, as a result of which and an individual object - an apartment building - is important. Media representations and legal regulations, lack of education, most often does not allow new ideas to develop in the field of sustainability aesthetics.

*The influence of artificial intelligence.* AI relies on online databases to create images, so it is easy to test what popular opinions are on the issue of sustainability aesthetics of architecture. It is important to emphasize that visual presentation of AI generated images has improved. At the moment, there are systems available, which can artificially generate images of various styles, including photo-realistic representation, as well as manipulate and rearrange objects in the image, add design elements into compositions using only text instructions. However, the question may be asked, how has the perception of aesthetics changed with this technology. The AI generated images in many instances demonstrate the lack of both aesthetics and contextuality. Naturally, beauty is difficult to define by any rules, but it is necessary to look at what coherence really is about. It's not about dressing up with green roofs or giant solar panels, it's about the added aesthetic, as a result, and the ethical value to the environment - the environment that connects each of us. In addition, this behavior of AI, continuing to form a flawed attitude towards coherence, an aesthetic shaped by coherence, in essence, catalyzes a bad practice that develops one or another understanding of society.



**Fig. 1.** Renovation of Soviet modernist apartment buildings designed using artificial intelligence (Arch Hive, 2024)  
*1 pav. Sovietinio laikotarpio modernistinių daugiabučių gyvenamųjų namų renovacijos siūlymas, sugeneruotas panaudojant dirbtinį intelektą (Arch Hive, 2024)*

The Arch Hive study using AI tried to combine the concept of coherence with the issue of renovating Soviet apartment buildings, as demonstrated in the Fig. 1, a rather narrow interpretation is seen in which trees could be one of the interpretations of sustainability understood by the AI, and the division of windows as the representation of modernity. However, there are lessons to be learned from such images – this gives the creator inspiration – either to improve and form a completely different, new starting point, or to continue the idea formed by the AI.

## Results

### *Observation*

In order to identify Kaunas neighborhoods in which apartment buildings were renovated or are in the process of renovation the map of renovation of apartment buildings in Lithuania (Daugiabučių namų renovacijos žemėlapis..., 2023) was used. Three residential neighborhoods were selected for observation on site: Eiguliai (97 377 m<sup>2</sup>), Gričiupis (104 559 m<sup>2</sup>), and Dainava (24 261 m<sup>2</sup>). In each of these neighborhoods, observation areas were identified: three observation areas in



the Eiguliai and Gričiupis neighborhoods, and one in Dainava (Fig. 2). The observation checklist was compiled, consisting of three main categories: biodiversity, livability, and renovation (Table 1). During the observation in spring months of 2023 the tables with checklist were compiled and the features of the areas and buildings were recorded in photographs, after the observation descriptive analysis of the areas was done.

**Table 1.** The main categories and related features that were observed during research on sites and used for descriptive analysis

*1 lentelė. Tyrimuose vietose stebėtos ir aprašomajai analizei naudotos pagrindinės kategorijos ir jų požymiai*

<p><b>Biodiversity</b>                  Diversity of vegetation                  Presence of wildlife (birds, butterflies, bees etc.)                  Presence of greenery and green areas                  Types of greenery and green areas                  Accessibility and maintenance of green areas                  Percentage of pavement and green area                  Signs of residents' interaction with wildlife (cat houses, insect hotels, nesting boxes)                  Signs of residents' interaction with nature (landscaping created by residents)                  The presence of rubbish</p>
<p><b>Livability</b>                  Public transport and alternative modes of transportation (cycling or walking)                  Public space amenities (benches, bike racks, trash bins)                  Availability of accessibility features (ramps or elevators)                  Users (gender, age, etc.) and activities (activities: sitting, walking with dog, running, etc.)                  Parking spaces (also in unauthorized places)                  Aesthetic quality of public spaces (including landscaping done by residents)</p>
<p><b>Renovation</b>                  Presence renovated and non-renovated buildings                  Are areas where renovation is ongoing well organized?                  Do non-renovated buildings have any aesthetic qualities that were lost in renovated ones?                  Are ventilation holes of renovated buildings covered?                  Aesthetic quality of renovation. Aesthetic changes compared to non-renovated buildings                  Physical state of buildings (exterior), signs of wear and tear, or damage                  Types of materials used in building renovation.                  Does the color palette of renovated buildings complement their surroundings?                  Do the buildings' details complement its surroundings? Do they add to the building's overall aesthetic appeal?                  Has the building's surrounding landscaping been upgraded and designed in a way that enhances the building's and area's overall aesthetic appeal?</p>



**Fig. 2.** Areas selected for observation in Kaunas: a. Eiguliai, b. Gričiupis, c., Dainava. Both shades of green represent renovated apartment buildings, blue represents buildings under renovation (Daugiabučių namų renovacijos žemėlapis, 2023)

**2 pav.** Stebėjimui pasirinktos teritorijos Kaune: a. Eiguliai, b. Gričiupis, c., Dainava. Abu žalios spalvos atspalviai žymi renovuotus daugiabučius namus, mėlyna - renovuojamus (Daugiabučių namų renovacijos žemėlapis, 2023 m.)



