sciendo ŚRODOWISKO MIESZKANIOWE/ HOUSING ENVIRONMENT 52/2025 WYZWANIA STOJĄCE PRZED ZRÓWNOWAŻONĄ ARCHITEKTURĄ ŚRODOWISKA MIESZKANIOWEGO e-ISSN 2543-8700 https://doi.org/10.2478/he-2025-0020

Received: February 05, 2025; **Received in revised form:** February 17, 2025; **Accepted:** July 18, 2025

Citation: Przesmycka, E., Przesmycka, N., Cortés Lara, M.A., Kronowski, D., Posuniak, Y. (2025). Biodiversity and synurbisation, challenges and perspectives: a comparative analysis of cities as places of animal life on the example of Kraków and Lublin. Środowisko Mieszkaniowe/ Housing Environment, e2025020. https://doi.org/10.2478/he-2025-0020

ELŻBIETA PRZESMYCKA*, NATALIA PRZESMYCKA**, MARA A. CORTÉS LARA***, DARIUSZ KRONOWSKI****, YARYNA POSUNIAK*****

Biodiversity and synurbisation, challenges and perspectives: a comparative analysis of cities as places of animal life on the example of Kraków and Lublin

Abstract

This article presents the results of a comparative study of two Polish cities, Krakow and Lublin, in terms of the presence of wild and free-living animals in them, as well as the problems and challenges involved. The topics investigated included biodiversity and synurbisation, as well as residents' perceptions of wild animals, based on a pilot survey. Evidently positive attitudes toward the presence of free-living animals in the housing environment and support for city government policies on animal protection were observed. Based on an analysis of urban structures, the urban conditions conducive to the persistence of wild animals in cities were identified. Urban policies for managing biodiversity and free-living animals were also analysed.

Keywords: biodiversity, synurbisation, animals in the living environment

1. INTRODUCTION

The anthropocentric environment has special features that many plant and animal species can benefit from. Within cities, one encounters farmland, green squares, allotments, home gardens, parks, green spaces, plant nurseries, lawns, avenues etc. Urban and metropolitan environments can provide suitable habitats for some animal species (Strumińska, 2004, p. 170). Biodiversity is a combination of two words, 'biological' and 'diversity'. This term refers to the diversity of life in a particular ecosystem or region. It encompasses all living creatures, from bacteria and plants to animals and humans. Biodiversity plays a key role in ecosystem services, i.e., services provided by nature. Since 2000, the European Union has adopted a number of biodiversity plans and strategies, including the most recent Biodiversity Strategy 2030, which aims to put Europe's biodiversity on the road to recovery by 2030. This strategy, part of the European Green Deal, includes targets and commitments meant to address the main causes of biodiversity loss.[1]

One factor that can affect biodiversity in urban areas is synurbisation, or the 'urbanisation' of plants and animals. This is a narrower concept of synantropisation, i.e., the coexistence of living beings, including humans. This phenomenon is characterised by dynamics: some species may increase their abundance and diversity in urban areas, and there may be a decrease in other species that cannot adapt to living in a changing housing environment. The term was first used in 1978 in a paper by Roman Andrzejewski and colleagues on the ecology of field mice in Warsaw (Andrzejewski, 1978). The result can be a depletion of biodiversity, through the displacement of species by others that are unable to adapt to urban conditions, but there can also be an increase in urban biodiversity through the emergence of new species that can live in this highly specific environment, which can increase 'diversity'. Synurbisation can be both a challenge and an opportunity for biodiversity, depending on how it develops and the extent to which humans are able to manage it, taking care of the balance in the housing environment (Milczarek, 1993, p. 42).

2. AIM AND FOCUS

The aim of this study was to analyse and compare the conditions of wildlife occurrence and life in the cities of Krakow and Lublin in the context of synurbisation and biodiversity, as well as to identify challenges and discuss prospects for the further coexistence of animals and humans. The occurrence of wild animals in cities was analysed in terms of their impact on the human habitat, as

*Elżbieta PRZESMYCKA, DSc PhD Eng. Arch., PhD, Department of Architecture and Fine Arts, Andrzej Frycz Modrzewski Krakow University, https://orcid.org/0000-0003-4190-9811, e-mail: ela.przesmycka@gmail.com

**Natalia PRZESMYCKA, PhD Eng. Arch., Department of Architecture, Urban Planning and Spatial Planning, Faculty of Architecture and Construction, Lublin University of Technology, https://orcid.org/0000-0002-1755-2448, e-mail: n.przesmycka@pollub.pl

***Mara A. CORTÉS LARA, PhD M.A. Arch., Department of Habitat and Urban Development Tlaquepaque, Western Institute of Technology and Higher Education (ITESO), Jalisco, Mexico , https://orcid.org/0000-0003-0971-9671, e-mail: maracortes@iteso.mx

****Dariusz KRONOWSKI, Ph.D. Eng. Arch., Chair of Landscape Architecture, Faculty of Architecture, Cracow University of Technology, https://orcid.org/0000-0002-5510-2122, e-mail: dariusz.kronowski@pk.edu.pl

*****Yaryna POSUNIAK, Ph.D. Eng. Arch., Doctoral School, Lublin University of Technology, https://orcid.org/0009-0005-0969-0161, e-mail: d605@pollub.edu.pl

Copyright: © 2025 Przesmycka, Przesmycka, Cortés Lara, Kronowski, Posuniak. This is an open access article licensed under the Creative Commons Attribution-NonCommercial-NoDerivs License (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Table. 1. Summary of basic data: Krakow, Lublin. On the basis of GUS[20]. Compiled by N. Przesmycka, Y. Posuniak.

Summary of basic data	**Krakow**	**Lublin**
Population	806,201	338,586
Area [km^2]	327	148
Share of green areas in the city area [%] (2022)	11.42	9.55
Green areas (walking and leisure parks, green areas, street greenery) area [ha]	1481.62 – Dynamic – 2015/2021 – 9.2%	821 – Dynamic – 2015/2021 – 7.3%
Share of territory covered by forests	4.3% (1377 ha)	11.1% (1675 ha)
Share of territory covered by nature conservation areas (municipality)	14.54% the Ecological System of Protected Areas – 13,5%	18.65 % the Ecological System of Protected Areas – 25%
Population density per 1 km^2	2,386	2,296
Nature reserves	Panieńskie Skały Skały Przegorzalskie Bielańskie Skałki Skołczanka Bonarka	Stasin (Lublin Municipality)
Protected areas (municipality)	Natura 2000: The Dębnicko-Tyniecki Meadow Area Nowa Huta Meadows Skawiński Meadow Area	Protected Landscape Areas: Ciemięga River Valley, Czerniejowski Protected Landscape Area, Bystrzyca Jakubowicka

well as urban planning solutions, architecture and urban policies that may support or hinder this presence.

This paper analyses the phenomenon of synurbisation, understood as a process in which wild animals adapt to urban life, often using man-made resources, and their presence in urban spaces becomes increasingly natural. The cases under study, in terms of analysing the coexistence of animals in a housing environment, concern two voivodeship capital cities: Lublin and Krakow. Krakow is currently the second-most populous city in Poland, while Lublin, with half the population, is in ninth place. Both cities are characterised by an increase in population density within their urban sections, as well as the development of transport infrastructure and housing development in hitherto non-urbanised areas, which has been noticeable in recent years. Population growth is also observed in neighbouring municipalities, reflecting the dynamic phenomenon of suburbanisation.

The subject of this study are wild and tame (free-living) animals occurring in the environment of human habitation, understood as the urban area in the immediate vicinity of the house or flat, as well as the perception of their presence by city dwellers and the identification of urban processes affecting the phenomena of synurbisation and biodiversity. Among the animal species whose presence is noticeable in the cities investigated, the following stand out: squirrels, wild boar, roe deer, foxes, birds (predatory, pigeons, magpies) and free-living cats. Other species occur sporadically (badgers, beavers, moose). In order to concretise the focus of the research, as well as to obtain preliminary information on the attitudes of the residents of the cities in question towards wildlife found in the housing environment, a pilot survey was conducted. This research aims to provide insight into how tame and wild animals function in cities such as Krakow and Lublin, which differ in terms of urban structure, infrastructure and environmental quality. The research focuses on two main research problems: identifying what urban planning measures contributed to the presence of wild animals in the city, and what urban planning and architectural solutions can support biodiversity in the housing environment. Finally, ecological and social solutions that can improve the quality of life of urban animals, increase their welfare and enable the sustainable development of urban space taking into account biodiversity and synurbisation were proposed.

