Harmonization of Conflicts in Contact Zones Between Dense Urban Landscape and Protected Natural Areas; Case Study Devinska Kobyla (Bratislava, Slovakia)

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Abstract. This paper explores the processes of harmonization of the interests of green infrastructure and urban development of specific areas at the urban fringe. The case study of Devinska Kobyla (Natura 2000 site) is located within the landscape with a high density of urbanization in Bratislava located in close proximity to the protected areas of Little Carpathians. The management and planning of contact zones are one of the tools for avoiding fragmentation of the landscape, but one of its limitations in practice is that the concept of contact zones of urban and natural structures [1] is not properly reflected in the existing policies, despite huge conflicts threatening the conservation areas. Therefore, the conflicting behaviour and multi-actor decision-making of stakeholders with conflicting interests, such as residents and vacationers, environmentalists, municipalities, developers and activists lead to fragile sustainability of these areas. Consequently, there is a need to cultivate the spaces - to develop them into deeper levels of understanding, participation and sharing [2] - by a thorough impact assessment, visionary planning, innovative design and sensitive management in the complexity. The paper concludes with a set of recommendations projected in the plan of measures for sustainable development of natural areas of Bratislava urban fringe developed in cooperation with local key stakeholders (Daphne and BROZ NGOs) [3] and State Nature Conservancy of the Slovak Republic as the Natura 2000 Bratislava partners. Using the methods of the field research, analysing historical and existing characteristics of the sites, participation of residents and visitors and consulting with experts, the landscape planning design proposal had been developed. The project segments – the buffer zones – were designed in greater details. These buffer zones respect both the values of nature and also human demands on democratic, accessible places with more opportunities for sociability, involving the concept of learning landscape design. The paper contributes to the debates on practical examples of harmonization of various interests in specific locations of contact zones by design and planning, minimising fragmentation of ecological corridors, solving it by spatial planning and landscape design.

1. Introduction
With the increasing trend of enlarging the population in cities, the urban landscape is becoming the most crucial environment for living for the majority of people who are becoming predominantly urban dwellers. Hence, it is necessary to strive for the quality of the urban landscape, trying to meet the requirements of human for the environment where he and she live. On the other hand, nature, its biodiversity and natural beauty are endangered by anthropogenic activities, nature provides the resources without which any life would not exist. It is therefore of utmost importance to protect them, especially to preserve the uniqueness, biodiversity and connectivity of natural areas such as Natura 2000 sites.
It is thus in the interest of the social systems and ecosystems to be in harmony, however in these areas often come to conflicts in the specific contact zones where the city meets the nature while both are negatively affected. The main effort should be to strive to preserve their values by flexible adaptation to changes in the context of sustainability and resilience. This study focuses on a particular urban landscape - urban fringe - seeking to formulate the appropriate concept of harmonization and demonstrate this approach on a case study of Devinska Kobyla in Bratislava, Slovakia.

1.1 Problem statement and importance of the study
Since long ago, it has always seemed as if there was a serious struggle for space and domination between the natural and urban environment, despite current efforts to harmonize these forces. Due to processes of urbanization and with the increasing trend of population growth in cities, the situation is becoming more serious; the urban landscape becomes the most crucial environment for living for the majority of the population. These constant pressures can be observed, especially in the urban fringe, where rural and urban environments intertwine and where the most intense growth and change happen [4, 5]. Urban fringe natural areas deal with an urban sprawl and also face to alterations in the relationship between people and nature. Particularly significant is the problem in contact zones of densely urban and highly protected natural structures [1, 6, 7].

Protected areas within the borders of larger cities provide a whole range of ecosystem services for the urban population. They are biodiversity hot spots, regulating hot summer temperatures, providing wildlife viewing, recreational, spiritual and eco-tourism opportunities and well-being for their visitors and residents of the locality, they are refuges from hectic city life [6, 8].