### Observation of Eiguliai neighborhood

*Area 1.* The observed area comprises mostly green spaces, accounting for approximately 80% of the total area, with pavement and roads making up the remaining 20%. The vegetation consists of various tree species, while the diversity of bushes, flowers, and grass is relatively low. Wildlife, including birds and insects, is present in the area. Limited park-like spaces and well-maintained community gardens are available. Interaction with nature is evident through the presence of nesting boxes and small gardens created by residents (Fig. 3). The area is clean and free of rubbish.



**Fig. 3.** Green areas and public space equipment, landscaping done by residents. Photographs by Anastasiia Kiuppier  
*3 pav. Žaliosios zonos ir viešųjų erdvių įranga, gyventojų atliekamo kraštovaizdžio tvarkymo požymiai. Anastasijos Kiuppier nuotraukos*

Transportation options include public buses, with bus stops in close proximity, as well as pedestrian and bicycle routes along main streets. However, public space amenities such as benches, trash bins, and bike racks are insufficient. Accessibility features such as ramps or elevators are lacking. User activities include families with children in playgrounds, elderly people and teenagers walking, and individuals walking their dogs. Unauthorized parking of cars is prevalent, occupying space in courtyards, driveways, and roads. Locals have contributed to the amenities of public spaces by creating self-made benches and flower beds.



**Fig. 4.** Renovated and non-renovated buildings in the analyzed area. Photographs by Anastasiia Kiuppier  
*4 pav. Renovuoti ir nerenovuoti pastatai analizuojamoje teritorijoje. Anastasiia Kiuppier nuotraukos*

The area comprises both renovated and non-renovated apartment buildings, but there are no ongoing renovation projects (Fig. 4). Furthermore, renovated houses were not deprived of the aesthetic qualities that non-renovated houses have and there are no new details. Renovated buildings exhibit changes such as insulation, changed colors (although each building has its own color scheme without color coordination for the entire area), and covered ventilation openings that previously served as bird habitats. The buildings show no external signs of damage. Renovated facades exhibit such types of materials as wall plaster or matte large tile panels. The color palette of the renovated buildings complements the surroundings, featuring pastel shades that harmonize with the unrenovated structures. The landscaping in the area has not been upgraded. In general, the aesthetic qualities of the buildings have improved after the renovation.

*Area 2.* The observation area consists of predominantly green spaces, accounting for approximately 70% of the total area, with the remaining 30% dedicated to pavement and roads. The vegetation types are not too varied and include trees, bushes, flowers, and grass. Wildlife is observed in the area, including birds and insects. There are a few small well-maintained community



gardens. Some nesting boxes and locally created gardens demonstrate residents' interaction with nature. There is no rubbish in the observation area.

Only pedestrian pathways are available, but there is no public transport or alternative modes such as designated bicycle routes. The area lacks sufficient amenities such as benches, trash bins, and bike racks. Accessibility features like ramps or elevators are absent. Users predominantly consist of young or elderly individuals walking. Unauthorized parking of cars is prevalent, occupying courtyards, driveways, and roads. Locals have enhanced the aesthetic quality of public spaces by constructing self-made flower beds.



**Fig. 5.** Renovated buildings in the analyzed area. Photographs by Anastasiia Kiuppier  
*5 pav. Renovuoti pastatai analizuojamoje teritorijoje. Anastasiia Kiuppier nuotraukos*

The area includes both renovated and non-renovated apartment buildings (Fig. 5). No ongoing renovation projects were observed. The renovated houses did not lack the aesthetic qualities that non-renovated houses possess, and no new details have been added. Renovated buildings feature changes such as insulation, color change (each building having a distinct color scheme), and in one building ventilation openings were covered that previously served as bird habitats. The buildings exhibit good and medium physical state, with a crumbling plaster on one of the renovated buildings. Renovated facades use such materials as wall plaster or combination of plaster and matte large tile panels. The color palette of the renovated buildings uses pastel shades that are not too bright and saturated. The area's landscaping remains unchanged. Overall, the aesthetic qualities of the buildings have been enhanced following the renovation.

*Area 3.* The approximate percentage ratio of pavement and roads to green spaces 40 % to 60 % was observed in this area. The vegetation of the area primarily consists of a few common plant species. Although the variety of plant species is limited, the presence of trees, bushes, and grass contributes to the overall greenery. Signs of wildlife have been observed there, including birds and insects. The green areas are well-maintained and accessible to the community. No objects of interaction with wildlife and nature were seen on the observation site. There is no presence of rubbish.



**Fig. 6.** Public spaces lacking amenities and equipment in the observed area. Photographs by Anastasiia Kiuppier  
*6 pav. Viešosios erdvės, kuriose trūksta patogumų ir įrangos stebimoje teritorijoje. Anastasiia Kiuppier nuotraukos*

The area has public transport and alternative methods of transport such as buses (bus stops are close to this site), as well as walking paths and new bicycle routes along the main streets. The lack of public scape amenities such as benches, trash bins, and bike racks was observed (Fig. 6). There are ramps available, and one of the renovated buildings has an elevator for the first-floor apartment. In terms of users and their activities, there were only seen young or elderly walking, or walking their dogs. A lot of cars were observed parked in unauthorized parking places occupying space in



courtyards, driveways, and roads. There are no public space objects created by locals, only one self-made bench.