3. RESEARCH METHODS

To obtain a comprehensive picture of the coexistence of tame and wild animals in the cities studied in the context of synurbisation and the challenges of their adaptation to the urban environment, diverse research methods were used to collect, analyse and interpret data on the presence of animals in urban space.

A literature review was carried out as preliminary research. The survey was preceded by a review of press reports (from the last five years), as well as an analysis of the available reports of the municipal services responsible for implementing policies towards wild and free-living animals. This data made it possible to formulate the research questions. The research methods used for this study were interdisciplinary and included qualitative and quantitative approaches.

A survey questionnaire was designed and distributed online, as an anonymous questionnaire, to a group of more than 200 respondents (people who resided in Krakow and Lublin in different areas in terms of urban morphology). In parallel, an analysis of the spatial structure of both cities was carried out in terms of the occurrence of areas that allowed wild animals to migrate into the city, their habitats and movement zones. This provided a basis for drawing conclusions about the living conditions of free-living and wild animals in urban spaces, and the occurring 'interactions' between animals and humans, in the same space of the habitat environment.

In addition, experts and stakeholders (representatives of local authorities and municipal services) responsible for urban space management, animal protection, animal care regulations and biodiversity protection were interviewed. Available documents and source materials relating to urban policies in the study area were also analysed.

A comparative analysis of the research results obtained in Krakow and Lublin was carried out. On the basis of this, conclusions

were drawn concerning the specifics of animal coexistence in the two cities, the relationship with urban morphology and urban planning solutions, as well as the challenges of animal adaptation to urban conditions, and the prospects for the sustainable development of urban ecosystems including animals.

4. STATE OF RESEARCH

Analysing the bibliographic items on the relationship between animals and the city, several research currents can be identified, depending on the academic discipline represented, and most research is inter- and transdisciplinary. These relationships from the field of urban studies are of interest to cultural scientists, sociologists (Wischermann, Steinbrecher, 2018), geographers, biologists, urban planners and architects alike.

Different approaches are emerging in the study of urbanism and the shaping of the housing environment and the place of animals in its planning and functioning. One of these is the interspecies theory of the city by Jennifer Wolch, who developed an understanding of cities and urban spaces in the context of interactions between humans and other species (Wolch, 1998). Wolch, a professor of urban studies at the University of California, Los Angeles, is one of the pioneers of interspecies research in urbanism. Her theory asks how a city can be designed, managed and perceived in the context of a wide diversity of species – not only humans, but also animals, plants and microorganisms. As Wolch notes, there are strong connections between a given period's prevailing urban planning methods and sign discourses, social movements and the position of animals in culture (subject or object) (Wolch, 2021), all related to the question of who has a 'right' to the city. Wolch has introduced the concept of 'interspecies ethics', which involves issues of equality and justice in the relationship between humans and other organisms. One key element of the interspecies theory of the city is the consideration of sustainability beyond the needs of humans. This means that cities must be designed to protect and support biodiversity and to consider the changing needs of the environment. Wolch points to the need to think of cities as spaces that connect people to nature. The idea is to make cities a place where different species are able to both coexist and influence each other. The city is thus not just a backdrop for human activity, but becomes a space where different forms of life interact. Wolch calls for a reintegration of people with nature and animals, guided so that people can gain information about animals and their needs and functioning. This knowledge could influence the integration of the welfare and animal needs of urban dwellers into the practice of everyday life. Animals' chances of survival in the city mainly depend on the actions of people, as well as the ecology that can influence their presence in the city. It is also important to reduce violence against wild and tame animal inhabitants through legal tools, as well as planning activity with design practice. Another new term, 'zoopolitics' can be evoked here, namely the political status and role of animals in cities and contemporary societies (Lange, 2022).

According to Maria Rosińska and Anna Szydłowska, the 'zoopolis' can become a philosophical and social concept that poses questions about how the city and society can reorganise structures so that they not only accommodate the needs of humans, but also protect and support the lives of other species (Rosińska, Szydłowska, 2017). Cities can be seen as spaces of coexistence between humans and animals, not only in a physical sense, but also in a socio-political sense. Rosińska and Szydłowska highlight how the social status of animals is changing in the context of urbanisation, in which animals, both wild and domestic, have limited living space. In this context, it is important to analyse the potential living spaces dedicated to animals and to improve the institutions that should create decent living conditions for them. The city is an ecosystem that is not a human-only habitat. Zoopolitics suggests that cities should specifically consider biodiversity and incorporate the needs of different species in spatial planning (Gurowska, Rosińska, Szydłowska, 2020). Interesting research findings are included in ***Animals in the City***, where, in the context of interspecies relations, animals are presented as actors with a voice in urban space (Reese, 2021). The right of animals to their place in urban space is also recognised by Marie Carmen Shingne (Shingne, 2022). The treatment of animals as equivalent participants in life in a given environment is now noted (Schneeberger, 2024).

The role of animals has also recently been recognised in a number of so-called Nature-Based Solutions (NBS), i.e., urban support solutions based on natural and ecological processes (Granai et al., 2024). Any urban rehabilitation of decayed areas is practically impossible without the presence of animals. Attention to the presence and role of wild animals in cities was first drawn by researchers from Europe, Australia and North America (Marinelli, 2021) Animals are also seen as part of increasingly popular urban farms providing milk, eggs, honey or even meat (although the latter rather only in developing countries).

Urban biodiversity has also been studied in terms of planning methodology (Bekessy et al., 2012). Apfelbeck et al. list the following characteristics of successful wildlife-sensitive urban design: 1) interdisciplinary design teams that involve ecologists at an early stage, 2) consideration of the entire life cycle of target species, 3) post-settlement monitoring and evaluation with feedback to communicate best practices, and 4) stakeholder involvement and participatory approaches (Apfelbeck et al., 2020). Well-designed and managed cities can create animal-friendly spaces for wildlife (e.g., parks, gardens, ecological corridors) and domesticated animals (e.g., dog parks, cat parks, bird parks, shelters). The needs of humans and animals in cities should be treated equally. The city should be seen as a dynamic ecosystem in which both the human species and other organisms have their place (Gurowska, Rosińska, Szydłowska, 2020). The current legislation on the legal status of animals, especially free-living ones, is a separate issue that also influences the perception of human–animal relations (Spasowska-Czarny, 2021).

The presence of animals in the city is a natural element showing the historical moment and the current state of civilization and culture. Draft animals until the beginning of the 20th century were a permanent part of the urban landscape. Among the 'consequences' of their presence, a specific smell was inherent. This aspect of the urban landscape, using the example of Lublin, is described in Volume 8 of the ***Anthropological Almanac on Interspecies Relations in Urban Spaces*** (Weismann, 2021). Areas of high natural value occurring within the city of Lublin, are of interest to researchers and planners, who have been noting the need for their protection since the second half of the 20th century. These are areas associated with terrain: dry ravines and uplands, as well as river valleys. Lublin's zoning plan of 1959 provides for the protection of the area of the so-called Czechowskie Mountains, and in 1989 a system of Ecological Protected Areas (ESOCh) was established. It is made up of interconnected areas of different nature, which were intended primarily to play a ventilation role (river valleys of the Bystrzyca, the Czechówka, the Czerniejówka, the Zemborzycki Reservoir, Czechowskie Hills, Stary Gaj, city parks).

Unfortunately, the continuity of the system is only apparent, because as a result of the city's development in the last two decades, the cutting through of these zones and the threat of development to protected areas has intensified, as well as the development of buildings outside the city's administrative boundaries, in areas immediately adjacent to the ESOCh area. Particularly agitating public opinion is the urbanization pressure on the area of the Chekhov Mountains, which is home to a number of protected plants and animals, among them their symbol – the European hamster (Boguszewska, Przesmycka 2019). The natural and landscape potential of undeveloped areas of dry valleys, commonly known as gorges, is described in a multi-author academic monograph edited by E. Trzaskowska (Trzaskowska ed., 2014). One of the chapters analysed the role of gullies as migration corridors for animals and the barrier posed by a road that runs through the forested area at Zemborzycki Reservoir (Lubiarz et al., 2014).