Whereas the relations in these areas are fuzzy and often contradictory, many problems occur. Urban fringe natural areas in conservation face different threats. The main issue to address is that the abrupt development in the urban fringe results to high recreation use pressure because of the attractiveness of its natural areas, to conflicting interests of diverse actors, such as residents, vacationers, environmentalists, developers, activists and municipalities. It generates frequently uncertainty, disharmony of relations and territorial conflicts. Their underestimating results in unsatisfactory compromises or severe neglecting of some interest groups, heading to physical and mental decay, deviating from sustainability and resilience of the environment. It leads to degradation of the areas, threatening the biodiversity of the nature, also depreciating the genius loci, resulting in a lack of awareness among people (especially residents) about the uniqueness of the locality. Similarly, the recreational quality of what natural areas offer is reduced. Hence, it is essential to focus on these areas and to find innovative mitigation measures appropriate for these specific localities.

1.2 Main research objectives and questions
One of the biggest challenges is the question of harmonization of different demands between diverse elements of contrasting environments – the urbanized area as a social system and protected nature as eminent eco-system in the confrontation with the preferences in the access to them and function of sustainability.

Thus, the paper aims (1) to identify the optimal planning and designing measures and management options useful for cultivation of conflicting relations and threats resulting from contradictory interests between natural and urban environments, including protecting of rare natural aspects and biodiversity of the site, optimising the ecological connectivity between natural habitats and also including improving the identity of the specific locality and awareness of its uniqueness; and (2) to describe the set of recommendations projected in the plan of measures for harmonization and sustainable development of Bratislava urban fringe natural areas Devinska Kobyla (Natura 2000 site), elaborated also graphically.

The key question is how and whether it is possible to plan, manage and design effective infrastructure for recreation which will satisfy the demands of various users and concurrently will help to protect the biodiversity and connectivity between natural habitats of unique Natura 2000 site and adjacent ecosystems, despite the density and proximity of urban settlements?
2. Literature review

2.1 Harmonization, biodiversity, the conflicts

In urbanized areas of the developed world, it is highly important to maintain landscape connectivity. For the past decades, the strong phenomenon of suburbanization and related processes has been consuming the natural assets around cities. Several European strategies highlight the importance of controlled development and preservation of ecological network and connectivity (EU Biodiversity Strategy, The Habitat Directive 92/43/EEC, EU Network of Nature 2000 sites etc.). There is a strong demographic and economic pressure on the growth of urban areas, especially in the large agglomeration zones. Hence, in the driving of maximum economic benefits, the urban ecological corridor can be easily transformed into construction land, so there is an extremely large pressure on the remaining ecologically valuable areas, unbuilt areas in agglomeration zones which can be enforced by planning the urban fringe zones with particular focus on biodiversity. Urban expansion is not a simple one-way process; it also generates responses and changes in the surrounding peri-urban and rural areas [9]. In spite of a free-standing city in rural surroundings, there is a wider regional urban system of inter-connected and polycentric settlement forms where to maintain the ecologic network several tools are necessary. There is a growing need of urban residents towards the high-quality recreation and ecological green living open space.

The green infrastructure which is a strategically planned network of natural and semi-natural spaces represents a crucial approach in the maintenance and development of ecosystems and ecosystem services [10]. Green infrastructure covers a wide range of natural-semi natural features as reserves, parks, recycled land, parks and open spaces, agricultural lands, forests, conservation corridors, landscape linkages and greenbelts [11]. The most important aspect in this context is the preservation of multi-functional open spaces around fast growing cities offering the integration and interaction of different services and benefits [12].

Fragmentation of populations caused by transportation and urbanization, therefore, becomes a key issue for the survival of many species [13]. Habitat fragmentation, the splitting of natural habitats and ecosystems into smaller and more isolated patches, is recognised globally as one of the biggest threats to the conservation of biological diversity. Habitat fragmentation is mainly the result of different forms of land-use change. The construction and use of transport infrastructure are one of the major agents causing this change as well as creating barriers between habitat fragments [14].