**Fig. 7.** Renovated and non-renovated buildings. Photographs by Anastasiia Kiuppier  
*7 pav. Renovuoti ir nerenovuoti pastatai. Anastasiia Kiuppier nuotraukos*

There are both non-renovated and renovated apartment buildings on this site, and one building is in the process of renovation (Fig. 7). The renovation area is well organized, construction materials are stacked and there is no rubbish outside the fence of the site. Also, the renovated houses were not devoid of any aesthetic qualities that non-renovated houses have and there are no new details. Among the changes are building insulation, changes in color (renovated buildings have more than one color), and the ventilation openings were covered, which in the non-renovated houses serve as housing for birds. No external signs of damage were observed on the buildings, they are in a good physical state. The type of material used on the facades of the renovated buildings is wall plaster. The color palette of the renovated buildings matches their surroundings - the colors are pastel, not too bright, or saturated, only the balconies are red and brown. The landscaping has not been upgraded in this area. As a result of the renovation, there has been a noticeable improvement in the overall aesthetic qualities of the buildings.

#### *Observation of Gričiupis neighborhood*

*Area 1.* The observed area predominantly consists of green spaces, comprising approximately 90% of the total area, while the remaining 10% is dedicated to pavement and roads. The vegetation primarily includes various tree species and the diversity of bushes, flowers, and grass. Wildlife, such as birds and insects, is present in the area. There few park-like spaces and well-maintained community gardens (Fig. 8). Residents interact with nature by installing some nesting boxes and creating small gardens. The area is clean and free of rubbish.



**Fig. 8.** Lots of open green space with no public space amenities observed in the area. Photographs by Anastasiia Kiuppier

*8 pav. Analizuotoje teritorijoje gaus atvirų žaliųjų plotų, tačiau nėra viešųjų erdvių įrangos. Anastasiia Kiuppier nuotraukos*

In terms of transportation, the community has access to public buses, with conveniently located bus stops not far from the area. Pedestrian routes are also present there. However, there is a lack of public space amenities such as benches, trash bins, and bike racks. Additionally, the community lacks accessibility features like ramps or elevators.



Various user activities can be observed in the area, including families with children enjoying playgrounds, children, young or elderly individuals going for walks, and people walking their dogs. Unauthorized parking is prevalent, with cars occupying space in courtyards. Residents have contributed to the amenities of public spaces by creating self-made benches and flower beds, but it doesn't always have a positive aesthetic effect.

The area comprises a mix of both renovated and non-renovated apartment buildings. The ongoing renovation of a building is currently underway, displaying a well-organized site where construction materials are neatly stacked, and there is no rubbish or waste outside the fenced area. The renovated buildings have not lost any aesthetic qualities compared to the non-renovated ones, and no new details have been added. The renovated buildings exhibit changes such as insulation, changed colors (each building having its own color scheme), and the covering of ventilation openings that previously served as bird habitats. The buildings are in good physical condition, without any visible signs of damage. The renovation process involved the use of materials such as wall plaster or matte large tile panels. The color palette of the renovated buildings is pastel in combination with dark ones - creating a slight contrast but look harmonious in an environment with a density of trees. However, the landscaping in the area has not been upgraded. Overall, the building renovations have enhanced the aesthetic qualities of the area.

*Area 2.* The observation area consists of predominantly green spaces, accounting for approximately 80% of the total area, with the remaining 20% dedicated to pavement and roads. The vegetation species are not too varied including trees, bushes, flowers, and grass. Wildlife is observed in the area, including birds and insects. There are only green areas with greenery well-maintained and accessible to the community. During the observation no evidence of human interaction with wildlife or nature was observed. There is no rubbish in the observation area.

Regarding transportation, the community benefits from convenient access to public buses, with bus stops located nearby. Additionally, pedestrian routes are present, encouraging the use of alternative modes of transportation. Accessibility features like ramps are partially available as half of the houses have ramps. Users predominantly consist of young or elderly individuals walking. Unauthorized parking of cars is prevalent, occupying courtyards, driveways, and roads.

The area includes both renovated and non-renovated apartment buildings (Fig. 9). Currently, there are ongoing renovation projects, and no rubbish outside the fence of the site is visible. In addition, the renovated houses did not lack the aesthetic qualities that non-renovated houses possess; there were no ventilation openings before, and no new details have been added. Renovated buildings feature changes such as insulation, color change (renovated buildings have more than two colors, and each renovated building differs in colors).



**Fig. 9.** Renovated buildings. Photographs by Anastasiia Kiuppier  
*9 pav. Renovuoti pastatai. Anastasiia Kiuppier nuotraukos*

The buildings exhibit a good physical state. Renovated facades exhibit such materials as wall plaster, matte large tile panels, or their combination. The color palette of the renovated buildings uses pastel colors in combination with bright and dark ones - creating a contrast and look



disharmonious. The area's landscaping remains unchanged. Overall, the aesthetic qualities of the buildings haven't changed much and, but in some cases, has gotten worse.