A 2021 article featured a discussion on preserving biodiversity in the urban areas of Lublin and Warsaw, noting the need to integrate planning with specialised studies on threats, and also pointed out the presence of particularly problematic invasive species in Lublin (Dudkiewicz et al., 2021). A survey on the perception of the presence of wild animals in one of Lublin's housing estates (Lublin Housing Cooperative) on a sample of 60 people was conducted by researchers from the Catholic University of Lublin in 2015. The survey topics focused on the presence of animals within housing estates, as noted by residents, and the management of the housing cooperative. Of the respondents, 71% stated that animals should be present in housing estates, and noted the negative effects of their presence (80%), listing among them: polluting the space of the estate (33%), appearing in basements and garages (28%), appearing in apartments and 'being parasites' (27%), as well as making unattractive sounds, 'being pests to plants', 'damaging lawns' and others (Lubiarz, Solski, Mackoś-Iwaszko, 2015, 121–123).

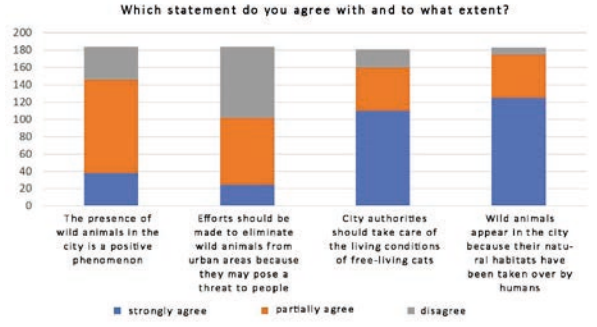
5. URBAN RESIDENTS – HUMAN–ANIMAL RELATIONS

The results of the December 2024 pilot survey show that the majority of respondents had encountered a number of wild or free-living animal species in their places of residence, and there was an apparent acceptance of most animal species found in the cities investigated.[2] The acceptability was determined by questions about the respondents' reactions to statements listedin the survey (Ill. 1).

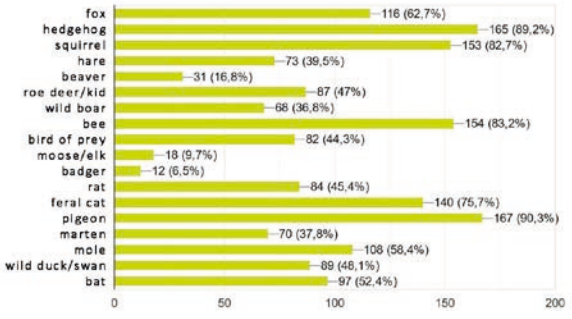
Among the animals encountered in the place where they lived, the following were mentioned: hedgehogs, pigeons, bees, squirrels and free-living cats. Further mentioned were: foxes, moles, bats, wild ducks/swans, deer, birds of prey, rats, hares, wild boars, martens, beavers, moose and badgers.

The respondents were also asked about their feelings about the species they encountered in the city. The species that evoked the greatest affection (feelings of curiosity and joy) were squirrels, hedgehogs, wild birds, deer, hares, free-living cats and bees. Among the species that elicited feelings of fear or uncertainty, respondents the ranked wild boars first (58 out of 68 people who declared an 'encounter'), foxes (4 /116), bees (34/154), moose and rats. Indifference was the feeling that accompanied most encounters with pigeons, moles, cats and bees. Grief and sadness were the feelings least frequently reported by the respondents – among the species listed, it accompanied primarily encounters with free-living cats. Interestingly, most respondents fully agreed with the statement that 'The presence of bees in the urban environment is a positive phenomenon'. City

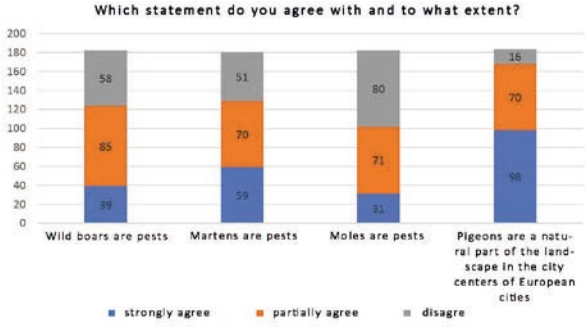
Ill. 1. Response to selected statements. By Authors based on survey results, visualised by Y. Posuniak



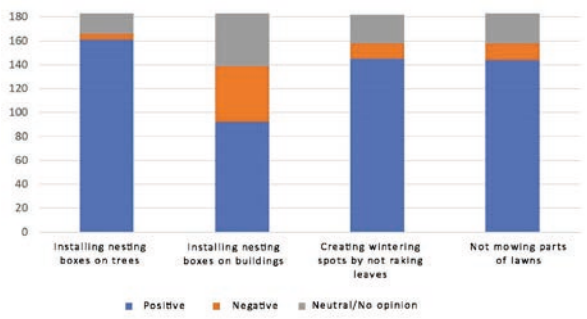
Ill. 2. Species encountered by respondents at their place of residence in the last five years (multiple choice). By the Authors based on survey results, visualised by Y. Posuniak

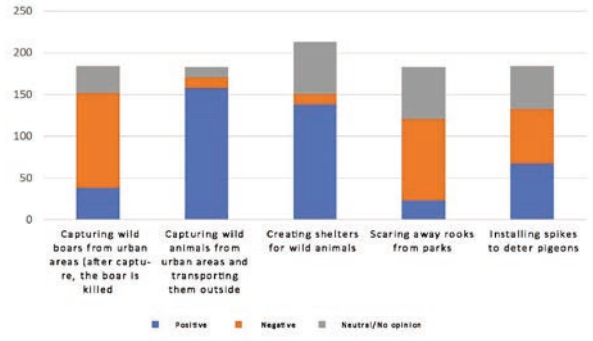


Ill. 5. Attitude to activities in urban space 2. Elaborated by the Authors based on the results of the survey. By the Authors based on the results of the survey, visualised by Y. Posuniak



Ill. 4. Attitudes toward activities in urban space 1. By the Authors based on the results of the survey, visualised by Y. Posuniak





Ill. 3. Perception of selected species as 'pests'. By the Authors based on survey results, visualised by Y. Posuniak

residents were reluctant to agree with categorical statements about the 'harmfulness' of a particular species (Ill. 3), and they were positive about a number of tasks implemented by municipal authorities as part of wildlife policy (Ill. 4). The acceptability of actions such as not mowing lawns, installing nesting boxes or leaving piles of leaves to allow small animals to survive the winter is primarily a testament to the environmental awareness of residents. These measures are also increasingly becoming part of urban infrastructure management policies and sustainable development strategies.[3]

Most of those surveyed had a positive view of animal protection measures, opposing violent methods of removing or deterring animals (for example, trapping wild boars to kill them, as happens in Lublin, or scaring rooks out of parks). The residents' opinions were divided on the most popular methods of 'deterring' pigeons by installing spikes.

Given the pilot nature of the survey, it makes sense to repeat the survey on a larger sample, and expand it to other areas. Nevertheless, the results of the survey presented indicate the seriousness of the problem of the urban synurbisation of wild animals, and how emotional and complex the relationship between humans and other urban residents can be.

6. URBAN STRUCTURE OF THE CITY AND THE POTENTIAL FOR BIODIVERSITY – A COMPARISON OF THE CASES STUDIED

In the cities under study, that formed through historical development and featured a highly transformed natural environment, wild animals have found their way into urban areas both through the inclusion of their habitats in urbanisation processes and as a result of migration processes. Modern cities, despite being the sites of intense human activity, have the potential to become places with high animal biodiversity. Unlike farmland, where management has always been associated with the elimination of biodiversity, in urban spaces we have an opportunity to create a framework for its support. Urbanised areas are inhabited by two main groups of animals: tame ones, which live with humans in a controlled and dependent way (e.g., dogs, cats, domestic birds), and wild ones, which, although increasingly associated with the city, still remain independent (e.g., urban birds, wild boars, squirrels, foxes, amphibians). Insects, which, with the exception of honeybees, should be considered wildlife, are an integral part of the ecosystem.

Modern cities are likely to become increasingly complex ecosystems in which humans not only dominate, but also coexist with a variety of tame and wild animals, as well as insects and amphibians. Krakow and Lublin, two Polish cities with different character and structure, are interesting examples in which to study the aforementioned phenomena.