Most threatened are species inhabiting large areas in relatively small numbers. The impact of fragmentation on populations significantly increases under the conditions of global climate change, which bring modifications of habitats and by that also relocations of both individuals and populations into new areas [14]. The seriousness of the fragmentation issue is increased also by the fact that it is an irreversible process, usually manifesting itself with delay. Isolated populations still survive for some time in the landscape even after negative changes. However, if the issue is first dealt with when the populations are already declining, it is usually too late for a successful solution.

Fragmentation has two primary effects on species; firstly, it can reduce the size of habitat patches so much that they can no longer support viable populations of important species; and secondly, it can result in the remaining patches being so isolated from each other that individuals have a low chance of moving between patches. Being unable to move between patches renders species vulnerable to local and regional extinction. Although human activity started to fragment nature many centuries ago, the rapid increase in density of transport networks and intensification of urbanization during the 1900s and the effect of increased accessibility have greatly accelerated this impact [14].

2.2. Urban fringe - contact area of the city

Urban fringe as a territory of immediate contact of the city and its surrounding landscape presents a specific phenomenon of the urbanized landscape. In this territory, the prevailing man-made environment conflicts with areas of natural systems. The processes of urbanisation have a very strong impact and manifestation especially in the urban fringe territory, which is characterized by a great
dynamic of changes, by diffusing of those two environments and by many collisions as a result. The role of urban fringe as a border area of the urban structure is to transform interactions between the city and surrounding country, to make a contact and transitional area between them. During the development process, urban fringe of most cities has become a territory of uncontrolled conflicts of different activities that occur wherein. Urban fringe in many cases becomes a barrier between the city and its surroundings owing to often unsuitable exploitation and devastation of natural resources, that are demonstrated by waste dumps, extraction sites, polluting industries, some forms of individual recreation etc. That means that a biological activity of urban fringe with a great primary potential for city environment grows weak. On the other hand, this territory offers areas with valuable and crucial bioclimatic and landscape qualities as forests, woods, parks, gardens, orchards, vineyards, waters, etc. and is a subject of a great recreational interest of city inhabitants.

In this context, a great importance of contact areas for visual perception of the city scenery cannot be forgotten, which is very considerable especially in locations of main entries to the city as well as in local dimension by penetrating of city areas to the different types of the surrounding landscape.

By landscape planning in these special locations of a city – contact areas between the city and surrounding country – we used the method based on next steps [1]: (1) analysing the urban fringe character, (2) determining the urban fringe pattern, (3) applying the model principles of urban fringe development.

2.3 Comparing practical examples
There are many positive examples of landscape design, planning and management of protected areas in close proximity to a large city. Such important previous study is focused on Donau-Auen National Park in Vienna, where the effectiveness of buffer zones is deeply investigated [6, 15].

However, the previous studies differ considerably from this paper’s case study mainly due to the character of transition zones between urban environment and protected nature. The focused case Devinska Kobyla is characterized particularly by the mentioned problem – the direct bordering of the protected nature with housing developments, with almost any buffer zones. Furthermore, the contribution of this study is also a deep emphasis on human needs and requests on the natural environment, as the important cultural ecosystem service.

3. Methodology
The first step of the research was the formulation of the problem on urban fringe zone persistent in the Devinska Kobyla site that was studied using the desk research for literature review and review of approaches to this issue and potential solutions and case studies on the topic of harmonization of the conflicts between nature vs demands of society, especially users. Then the case of Devinska Kobyla was closely studied, see part 4 below, including data collection and analysing the specific issues in the area. Afterwards, a concept of harmonization was prepared followed by application of the concept which is briefly described in part 5.

4. Case study Devinska Kobyla
4.1 Introducing case study Devinska Kobyla
The harmonization of contact zones between natural and urban environment is examined on the case study Devinska Kobyla (Natura 2000 site), the urban fringe natural area in Bratislava, the capital of Slovakia. Contact zones of the city districts Devinska Nova Ves and Devin and the protected mountains Devinska Kobyla belonging to Little Carpathians are the ones with the most fragile balance between various actors, where the ecological stability is the most at risk within the capital urban fringe natural areas.