**Area 3.** The observed area comprises mostly green spaces, accounting for approximately 95% of the total area, with pavement and roads making up the remaining 5%. The vegetation consists of various tree species, while the diversity of bushes, flowers, and grass is relatively low. Wildlife, including birds and insects, is present in the area. Few park-like spaces and well-maintained community gardens were observed in the area (Figure 10). Interaction with nature is evident through the presence of nesting boxes and small gardens created by residents. The area is free of rubbish.



**Fig. 10.** Public space amenities and landscaping created by residents. Photographs by Anastasiia Kiuppier  
*10 pav. Gyventojų sukurta viešųjų erdvių įranga ir akcentai. Anastasiia Kiuppier nuotraukos*

Transportation options include public buses, with bus stops in proximity, as well as pedestrian routes. There are a few benches, however, public space amenities such as trash bins and bike racks are insufficient. Accessibility features such as ramps or elevators are lacking. User activities include families with children in playgrounds, elderly people and teenagers walking, and individuals walking their dogs. Unauthorized parking of cars is prevalent, occupying space in courtyards, driveways, and roads. Locals have contributed to the aesthetic quality of public spaces by creating self-made flower beds.



**Fig. 11.** Renovated and non-renovated buildings. Photographs by Anastasiia Kiuppier  
*11 pav. Renovuoti ir nerenovuoti pastatai. Anastasiia Kiuppier nuotraukos*

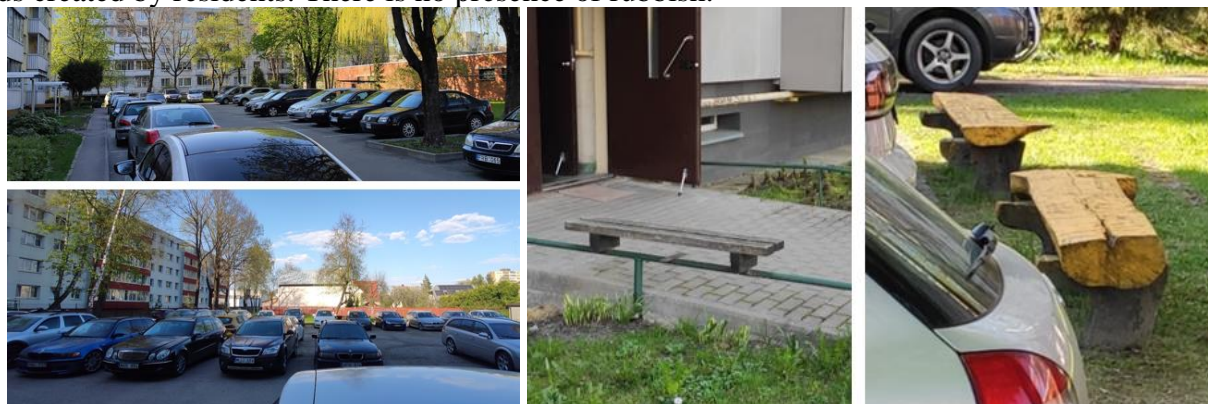
The area comprises both renovated and non-renovated apartment buildings (Fig. 11). The ongoing renovation of a building is currently underway, displaying a well-organized site where construction materials are neatly stacked, and there is no rubbish or waste outside the fenced area. Furthermore, renovated houses were not deprived of the aesthetic qualities that non-renovated houses have; there were no ventilation openings before, and there are no new details. Renovated buildings exhibit changes such as insulation, changed colors (each building having its own color scheme, and each renovated building differs in colors). The buildings show no external signs of damage. Renovated facades exhibit such types of materials as wall plaster, matte large tile panels, or plaster in combination with corrugated metal sheets. The colors palette of the renovated buildings is pastel or in combination with dark ones - creates a slight contrast but look harmonious in an environment. The landscaping in the area has not been upgraded. In general, the aesthetic qualities of the buildings have improved after the renovation.

#### *Observation of Dainava neighborhood*

**Area 1.** The area where the observation was carried out has an average number of green areas. The approximate percentage ratio of pavement and roads to green spaces is 40 % to 60 %.



has a variety of species, the presence of trees, bushes, flowers, and grass contributes to the overall greenery. Signs of wildlife have been observed there, such as birds and insects. There are just a few gardens made by residents, which are well-maintained and accessible to the community. Interaction with nature is evident through the presence of nesting boxes and self-made gardens with flower beds created by residents. There is no presence of rubbish.



**Fig. 12.** The lack of public green spaces leads to the lack of public space amenities. Photographs by Anastasiia Kiuppier  
*12 pav. Žaliųjų plotų trūkumas lemia viešųjų erdvių patogumų trūkumą. Anastasiia Kiuppier nuotraukos*

The area has public transport and alternative methods of transport such as buses (bus stops are close to this site), as well as walking paths. The lack of public space amenities such as benches, trash bins, and bike racks was observed (Fig. 12). Accessibility features such as ramps or elevators are lacking. In terms of users and their activities, were only seen children, young or elderly walking. A lot of cars occupy space in courtyards. Locals have contributed to the amenities and aesthetic quality of public spaces by creating self-made benches and flower beds.