Lublin

The current scheme of the urban greenery system in the Lublin area can be described as a belt and wedge system. Natural bands are formed by river valleys that connect in the downtown zone and undeveloped areas located in dry valleys. The lack of development was most often due to topographical conditions and the difficulties associated with building on floodplains or steep slopes. It was the construction of the Zemborzycki Reservoir, used for retention and recreation, and the regulation of the Bystrzyca River in the 1970s enabled development to move closer to the rivers and the construction of the already planned important transportation arteries running through their valleys. At the same time, the thoroughfares planned since the second half of the 20th century and the ring road (which was built as late as the 2010s), cut through existing wedges of green areas, which are primarily areas included in the Ecological System of Protected Areas (ESOCh). There are various natural forms in the Lublin area that allow biodiversity to develop: xerothermic grasslands, loess dry valleys, ravines, forests. Currently, 86.1% of the area of ESOCh is developed as arable fields, the remaining 13.9% consists of built-up areas, industrial areas, roads and other areas of non-natural character (Chmielewski et al., 2013; Trzaskowska, Adamiec, 2014), which obviously limits the conditions for biodiversity's development. The improvement the continuity of natural systems in Lublin and also the pedestrian accessibility of the city is the idea behind Green Connections (initiated by Doctor Jan Kamiński of KUL), which was first prepared by the Spatial Culture Forum in 2010 as part of the city's application for the title of European Capital of Culture at that time.[4] The idea, which is related to the ESOCh system, has become so much a part of the city's policy that it was included in the Development Strategy of Lublin 2030. The presence of allotment gardens in the city area is a phenomenon that positively affects biodiversity. In Lublin, the total area of family allotment gardens occupies slightly more than 3% (Przesmycka, Strojny, 2018). The popularity of gardens increased significantly during the pandemic period, at which time the profile of their users changed. As in other Polish cities, in Lublin the development of the idea of allotment gardens and the allotment movement took place in the interwar period, and then developed during the communist period (Netczuk, 2015). Urbanization pressure is now a major threat to allotment gardens, and between 2000 and 2017, nationally, their area decreased by 3,400 ha, or 8% (Lewandowski, 2019, 84), but in the case of Lublin there is a chance to increase this area. A consultation on the establishment of community gardens was held in the spring of 2024. Lublin's varied topography promotes a diversity of land cover, both urban and natural. The highest point within the administrative boundaries: 233.7 m above sea level, the lowest in the bottom of the valley of the Bystrzyca River 162.5 m above sea level. A total of 84 ravines and dry valleys have been identified within the city (Information on the development of methods of natural assessment and how to proceed in the implementation of individual and other investments in the area of valleys and ravines of the city of Lublin. Office of the City of Lublin, 2012), a dozen of them in forest areas. Dry Valleys occurring in the city are mostly developed by infrastructural facilities – e.g., Głęboka Street. Only a few serve as open areas of public greenery (e.g., the ravines in Czuby, Jana Pawła II Park or in Kalinowszczyzna. These areas were natural animal migration trails. The gullies



Ill. 6. The layout of green areas in Lublin with marking of observed wildlife species in the last five years. Original work based on Municipal Police data, press reports and observations, visualised by Y. Posuniak

found in the Dąbrowa forest, which are natural migration routes for small animals towards the Zemborzycki Lagoon, are crossed by roadways, while underpasses for amphibians are frequently obstructed (Lubiarz et al., 2014). Areas of Lublin that are naturally valuable are associated with the presence of wildlife that inhabited them before the city's development. In the case of Lublin, the most characteristic example is the Chekhov Hills (European hamster, wild boar, roe deer, insects) (Balana et al., 2004), or river valleys (beavers, fish, birds).

The construction in 2015 of new sections of the S17 route in the northern and eastern parts of Lublin, closing green suburban areas in its course, significantly changed the migration opportunities of animals living in suburban areas. Since then, species such as wild boar, roe deer and elk have become more frequent in the city. Among the most common technical solutions to improve animal migration and movement are underpasses made along expressways. These places can also be great control elements for observing animal behaviour. Due to the small size of these underpasses on the Lublin bypass, animals have to get used to them; unfortunately, their location is not always accurate, and in the case of one of the underpasses, as Kowal and Karaś note, the structure has probably become an interesting amenity for members of the hunting club in the area, as a shooting pulpit has been erected 150 m north of the structure (Kowal, Karaś, 2016).

Krakow

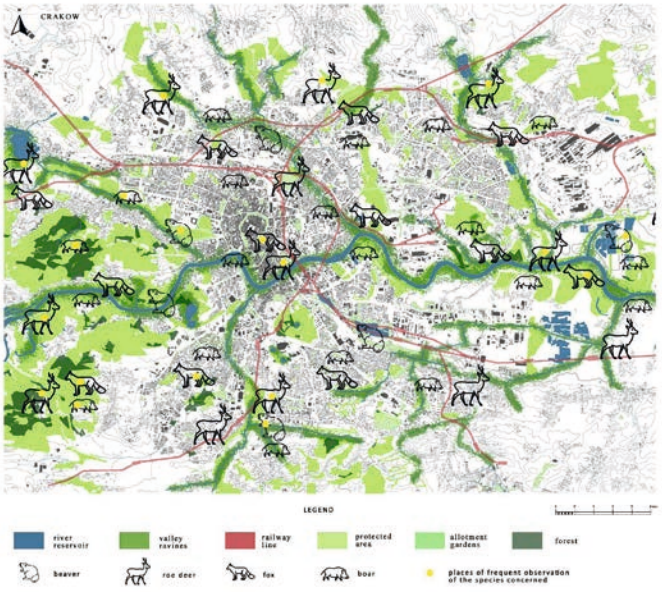
Research by the Chair of Landscape Architecture, commissioned by the Krakow City Council in 1996–1997, became an opportunity to formulate a new system of public greenery, and then introduce it into the draft Spatial Development Conditions and Directions Study.[5] The guiding idea in it was to use the city's hydrographic system as a canvas for a system of green areas, called river parks. In the case of Krakow, four elements spoke in favour of this proposal: the scale and shape of the city's territory and the structure of its neighbourhoods, the possibility of linking river parks with the system of legally protected landscape areas surrounding the city, the existing land reserves along the Vistula and its tributaries within the city limits, the chance to build river parks in conjunction with flood control investments, economic activation and passenger shipping. Krakow had a concentric-radial green system until 1951; after the annexation of areas on the eastern side of the city, due to the construction of Nowa Huta, the near-circular shape transformed into an irregular patch (Böhm, 2001, p. 19), stretching along the Vistula River. As a result, the area of urban investment increased, as well as the requirements for balancing it by expanding green areas. In this context, the canvass of the green system cannot be the development of a radial-concentric composition, as the city enters into closer proximity or encroaches on the surrounding protected landscape zones. An indispensable link between the nature surrounding the city and its urban ecological zones, the so-called eco-zones, is the water network. In the case of Krakow, it is unique in that the zones cover all districts without exception, providing each of them with access to riverside greenery (Böhm, 2001, p. 20). The backbone of Krakow's hydrographic system is the Vistula River. To the north it is fed by the Rudawa, the Prądnik, the Dłubianka and the Kościelicki Creek, and to the south by the Wilga and the Drwina with the Serafa. From the west, the Vistula flows into the territory of the city through the Jurassic Landscape Park Complex with the dominant Wolski Forest complex. Moving along the course of the Vistula Park, we pass the monasteries in Tyniec and Bielany, the complex of residences in Przegorzały, Salwator, the Kościuszko Mound, the Norbertine Monastery, Wawel, the panorama of the Old Town and Kazimierz, Skałka, St Benedict's Hill with a fort, the Krakus Mound, the monastery in Mogiła, and the meadows of Nowa Huta. Just beyond the city limits, the Vistula flows into the Niepołomice Forest. The area of the Vistula landscape parks is complemented by the river parks of the tributaries. Rudawa Park runs along Błonia and Bielańsko-Tyniecki Landscape Park. Prądnik Park leads to the Krakow Valleys and further to Ojców National Park. Dłubnia Park leads to Dłubiański National Park, while Kościelicki Creek leads to the Kościelnik Palace Complex (Szczerbak, 2013, p. 105). The southern basin is the Wilga Park adjacent to a complex of ponds among the limestone rocks of Zakrzówek. A less attractive area is the surroundings of the Drwina and Serafina, but in this location, once the industrial area is transformed into a modern district, parks connecting the Vistula River with the Bagry pond complex can be expected.