Devinska Kobyla is unique, mainly forested massif significant in several aspects. It is exceptional by its location; almost whole surrounded by neighbourhoods of Bratislava, with the direct contact with Austria from the west, separated from it only by rivers Danube and Morava. The protected National Nature Reserve Devinska Kobyla occupies most of the study area, containing unique protected
paleontological sandstone Sandberg. The area is managed by organization Urban forests in Bratislava, involved in the Natura 2000 BA project - Restoration of NATURA 2000 sites in cross-border Bratislava capital region.

The case study area (almost 400 ha), defined on the western slopes of the massif, is remarkable also by its very close proximity to another Natura 2000 area – Devinske alluvium of Moravia - isolated one from the other only by road and a cottage settlement. Therefore, there is also a need to maintain the connectivity as close as possible; to avoid the fragmentation of the green infrastructure. Moreover, due to incomparable landscape character, rare protected steppe flora, significant historical, cultural, geological, topographic and singular paleontological structures and beautiful views of the landscape from steep slopes and for historic and cultural wealth, the significance of the locality is great.

4.2 Data collection – methods
In the first phase, the deeper research about Devinska Kobyla area was necessary; for understanding the conditions, potentials and limits of the territory. It was conducted from Sept. 2013 to June 2014 on the basis of field survey and mapping, desk research - literature and documentations survey on various aspects of the landscape. Afterwards, the meetings and consultations with experts were conducted; environmentalists, stakeholders from NGOs Daphne and BROZ participating on Natura 2000 BA project in the area, stakeholders from local government and the public. In the next phase, data from the survey were analysed in the complex context – also using historic plans. Analyses of land use, relief, functions, legislative, dendrologic, visual and compositional relationships were included.

5. Participating in human values
In the third phase, the qualitative research with the users of the area was conducted. The knowledge and views from the ‘local experts’ – the visitors and residents were obtained. Data were collected by the method of individual structured interviews with a random representative sample of the public across the study area. A total sample of respondents involved in the survey was 51; respondents were chosen randomly, trying for a varied and representative sample (Figure 1).

![Figure 1. Basic pattern of interview respondents – age structure and structure of domicile](image)

The questions of structured interviews were open, concerning the frequency of visiting the natural areas of Devinska Kobyla, their favourite locality, the motives and activities, what people use to do there, and their viewpoint of conflicts arising in these spaces. They were conducted as the walking interviews in the site. The data from the research were summarized to the patterns as the human motives for visiting natural areas in the locality (Figure 2) and the table of the perceived conflicts of interests.
5.1 Analysing problems and identification of the potentials and resulting challenges

First of all, the most serious problem connected to conflicts between the human need for recreation and natural conservation issue is high recreation use pressure. Natural areas of Devinska Kobyla are suffering from the masses of often undisciplined visitors, mainly over days off. The protected areas, especially its border zones (but very valued), are facing degradation since the contact with the housing estates and family houses developments is very close. The buffer zones in these contact zones are narrow, offering no activity for people, which could lighten pressure from protected natural areas, so the pressure passes directly into the biocentre. Gaps in the management and lack of complex established infrastructure for recreation, as the serious human need, is the critical treatment of this intensively used settings.

Similarly, the issue of low general awareness about the uniqueness of the territory and its attributes needs to be resolved. The Daphne NGO has addressed this problem through the application of a nature trail, but the challenge is to solve this problem more complexly in the whole infrastructure. Next, there is the problem of the succession of the forest threatening the extraordinary steppe flora of the meadows, that has been solved in recent years by BROZ NGO. Traditional sheep herding as a solution to this problem, though, has also the potential for recreation and its proper direction, which is currently a neglected aspect.