**Fig. 13.** Renovated buildings. Photographs by Anastasiia Kiuppier  
*13 pav. Renovuoti pastatai. Anastasiia Kiuppier nuotraukos*

The area comprises both renovated (Figure 13) and non-renovated apartment buildings. There is no ongoing renovation of buildings. Furthermore, renovated houses were not deprived of the aesthetic qualities that non-renovated houses have; there were no ventilation openings before, and there are no new details. Renovated buildings exhibit changes such as insulation, changed colors (each building having its own color scheme, and each renovated building differs in colors). The buildings show no external signs of damage, and good physical state. Renovated facades used such types of materials as wall plaster, matte large tile panels, or plaster in combination with corrugated metal sheets. The colors palette of the renovated buildings is predominantly pastel, but some buildings are pastel in combination with bright tones and stand out a little in relation to the environment. The landscaping in the area has not been upgraded. In general, the aesthetic qualities of the buildings have improved after the renovation.

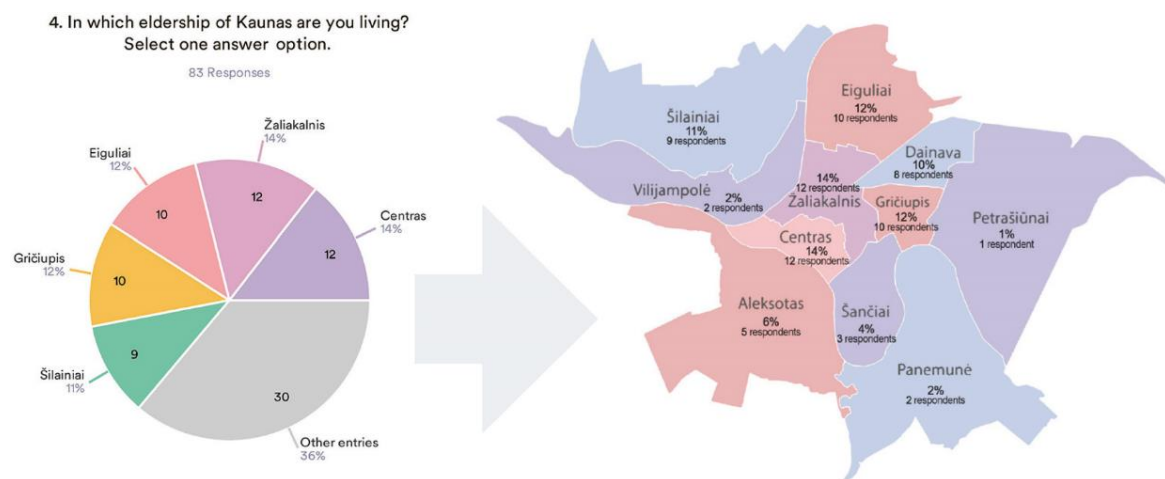
### **Sociological survey**

*Structure of the questionnaire.* The sociological survey questionnaire was designed using an online platform Jotform. Twenty-nine questions were prepared, which can be relatively divided into five groups: general information about the respondents, perception of nature and wildlife, biodiversity, changes in the neighborhood and biodiversity, biodiversity preservation and eco-



friendly behavior. Questions aimed at general information about the respondents focused on demographic information, including gender, age, educational background, place of residence (Kaunas neighborhoods), and housing types. Question group focused on perception of nature and wildlife included questions on survey participants' attitudes towards nature, including their appreciation, enjoyment, and protection of nature, frequency of spending time outdoors in nature for recreation, perception of wildlife presence in their neighborhood and awareness of different wildlife species. Question group focused on biodiversity (vegetation and wildlife observation) focused on variety of vegetation observed in the neighborhoods, including trees, shrubs, flowers, and grass, description of vegetation quality, ranging from poor, average to lush and diverse and survey participants' beliefs about the positive influence of vegetation on wildlife. Question group on changes in the neighborhood and biodiversity focused on survey participants' observations of significant changes in their neighborhood and its potential impact on wildlife, their perception of changes in biodiversity, including perceived increases or decreases in wild animals, insects, or plants, perception of aesthetic qualities of the neighborhood after changes occurred. Question group on biodiversity preservation and eco-friendly behavior included questions about importance of biodiversity preservation in the renovation process, survey participants' appreciation of green spaces and eco-friendly behaviors, their proposals for improving the presence and management of wildlife and vegetation, including the creation of green spaces, wildlife corridors, education and outreach programs, and wildlife management plans.

*Data analysis and interpretation of results.* The survey was carried out online in April – May 2023. 84 respondents answered the questionnaire. Most of the respondents were female (75%), while the remaining participants were male (23%), and 2% chose not to answer. The age range of the respondents varied, with the highest percentage falling in the 18-24 age group (29%), as well as almost the same number in 45-54 (27%) and 35-54 (24%). The remaining respondents were distributed across the 25-34 (13%) and 55-64 (6%) age ranges. Most participants held a master's degree (34%), followed by a doctoral (22%), and an equal percentage of respondents have a bachelor's (18%) degree and completed secondary school (18%). A smaller percentage had a college diploma (8%). The respondents represented various residential neighborhoods in Kaunas (Figure 14), with Žaliakalnis and Centras being the most common (12% each), followed by Eiguliai, Gričiupis, and Šilainiai (12% each). The remaining participants lived in other neighborhoods. Most of the respondents lived in apartment buildings (61%), while the rest lived in individual houses (29%), and the remaining (10%) chose other type of housing option.