A condition for ensuring the sustainability of river parks, as foregrounds of landscape parks, is to give them statutory forms of protection, on the basis of natural and landscape complexes.[6] Land reserves along the Vistula River and its tributaries, allowing for the development of river parks, are the result of provisions in Krakow's land use plans. The plans protect waterside areas from development, allocating them for greenery and the habitat of wild birds and animals such as beavers, wild boars, roe deer, and small insects. Such areas have always been wetlands or flood-prone areas, so they are not suitable for development, so they can be designated as small nature reserves in cities. Transforming these areas into river parks has a double benefit. The first – natural conditions make these areas cheap to buy and develop, the second – the linear structure of river parks is subordinated to riverbeds, creates natural conditions for the development of flora and fauna, as well as wildlife corridors, connecting the city

with the surrounding open landscape (Radziejowski, 2011). The activation of the banks of Krakow's river parks has been a problem for years, due to an underdeveloped flood protection system, the occupation of these areas by unwanted or temporary uses. As in the case of Lublin, new sections of the S7 route, Krakow's northern bypass, have also closed off suburban areas, making it difficult for animals who live in this location to migrate. In the Zielonki area, you can see herds of wild boars that have no way to cross to the other side of the ring road and stop in the fields here, becoming, as in the case of Lublin, a convenience for members of hunting clubs, as several pulpits and artificially formed trapping areas have welcomed them in this area. In Krakow, foxes, as well as the aforementioned wild boars, are increasingly appearing in the city centre. Beavers have appeared in the Rudawa and Młynówka Królewska areas, as well as recently in Prądnik Biały River Park. Unfortunately, no wildlife crossings have been designed over the ring road, and the underpasses are unnoticeable, and can also provide, as in Lublin, excellent locations for wildlife observation. These facilities include culverts, crossings, flyovers and green bridges. The construction of such solutions is a method of minimising the negative impact of roads on wildlife. However, the high ecological significance and high costs cause numerous complications, hence decisions on construction and location are preceded by complex procedures (Lachowicz, Podhorecki, 2012, p. 74).

In the cases of the two cities studied, the development of urban development, in the context of the presence of animals, can be divided into several stages:

- Stage 1 – the development of cities from the early Middle Ages to the mid-19th century. The existing river valleys, despite their importance in the economy of cities and transportation, are natural ecological corridors. Development develops concentrically and in strips, agricultural land borders urban land.
- Stage 2 – mid-19th century – 1918
- Developing industry, military assumptions (the Krakow Fortress as a reservoir of greenery), technical possibilities enabling land reclamation, land drainage and expansion of development into areas previously unsuitable for these purposes. Establishment of public parks, promenades and green areas, industrialisation of slaughterhouses, establishment of an animal park (Krakow).
- Stage 3 – 1918–1945 – development of new housing estates including single-family housing, urban planning in accordance with the concepts of 'great cities' and 'garden cities' and functional zoning, establishment of a zoo (Krakow), road and bridge investments, gradual approximation of development to river channels in their valleys.
- Stage 4 – 1945–1989 – intensive development of multi-family housing estates and industrial assumptions (Krakow – Nowa Huta, Lublin – Ursus-Zadębie), delineation and construction of new transportation routes in river valleys, land reclamation and regulation of rivers, implementation of retention and recreation reservoirs.
- Stage 5 – 1989–2008 – collapse of industry, less residential projects, beginning of suburbanisation.
- Stage 5 – 2008 – until today – road infrastructure projects including expressways and bypasses, development of settlements and developer investments, transformation of post-industrial zones into economic zones, recognition of the dangers of sprawl and built-up zones, reduction of green space in built-up areas, overdevelopment in downtown zones.



Ill. 7. Map of river park protection zones of the City of Krakow with marked locations of wildlife. On the basis of, BIP of the City of Krakow – Planned municipal investments in the field of greenery, as well as an interview among residents of Krakow and information obtained at the City Hall. By D. Kronowski and Y. Posuniak

The above stages are associated with the gradual reduction of existing enclaves of wildlife in the city, but only large-scale infrastructure investments in expressways in the last decade, caused the phenomenon of 'closing' animals inside urban systems. At the same time, the change in the farming system, cultural landscape and the functioning of suburban areas, has caused a complex process of adaptation of some species to new living conditions.

7. CITY POLICIES TOWARDS WILD AND FREE-LIVING ANIMALS – A COMPARISON

Krakow

Wild animals such as squirrels, boars, foxes, pigeons, and magpies have found their place in cities over the years. In Krakow, with its extensive Old Town, numerous parks, and gardens, wild animals enjoy a rich ecosystem. However, they face challenges such as heavy traffic, noise pollution, and environmental contamination. Interactions with humans also pose issues; in cities like Krakow, wild animals are sometimes seen as nuisances-especially boars, which can damage urban gardens and attract attention at night.

The Municipal Greenery Authority (Zarząd Zieleni Miejskiej) plays a central role in shaping and implementing policies concerning wild animals in Krakow.[7]

Krakow is witnessing an increasing number of animal species adapting to life near humans and urban infrastructure. Synurbisation refers to the presence of wild animals in urban spaces, such as boars, foxes, squirrels, and birds (e.g., pigeons, sparrows). Urbanisation has also led to behavioral and developmental changes in these species—for example, foxes exploiting urban trash bins and inhabiting closed spaces like Krakow University of Technology's campus, or pigeons nesting in buildings. The fox population in central Krakow is estimated at 700 individuals, according to the Krakow City Office.[8]

Conflicts between humans and wild animals are also common in urban areas, including traffic collisions, property damage, and environmental contamination caused by animals. Urban interventions often involve population control – such as managing Krakow's wild boar population, estimated at 1,500 – or relocating birds to other areas.

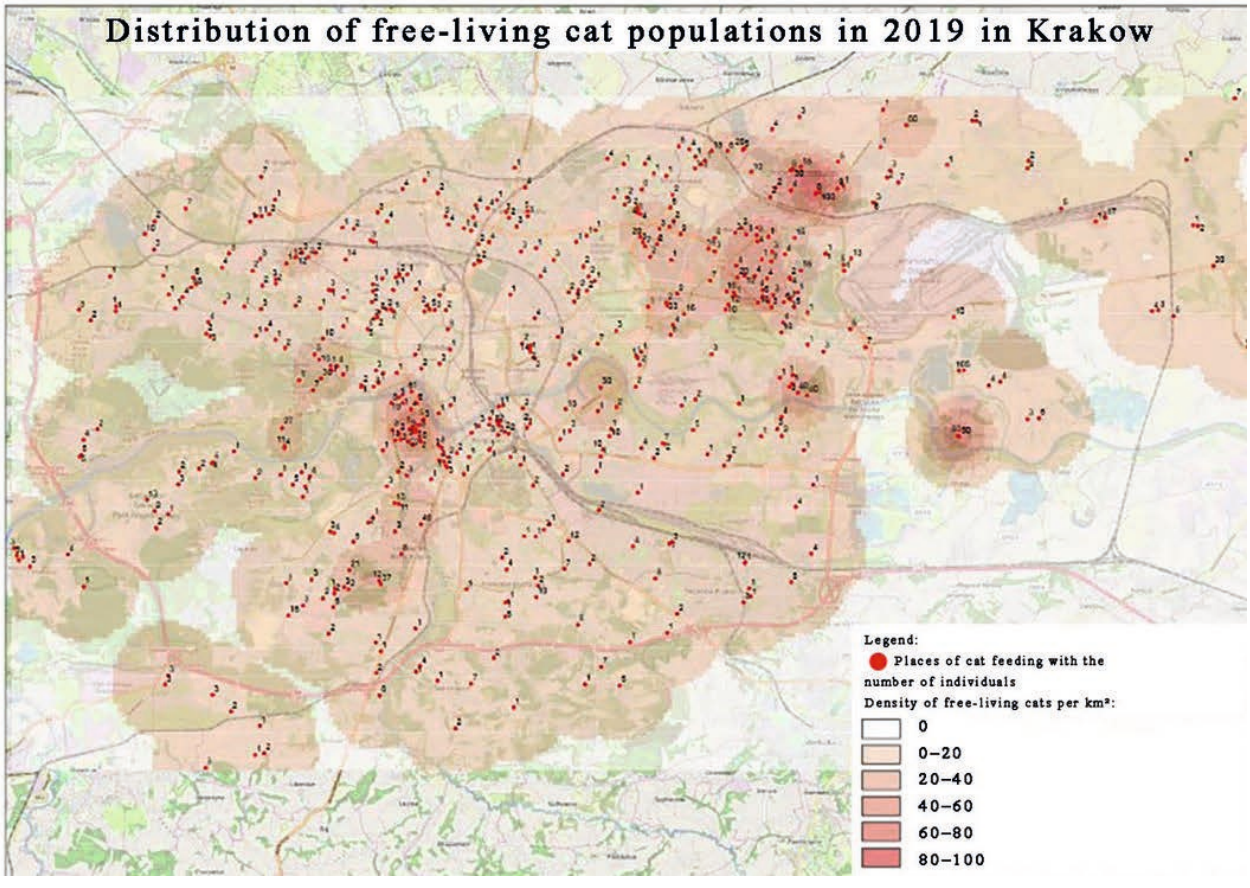
Krakow's geographical structure, with the Vistula River, green spaces, parks, and forests, fosters biodiversity not only in central areas but also on the outskirts and along ecological corridors. However, the presence of wild animals in the city has negative consequences for the animals themselves, humans, and the urban environment. The main issues occurring in Krakow include an increased risk of traffic accidents. Wild animals such as deer, boars, foxes, and squirrels often enter roads, raising the likelihood of collisions with vehicles. In recent times, animal carcasses on city streets have become a common sight. These accidents result in human injuries, vehicle damage, and animal fatalities.