Subsequently, it is essential to deal with the conflict resolutions in the locality, since conflicting interests can impact negatively the natural resources and consequently the quality of the resident well-being and the visitor experiences. All the challenges arising from the analysed problems and the identified potentials are taken into account in the plan of measures for sustainable development of natural areas of the contact zones of Devinska Kobyla. In Figure 3, there is the researched simplification of the conflicts of interests generalized to main groups of interests.

6. The concept for harmonization - inspirational approaches; the plan of measures

6.1 Harmonization of the aspects in the urban fringe of Bratislava

To achieve a relevant approach to harmonization and avoiding fragmentation, the concept was developed reflecting the most important characteristics of the area. This process involves many layers, elements and specifics in the case study Devinska Kobyla. The research should be complex, noticing enough attention to all of the aspects, so then it is possible to avoid negative impact at the natural areas.
resources and biodiversity, at the quality of the recreation and quality of the living environment for residents in the locality. However, the limits resulting from the nature conservation should serve as fundamental fenders for the planning process, while the preservation of the identity of the locality, the natural and historic values is the priority in the area.

The uniqueness and strengths of the locality formulate a specific identity – the sense of place, what should be cultivated, so the values bring a lot of opportunities and benefits for whole Bratislava region. However, it also entails the challenges; the majority of the most important approaches and brief relevant proposals for solutions are outlined below.

6.2 Motivational approaches to the protection of nature - harmonization the relations by learning landscape design

An important challenge in the area is the indifferent relationship to the nature and lack of awareness about its values. The issue of increasing respect for the nature and harmonization of the positive relationship should be underpinned by creative means. Cultivating human values is very effective from the earliest age [16, 17], so planning and designing the interactive learning parks – Nature Play Areas could be the appropriate solution. Landscape architect Mathis [18], the initiator of such areas in Oregon, is emphasizing the need to introduce nature to children by inspiring, interactive and playful way. The Nature Play Areas can provide creative, free form play spaces, harmonizing children connection to the nature.

In the locality, the sustainable grazing management was conducted since 2013, as the uncontrolled expansion of invasive tree species is threatening the unique plant communities. The occurrence of the unique xerothermic grasslands that spread through human agricultural activities [19, 20] is one of the main reasons, why the locality is registered as Natura 2000 area. However, the application of grazing also increases the attractiveness of the site and naturally adopts people to appreciate the values of nature and it also offers the possibility for production of the milk products. But very important measure for harmonization and complexity in the locality is to join the activities of grazing management to the system of learning landscape design. Then, connecting such areas with the educational trails and the Nature Play Areas is the efficient measure for improving environmental awareness of human society and it is the possibility to complete environmental education with the interconnected infrastructure for recreation.

6.3 Harmonized infrastructure for recreation, entrances and buffer zones and its management

As mentioned above, in the contact zones, there occurs direct contact of settlement and nature. The relations of city and protected nature intertwined and emerging conflicts lead to degradation of the environment. The situation is much more alarming with the recreation use pressure.

Thus, linking, structuring and hierarchization of the system of the natural environment from the core entrance zones and urban recreation areas are essential [1]. Subsequently, areas of major intervention of the city to the country would become the core areas of interest for the urban dwellers. Although the management and the realization of attractive buffer zones should be defined, as well as the main recreational areas and various points of interest within the infrastructure for the recreation. Then, the defined structure of the connected trails and nodes could be effective to harmonize and clearer spatial fuzziness. Further, there should be also the satisfactory quality of particular recreational spaces and interest points, since their design and program significantly influence well-being and experience of the visitors. Hence, human values, requirements and needs should be properly included – to create democratic, accessible places with more opportunities for sociability [21].

7. Results and discussions

7.1 Results

Synthesizing the complex knowledge from previous stages of the research, the design concept for the landscape planning design proposal had been developed. It is applicable in practice, graphically elaborated into details.
Harmonization plan for sustainable management of Devinska Kobyla locality is designed across multiple scales to complex design concept; from the overall design of the infrastructure of routes and trails and its hierarchization, mutually connected to the principal interconnecting sports circuit, to the detailed design of various recreational spaces, points of interest and interactive stops.