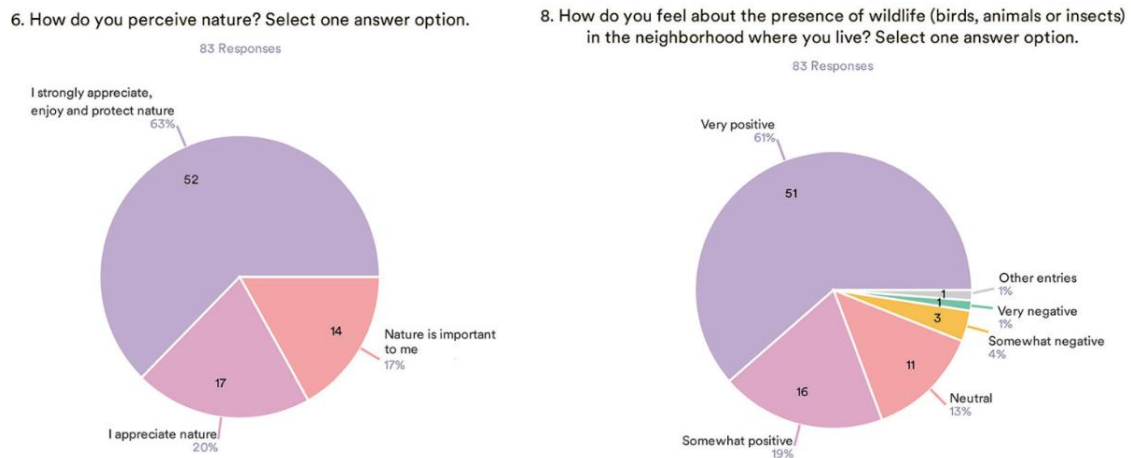


**Fig. 14.** Distribution of respondents by Kaunas neighborhoods. Scheme by Anastasiia Kiuppier, graph generated by Jotform (2023)

**14 pav.** Respondentų pasiskirstymas pagal Kauno rajonus. Anastasiia Kiuppier schema, grafikas sugeneruotas Jotform (2023 m.)



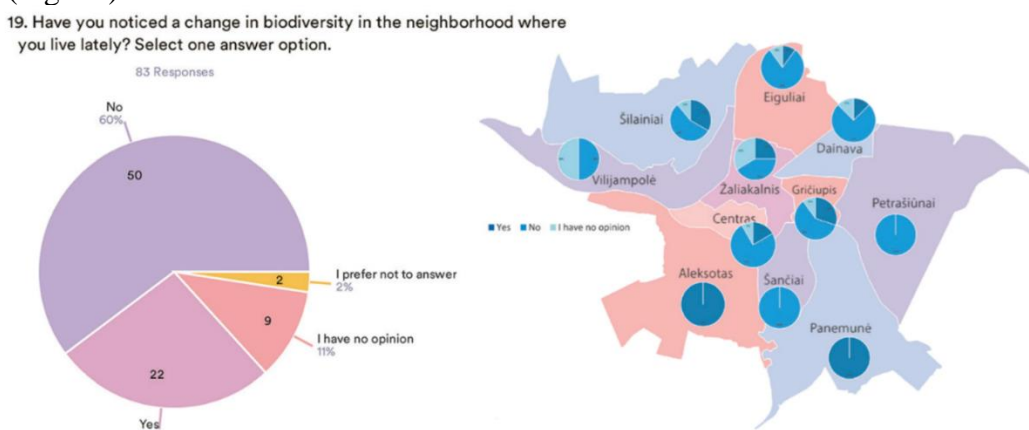
Most respondents expressed a strong appreciation, enjoyment, and protective attitude towards nature (63%), while others appreciated nature (20%) or considered it important (17%) (Figure 15). Approximately 38% of the respondents spent time outdoors in nature for recreation at least once a week, and 23% every day, while the rest had varying frequencies.



**Fig. 15.** Perception of nature and the presence of wildlife, graphs generated by Jotform (2023)  
**15 pav.** Gamtos ir laukinių gyvūnų buvimo vertinimas, grafikas sugeneruotas Jotform (2023 m.)