Animals can also carry various parasitic diseases that are transmissible to humans. Another significant and increasingly frequent problem is property damage, especially caused by rodents (e.g., rats, mice, and martens). These small creatures can cause extensive damage to building facades, insulation, and the structure of roofs, walls, ceilings, and plumbing systems. In Krakow's Old Town, it is common to see rats emerging from sewers or other infrastructure. They also consume plants that are part of urban gardens and parks.

An important component of Krakow's biodiversity is its population of cats, which also assist the city in controlling rodents such as rats. This is especially critical as the population of free-roaming cats decreases, leading to an increase in the number of rats and mice in the city (Pietrzykowski, 2016, p. 191). According to information obtained from the Krakow City Office, Department of Nature, Agriculture, Forestry, and Animals (WS-07),[9] research on the population of free-roaming cats has been ongoing since 2019. To conduct the analysis, the Krakow City Office designated six enumerators who engage in numerous interviews with residents and perform calculations to estimate the number of feral cats in the urban environment. An analysis of the recorded cat population in 2019 reveals a noticeable correlation between free-roaming cats and older urban housing complexes.[10] In the old parts of Nowa Huta, Podgórze, Zwierzyniec, and Dębniki, there are approximately 2,500 free-roaming cats. Research results confirm that the population of these animals is decreasing despite the involvement of residents, non-governmental organisations, and municipal efforts. This is the first large-scale study based on an environmental survey conducted among Krakow residents across the entire city.

The census determined that Krakow is home to 2,416 free-roaming cats, with an estimated population ranging between 2,000 and 3,000 individuals. An additional 410 cats were counted in areas such as Nowa Huta, Wzgórza Krzesławickie, Dębniki, and Podgórze, as well as in agricultural and peripheral areas of the city, including Przewóz, Swoszowice, Tyniec, and Wola Justowska. In Bronowice Stare, the cat population was assessed as residual and declining, and a similar situation exists in areas like Prokocim-Bieżanów, Kurdwanów, Piaski, and the very centre of Krakow. This decline is likely due to the construction of new residential estates that lack feeding spots and are tightly fenced, increased noise levels, the redevelopment of attics and lofts, the demolition of wooden buildings, and the conversion of basements into residential spaces. Another factor contributing to the decrease is the sterilisation programmes conducted by the City Office in collaboration with social organisations caring for animals and Krakow's animal shelters. Additionally,

Ill. 8. Density of free-living cats per km² in the area of Krakow. Elaboration based on GIS spatial data from the Krakow City Office, Department of Nature, Agriculture, Forestry, and Animals. By D. Kronowski



debilitating diseases such as feline leukaemia, mange, feline herpesvirus, and FIV (Kita, Frymus, 2004, p. 53) play a role. Residents also frequently capture these animals and take them to shelters, believing this will ensure their adoption. However, this is not entirely true in the case of feral cats. While the adoption of well-socialised ***Felis catus*** is straightforward, feral cats pose challenges. They are too wild to be safely integrated into human families, leading to overcrowding in shelters and a decline in their welfare (Levy, Crawford, 2004, p. 1354).

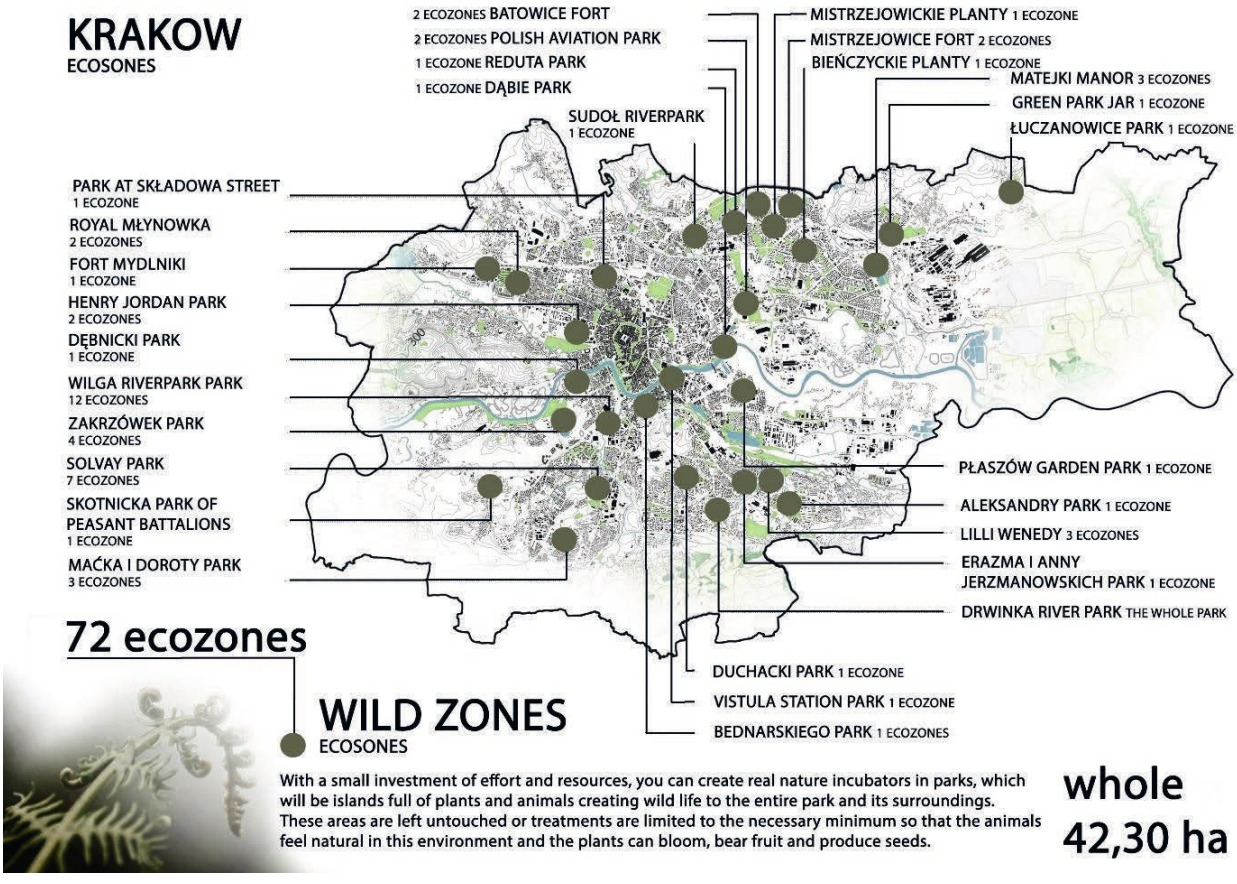
The conducted studies indicate that a high concentration of cats is observed in locations where the animals are regularly fed, including in community garden areas where special protective shelters with feeding stations have been set up for the cats. The research results have enabled a more effective allocation of funds within the annual 'Programme for the Care of Homeless Animals and Prevention of Animal Homelessness' specifically targeting free-living cats. Under this program, the city finances cat feeding, as well as sterilisation and castration procedures, vaccinations, the purchase of antiparasitic treatments, and insulated shelters to help the cats survive the winter.