Since in the transparent recreational infrastructure of Devinska Kobyla is cumulated the main pressure of visitors, the Nature Reserve Devinska Kobyla is protected from the degradation of lively activities.

These activities are transferred to peripheral buffer zones in the contact with urban zones and also inside the forested massif, beyond the highest protected Nature Reserve with unique grasslands. Furthermore, by the network of trails, the city districts surrounding the massif are mutually interconnected. In the strategic crossroads, where the main sports circuit intersects the other trails from the districts, hubs for recreation are designed. In particular, recreational spaces are equipped with several components for rest and recreation, according to their hierarchy. They are accessible and attractive to various visitors (Figure 4, 5).

The design concept for harmonization of Devinska Kobyla urban fringe natural areas is based on the very nature of the locality; its philosophy is based on the tremendous wealth and uniqueness of its many aspects and layers. The joining theme is ‘Finding the treasures of Devinska Kobyla’. Particular stories about different layers of the area are introduced by individual elements, creating the mosaic of the complex natural, cultural and historical background of the locality. The infrastructure of areas and trails consists from (1) three main interactive trails in the Nature Reserve Devinska Kobyla, introducing ‘The Story of Nature’, ‘The Path of History’ and the active sports route ‘Circuit Kobyla’; (2) identity and navigation elements in the form of a mare – using land-art elements - reference to the name of Devinska Kobyla (kobyla in Slovak = mare). These navigation elements highlight the identity of the site, unite the locality, improve the orientation, and elevate the artistic value of the site, creating the art libretto; (3) interactive hubs and points of interests at these trails have learning, informative and recreational character with the character of Nature Play areas – inspired by Learning landscape design – the buffer zones and grazing areas included. The main recreational spaces and entrances to the...
Nature Reserve are located in the peripheral zones of the urban areas, serving as the buffer zones providing various forms of activities, answering also on the need of lively recreational activities as downhill, skating and dog exercises.

7.2 Discussions
Thanks to proposed measures, as the hierarchization and highlighting the identity of the locality areas, its structuralisation into clear infrastructure, the conflicts in the locality should be harmonized. By overlaying the recreational infrastructure program with environmental education content and by joining the system of trails with activity hotspots – buffer zones in entrances and main grazing areas – the complex unite plan (Figure 6) for the locality, contributing to the protection of nature and biodiversity is created. As a result of this action plan, not only recreational experience would be cultivated, also the Natura 2000 areas would face lower pressure and the fuzzy relations in the locality would be cleared.

![Figure 6. Complex plan of development measures in Devinska Kobyla](attachment:image.png)

There is the opportunity to transfer the measures on similar urban fringe areas with protected localities. There are many opportunities to investigate the impact of such measures on people's awareness about preserving the nature and biodiversity and about a possible future change of their behaviour.

8. Conclusions
The study was dealing with the urban landscape of Devinska Kobyla according to the set objectives. The resulting output answers to the conflicts of nature and the city by proposing facilities for recreation in accordance with the protected landscape by management and design measures. The methodology and creative approaches in the process of development could contribute to solving similar territories with spatial fuzziness, where the great pressure of urbanization on highly protected nature negatively impact the landscape and its identity and where residents and visitors have a high demand for recreational use of the environment.
The research has not solved the policies and governance of the locality more in details. Hence, the next phase of the research proposes to focus on this issue. The follow-up research will be dealing also with the concept of Placemaking, as a bottom-up approach for the cultivation and activation of the communities in the locality. The issue of articulation of the identity of urban landscape and enrichment of it by culture will be further associated with the concept of cultural ecosystem services, which will be innovated. The paper contributes to the debates on practical examples of synchronizing various interests in specific locations with fuzzy relations between the natural and urban aspects in general.

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