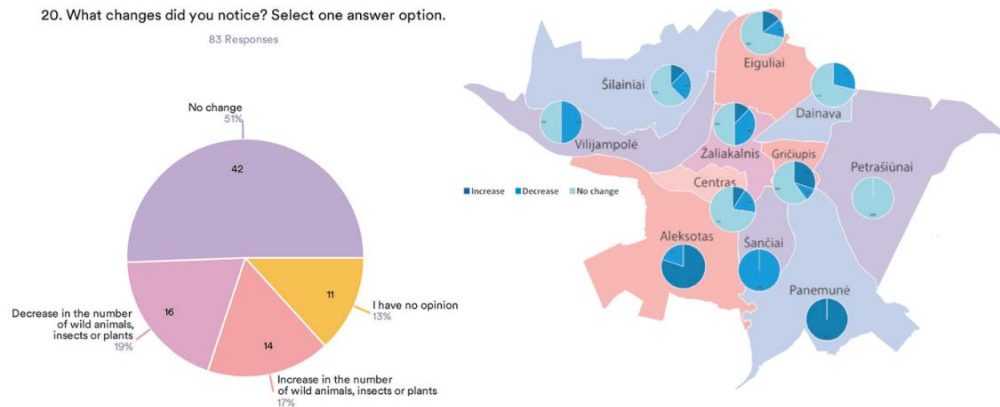
Most participants had a very positive or positive perception of wildlife presence in their neighborhood (80% in total), with only 5% having a negative attitude (Fig. 15). The majority (88%) noticed wildlife species in their neighborhood, including birds, small mammals (squirrels, hares, etc.), and insects. The most common types of vegetation observed in the neighborhoods were trees, shrubs, flowers, and grass. The respondents described the vegetation as average or moderate (43%), followed by lush and diverse (39%). The participants believed that the presence of vegetation positively affected wildlife in their neighborhood (82%).

Most respondents reported significant changes in their neighborhood in recent years that could have affected the presence of wildlife (55%), while more than a quarter of the respondents did not notice any change (27%). Meanwhile only 27 % of respondents noticed actual changes in the biodiversity of their neighborhood (Fig. 16). Regarding changes in biodiversity, 19% of respondents believed there was a decrease in the number of wild animals, insects, or plants, and 17% that it had increased (Fig. 17).



**Fig. 16.** Changes in biodiversity. Scheme by Anastasiia Kiuppier, graph generated by Jotform (2023)  
**16 pav.** Biologinės įvairovės pokyčių vertinimas. Anastasiia Kiuppier schema, grafikas sugeneruotas Jotform (2023 m.)





**Fig. 17.** Types of change in biodiversity. Scheme by Anastasiia Kiuppier, graph generated by Jotform (2023)  
**17 pav.** *Biologinės įvairovės pokyčių pobūdžio vertinimas. Anastasiia Kiuppier schema, grafikas sugeneruotas Jotform (2023 m.)*

The aesthetic qualities of the neighborhood were perceived as improved since the changes (36%), but in some cases, it got worse (18%). Most respondents believed it was necessary to pay attention to biodiversity preservation in the renovation process (94%).

Respondents appreciated green spaces, well-looking buildings, and areas with grass in their neighborhoods. Respondents regularly engaged in eco-friendly behaviors such as reducing pollution, waste, and water consumption. Several measures were suggested to improve the presence and management of wildlife and vegetation, including creation of more green spaces and wildlife corridors (32%), increased education and outreach about wildlife (27%), establishment of wildlife management plans and enforcement of existing wildlife protection laws (19% each). A significant number of respondents (33%) supported people who protect nature or sometimes donate money and time for nature protection (24%).

## Conclusions

The findings confirm the importance and potential of integrating biodiversity considerations into planning, renovation practices, and policies to create sustainable and livable neighborhoods. It can be summarized that, from aesthetical point of view, three aspects - multidisciplinary perception, bad practice and the results it causes, the influence of artificial intelligence - are inextricably important, and each of them is an unconventional way of looking at the question of harmonious aesthetics from a completely different perspective. However, it is only by realizing the fundamental root problems that it is possible to move towards a more comprehensive understanding and decide how to proceed: either leave these problems to be solved autonomously, or whether to aesthetically improve the design solutions in the near future.

Based on the observations on site conducted in the Eiguliai, Gričiupis, and Dainava neighborhoods, the following general conclusions can be drawn. All observed areas had varying but high degrees of green spaces, consisting of trees, bushes, flowers, and grass. Wildlife, including birds and insects, was present in all areas. However, the diversity of plant species was relatively low in some areas, while others exhibited a higher variety. Residents' interaction with nature, such as the presence of nesting boxes and locally created gardens, was observed in certain areas. Both renovated and non-renovated apartment buildings were present in all observed areas. Some areas had ongoing renovation projects, with well-organized construction sites and neatly stacked materials. Renovated buildings exhibited changes such as insulation, color changes (although no coordinated color scheme of the area), and covered ventilation openings (practice that is harmful to nesting swifts). The overall physical state of the buildings was good, with no external signs of damage. Renovated facades used materials such as wall plaster or matte large tile panels. The color palettes of the renovated buildings were generally pastel shades that complemented the



surroundings. The aesthetic qualities of the buildings generally improved after renovation. Renovated buildings in most areas maintained the aesthetic qualities of non-renovated buildings and did not lack any significant details. However, there were rare cases where the aesthetic qualities of the buildings did not change much or even worsened after renovation. Moreover, it is necessary to note that renovation of the buildings has not created any particular sustainability aesthetics and attractive, interesting or focused on biodiversity preservation and enhancement solutions are lacking. Residents in some areas contributed to the amenities of public spaces by creating self-made benches and flower beds. Which can both decorate the area and, on the other hand, worsen its visual qualities. This suggests that residents are acutely aware of the lack of amenities in public spaces as they do something with their own hands. The observed neighborhoods exhibited varying levels of biodiversity, social livability, and renovation. While there were positive improvements in terms of building aesthetics and signs of interaction with nature, there were also areas that lacked sufficient public space amenities and showed limited diversity in plant species. These observations highlight the need for further attention to enhancing livability and biodiversity aspects in the neighborhoods, alongside the ongoing renovation projects.