Ongoing research on free-living cats also allows the results to be used to combat rodent populations in the city. Domestication of the cat, which is a solitary species, is considered a peculiar form of commensalism, from which two species derive mutual benefits, e.g., pest control in exchange for shelter or food provided to the cat by humans, without the need to create strong personal bonds (Kamieniak, Mazurkiewicz, Tietze, 2016, p. 96). The presence of feral cats, in addition to the damage they cause, can have positive effects, and this is related to the fact that ***Felis catus*** victims are also considered pests in the housing environment. Thus, cats suppress their occurrence (Kamieniak, Mazurkiewicz, Tietze, 2016, p. 98). Drawing up a map on which to note places where residents report large numbers of rats is currently considered. A large number of predators limits the occurrence of rats, and thus limits the damage they cause. This map can be compared with the one showing the cat population, which will determine the a given area's free-roaming cat population on its rodent population. This can significantly impact comfort in the housing environment, so it should be concluded that the cat population is a positive aspect of preserving biodiversity in the city. Cats are a species capable of functioning independently in many natural ecosystems. Adequate control of feral or stray cat populations can directly or indirectly contribute to maintaining a greater degree of biodiversity in urban systems (Sims, Evans, Newson, et al., 2008, p. 392).

A shift to a positive attitude towards the presence of wild and free-living animals in the city has been observed in the policy of the city of Krakow in recent years. One example of specific tasks is the creation of so-called Ecospheres, located in selected green spaces, as well as the adaptation of buildings (bird and insect houses), development of spaces for the needs of animals, or insects (such as insect hotels and apiaries).

The Municipal Greenery Authority promotes the creation of Eco-zones in Krakow, also called natural zones, which are green enclaves left in parks to maintain the enhancement of biodiversity.[11] These areas play an important role in maintaining biodiversity and ensuring ecological balance. These are areas where natural diversity is likely to occur, providing places of life and reproduction

Ill. 9. Eco-zones of Krakow. Compilation based on GIS spatial data from the Office of the City of Krakow, Department of Nature, Agriculture, Forestry and Animals. By D. Kronowski



for many species of plants, animals, birds, insects and microorganisms. Eco-zones of Krakow are carefully selected areas where the city minimises interference with nature – leaves are not collected, lawns are not mowed, lying wood and branches are left in place. Thus, humans support the preservation of valuable natural habitats that serve hedgehogs, squirrels, pollinating insects, amphibians and birds, among others. Such green zones, depending on their characteristics, are referred to as eco-zones (wild zones) or biocenotic zones (Ozimkowska, Wojtatowicz, 2020, p. 124). Krakow also has a number of eco-zones, including the Bagry Reservoir, which is a remnant of an old gravel pit, between Lipska and Wielicka streets, in the area of Płaszów, in District XIII Podgórze. It is one of the largest bodies of water within the borders of Krakow.[12] Eco-zones in Krakow are a key element in creating sustainable urban development, due to the city's unique geographic structure, the presence of numerous green areas, parks, water and forest areas. Such spaces not only play an important role in the area of environmental protection, but also have societal and health-related significance, providing residents with access to nature, as well as supporting air purification and climate regulation. In the context of intensive urbanisation, taking care of eco-zones has become a priority in the city's urban planning, which has to face the challenges of protecting the environment and adapting space to the needs of the growing population.

Lublin

Municipal governments are responsible for implementing the policy towards homeless and wild animals. In Lublin, this problem is regulated on a yearly basis by the city council's resolution Programme of care for homeless animals and prevention of animal homelessness in the City of Lublin.[13] It defines the rules for dealing with animal homelessness, traffic accidents involving wild animals and free-living cats, as well as the funds allocated annually for selected purposes.

The presence of animals in the city is one of its policies: In addition to human-owned animals, a large number of free-living cats exist in our city, performing an important task in reducing the number of rodents. The city is home to wild animals associated with park areas (squirrels, wild birds, bats, reptiles and amphibians) or forest natives migrating to the city (foxes, deer, deer, wild boars, raccoons).[14] Cats native to the Lublin area are cared for by their social caretakers, who receive support from the city hall. Free-living cats (about 2,000) are not trapped but fed and sterilised, and individual housing cooperatives can submit requests for their location. Currently, the cat houses are located in the areas of housing cooperatives, and their distribution across the city is relatively 'even', excluding neighbourhoods built after 2000 and single-family house districts.

In order to protect biodiversity in the Lublin area, support native species of birds, pollinating insects and small animals, the 'Let's help wild animals' project is being implemented. The aim of the project is to create new habitats and nesting places for animals, as well as to promote proper attitudes toward birds, bees, hedgehogs, and to build awareness among residents about proper handling of animals. At the same time, Lublin organises numerous educational actions, e.g., 'Here sleeps a hedgehog', limiting lawn mowing, and, for the past four years, a spring action to move migrating frogs across the roadways at Janowska and Lipska streets (Niećko, 2024). Beginning in 2021, road signs announcing the presence of hedgehogs appeared on selected streets (reported by residents) (Jurkowski, 2021).

Wild animals in Lublin are captured in accordance with the city's policy, based on reports from residents to services such as the police or municipal police. The unit in charge of capturing animals is Eko-Patrol. When injured or dead wild animals are found, animals are helped under contracts signed annually with selected veterinary clinics. Reports of live animals (foxes, roe deer, elk, etc.) in good condition usually result in trapping with relocation to nearby forests. Animals usually end up in the Kozłowice Forest and the area around the Zemborzycki Reservoir.[15] As of 2020, the city has nine trapping stations, used primarily for the elimination of wild boars. Wild boars, spotted primarily in allotment gardens, are caught in cages – trapping stations – and then pharmacologically euthanised.[16] The total cost incurred by the city for trapping (147 wild boars and 1 roe deer) in 2020–2023 was PLN 164,119.45 (USD 40,908.16). In January 2024, the wild boar population was estimated at around 300 in the Lublin area.[17]

A peregrine falcon nest maintained on the smokestack of the city's thermal power plant is a national-scale curiosity. The first falcon appeared in 2015, and after consultation with the Lublin Ornithological Society, the falcon nest was installed on the

Tab. 2. Comparison of the number of incidents reported to the Municipal Police in Lublin from 2018 to 2023. By N. Przesmycka based on Reports on the activities of the City Guard.

	2023	2022	2021	2020	2019	2018
reports on wild animals	193	557 foxes, wild boars, deer, elk	446 foxes and wild boars, roe deer, elks	495 foxes and wild boars, roe deer elks	308 foxes, wild boars. deer, martens, bats, birds, snakes, hedgehogs, ferrets, beavers, squirrels	302 Including 123 foxes 56 wild boars, others: roe deer, martens, bats, birds, snakes, hedgehogs, ferrets, beavers, squirrels
reports on hurt wild animals	606	308	298	249	260	232
reports on dead wild animals	428	361	472	365	338	368
Total number of reports	1227	1226	1216	1109	906	902
Wildlife trapping	20 (birds, hedgehogs, bats) 58 wild boars	26 (birds, hedgehogs, foxes, snakes) 26 wild boars, 1 roe deer	30 (birds, hedgehogs, foxes, snakes) 54 wild boars	49 (no data available on species) 10 wild boars	287 (no data available on species)	210 (hedgehogs, foxes, snakes, beaver)

smokestack in March 2016. The birds can be observed live thanks to an edited camera, which reveals how many problems these rare birds face in the urban area. Interestingly, the biggest threat to Lublin's falcons is... pigeon enthusiasts, who have contributed to the death of several birds by planting poison.

In Lublin, the presence of large wild animals is sometimes noticeable even in the city centre. Frequent encounters occur with foxes, martens and small animals, but since 2016 moose have begun to be observed in the city.[18] The 'Bystrzyca Jakubowicka' Natura 2000 site adjacent to the city is one of their habitat areas. In May 2017, three moose appeared in the area of the inner city (Probostwo Street, Czwartek and Saski Garden). Two of the animals were in such severe condition that they did not survive the capture attempt, one managed to be taken outside the city. The presence of elk is also a problem in the southern part of the city, where there have been several traffic collisions in recent years.