Sociological survey results highlight the positive perception of nature and wildlife among the surveyed individuals in Kaunas. The presence of diverse vegetation was believed to positively influence wildlife in residential neighborhoods. Respondents expressed a need for increased attention to biodiversity preservation and suggested various measures to enhance wildlife and vegetation management. The results suggest a strong interest in nature protection and engagement in eco-friendly behaviors among the respondents. It is necessary to note that this survey was of pilot character and the social-demographic characteristics of respondents were not representative. However, the obtained results confirm the positive interest in nature and outline the direction for future research.

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## Ekologiškesnės ateities link: biologinės įvairovės išsaugojimo galimybės renovuojant daugiabučius namus kaip Europos Žaliojo kurso vertybių išraiška

(Gauta 2024 m. vasario mėn.; atiduota spaudai 2024 m. kovo mėn.; prieiga internete nuo 2024 m. gegužės 10 d.)

### Santrauka

Biologinė įvairovė dažnai yra nepakankamai įvertinama planuojant ir plėtojant miestus; tačiau miestams tankėjant ar plečiantis poreikis saugoti miesto gamtą ir didinti biologinę įvairovę tampa vis aktualesnis. Tyrime daugiausia dėmesio skiriama biologinei įvairovei miesto gyvenamuosiuose rajonuose, užstatytuose sovietinio modernizmo daugiabučiais gyvenamaisiais namais, ir biologinės įvairovės išsaugojimo bei didinimo poreikiui bei galimybės pastatų renovacijos procese, atsižvelgiant į ekologinius, socialinius ir estetinius aspektus.

Tyrimo metodiką sudaro šie metodai: literatūros apžvalga ir analizė, tyrimas vietoje (stebėjimas) pasirinktose Kauno miesto teritorijose ir sociologinė apklausa. Literatūros apžvalga ir analizė atlikta siekiant išanalizuoti svarbiausius šio tyrimo komponentus – gyvenamųjų namų renovaciją miestuose, gamtos apsaugą ir atkūrimą miestuose bei estetinius aspektus, susijusius su darnia miesto aplinkos plėtra ir Europos Žaliojo kurso politikos įgyvendinimu – ir jų sąsajas. Į literatūros analizę įtraukti šaltiniai – neseniai publikuoti moksliniai straipsniai ir kitos publikacijos, surinktos iš mokslinės literatūros duomenų bazių, tokių kaip Web of Science, Scopus, Google Scholar. Siekiant geriau suprasti situaciją (biologinės įvairovės, socialinio gyvybingumo ir renovacijos) teritorijose su renovuotais ir nerenovuotais daugiabučiais namais, atlikti stebėjimai vietoje – septyniose pasirinktose teritorijose Kaune (Eigulių, Gričiupio, ir Dainavos rajonuose). Siekiant nustatyti gyvenamųjų rajonų biologinės įvairovės ir estetinių savybių pokyčius dėl daugiabučių namų renovacijos, atlikta žvalgomoji sociologinė Kauno gyventojų apklausa. Literatūros analizės, stebėjimų ir sociologinės apklausos rezultatai išanalizuoti ir apibendrinti, suformuluotos išvados dėl biologinės įvairovės išsaugojimo ir gausinimo galimybių daugiabučių namų renovacijos metu ir po jos.

Tyrimo rezultatai patvirtina biologinės įvairovės išsaugojimo ir jos integravimo į miestų gyvenamųjų rajonų renovacijos procesus svarbą. Žvalgomosios sociologinės apklausos rezultatai išryškina teigiamą apklaustų Kauno miesto gyventojų požiūrį į gamtą ir biologinę įvairovę jų gyvenamojoje aplinkoje. Stebėjimai ir žvalgomoji sociologinė apklausa išryškina poreikį saugoti ir didinti biologinę įvairovę Kauno gyvenamuosiuose rajonuose. Apibendrinant galima teigti, kad analizuotose teritorijose buvo stebimas skirtingas biologinės įvairovės, socialinio gyvybingumo ir renovacijos lygis. Nors pastatų estetikos ir sąveikos su gamta požiūriu buvo pastebėta teigiamų pokyčių, tačiau buvo ir tokių teritorijų, kuriose trūko viešųjų erdvių įrangos, buvo ribota augalų rūšių įvairovė. Šie pastebėjimai rodo, kad greta vykdomų renovacijos projektų reikia skirti papildomo dėmesio gyvenamųjų rajonų gyvybingumo ir biologinės įvairovės aspektų gerinimui.