Since 2020, beavers have been regularly observed in river valleys: on the Czerniejówka River in the area of the Kosminek district, where they built a dam. In subsequent years, the animals made their home in the city centre, along Solidarności Avenue on the Czechówka River (where they began to cut down stately trees), as well as in the valley of the Bystrzyca River. The most important place for wildlife within the administrative boundaries of Lublin is the Zemborzycki Reservoir – a recreational reservoir built in 1976. It is a habitat for numerous birds; ducks, geese, ospreys, grebes, white and grey herons, rare species of gulls and terns, as well as numerous species of fish and mammals have been observed.

Interactions of Lubliners with wild animals are becoming more frequent, as evidenced by an analysis of data on incidents reported to the Lublin City Guard in 2018–2023 (Tab. 2). Based on the annual reports, it can be seen that there is an increasing number of reports of injured and dead animals found (twice as many in 2023 as in 2022), as well as reports of wild animals. In recent years, the number of trapped animals has declined, which can be linked to numerous educational campaigns for proper behaviour in case of an encounter with a wild animal.

The designation of natural zones in Lublin (on the model of Krakow's Eco-zones) is closely related to the work of the academic community, which identifies particularly valuable resources, and the need for inclusion in systemic protection. One of them are picturesque areas 'where the landscape in the city becomes close to the landscapes typical of natural areas'.[19] Researchers from the Catholic University of Lublin involved in their study write about their importance for the city landscape, aesthetic and cognitive values, along with a detailed description of the natural resource (Madej et al., 2014; Koszańska et al., 2014). The so-called Czechowskie Hills – an area of a former military training ground, where a naturalistic park was planned in the 1950s, now threatened by strong urbanisation pressure (Boguszewska, Przesmycka, 2019), is particularly valuable in terms of its fauna. It is home to a herd of roe deer, the region's most abundant population of the European hamster, prairie butterflies and redwing butterflies, and birds such as the quail and barred owl. At present, the situation of the area is still uncertain, and the project owner, after the construction of a small part of the park, is demanding to allow the construction of a residential complex on the basis of an Integrated Project Plan.

Changes in the biodiversity of Krakow and Lublin are dynamic and have been going on for several decades, but their intensification has largely been the result of modern urbanisation, especially after the 1990s, when the city began to intensively develop its infrastructure and changes in the landscape became increasingly visible. In the case of Lublin, the changing approach to natural issues can be combined with the increasing grassroots activity of initiatives related to the shaping of public spaces (NGOs) and the growing environmental awareness of residents, expressed, for example, in the huge interest in projects implemented as part of the Green Civic Budget, which in 2016 was the first initiative of its kind in Poland. Summarising the issue of shaping urban policy on animals, the following periods can be distinguished for both cities:

- 1990–2000 – higher numbers of urban animals are first observed as a result of urban development and the possibility of finding places for wildlife to live in some parts of the city;
- 2000–2010 – further development of urban infrastructure, densification of development in suburban areas;
- 2010–2020 – intensification of the process, a noticeable increase in the population of animals such as wild boars, foxes, and urban birds. Cities begin to implement programmes to manage wildlife populations and establish dedicated services;
- 2020–2024 – Today, biodiversity is widely studied and is becoming an element of interest for city authorities, animal population management operations are becoming a topic in urban planning. Initiatives are also emerging to harmonise the coexistence of humans and animals in the urban environment.

8. DISCUSSION

Sustaining and enhancing biodiversity in the city is primarily influenced by planning decisions. Only within their framework, further actions can either support or reduce it. Jennifer Wolch's interspecies theory of the city, mentioned earlier, represents an important step toward more sustainable and eco-friendly cities in which humans and other species coexist on equal terms. In the context of urban planning, the theory has the potential to change the way we think about cities, introducing new approaches to public spaces, sustainability and urban ecosystem management (Wolch, 2021). Urban wastelands are also an important potential for building urban biodiversity, and should be treated as areas susceptible to nature succession (Jakubowski, 2020).

They are designated areas within cities that aim to preserve specific types of ecosystems, such as xerothermic meadows and thickets, fresh meadows, variegated meadows and fragments of lawns that can be converted into meadows due to their biodiversity. These areas are subject to limited mowing – usually once or twice a year, with mowing dates agreed in detail with contractors and depending on the phenological cycle of the vegetation and its specific characteristics. The number and location of biocenotic zones and eco-zones are not fixed, but may change depending on their ecological potential. Therefore, it is possible to both change their distribution and increase the number of these zones in response to changing conditions.

The creation of eco-zones initiated in Krakow – spaces where natural processes take place naturally and man only minimises his interference is worthy of emulation by other city governments. Supporting biodiversity in urban areas requires not only actions at the level of urban policy but also education and a shift in residents' attitudes toward what is wild and natural. Processes such as the formation of tree hollows or the decomposition of wood can take many years, creating living conditions for various groups of organisms. Some of these organisms appear immediately, while others will have to wait for the appropriate conditions to develop. Unfortunately, this often conflicts with the widespread preference for tidiness and the practice of 'maintaining' green spaces. Many wild animals quickly adapt to wild enclaves or dead trees left for them. Over time, more demanding

species, such as owls, woodpeckers, or rare insects associated with deadwood, may also appear in these zones.

When creating eco-zones, it is essential that their structure is as diverse as possible since the greater the variety of 'housing options', the more species will benefit from these spaces. Designing nature zones helps protect specific microhabitats that are critical to the survival of many species. These microhabitats may be inconspicuous, yet their importance is immense. Examples include bark cracks, broken branches, decaying trunks, tree cavities, bracket fungi, or dense shrub zones. The mosaic of these different micro-environments is particularly significant in the context of biodiversity conservation, especially in cities where space is limited and must be utilised optimally. In addition to natural shelters, Krakow ensures that eco-zones are equipped with artificial structures such as insect hotels, bird, squirrel, and bat nesting boxes, feeders, and water troughs. Even with a small plot of land in the city, biodiversity can be supported by providing microhabitats. Flowering plants attract pollinators, while a pile of leaves can serve as a winter shelter for a hedgehog. It is also worth providing water troughs for animals, even at the level of individual residents, who thus become co-creators of habitats and participate with the city in their functioning. The appreciation of qualities such as wildness and naturalness as well as the minimisation of interference in the natural landscape and thus the creation of eco-zones also in areas of historic parks and gardens is also a noticeable trend (Zachariasz, 2022, p. 310).

Examples from many European cities demonstrate how effectively urban spaces can be designed with animals in mind, serving as inspiration for shaping urban plans in Polish cities, including Krakow and Lublin. In Berlin, numerous projects have been implemented where animals are provided with space not only in parks but also in dedicated wildlife rehabilitation centres, similar to those currently planned in Krakow. Copenhagen has created so-called 'green corridors' which allow wild animals to migrate through the city and ensure their safety and natural behaviours. Unfortunately, such corridors are almost entirely neglected in Polish cities, where the focus is instead on capturing wild animals that lack the ability to migrate and remain confined to the same areas due to the construction of bypasses, highways, or the replacement of previously planned 'green corridors' with residential buildings or other urban infrastructure.

Other interesting solutions include artificial ponds and water bodies inhabited by animals and waterfowl. For instance, in London, herons and cormorants nest near urban ponds, particularly in Richmond Park, which is not only home to birds but also deer and roe deer. Richmond Park, despite being close to the city centre, teems with wildlife. Similarly, Stockholm serves as an example of a city that develops dog-friendly spaces, including gardens for free roaming as well as urban zones specifically designed for pets.

In the context of the dynamic development of the studied cities, both positive and negative effects of synurbisation are noticeable, which may impact urban functioning and the quality of life for residents. Analysing these phenomena, their causes, and their effects has become a significant research topic that can contribute to a better understanding of the interactions between wild animals and the urban environment. Other solutions that can be implemented in urban environments include forest parks with diverse landscapes and terrain models, which can be established between residential neighbourhoods if they are sufficiently spaced apart. Where feasible, environments combining land and water can be created, serving as refuges for hydrophilic plants and animals. Parks and streets should be planted with shrubs and trees that provide food for birds and small mammals. Currently, their absence is particularly noticeable in the centres of large cities, which makes it difficult for birds, for example, to build nests, as streets are often lined with unsuitable tree species. Suitable tree species include hawthorn, Cornelian cherry dogwood, rowan, barberry, elderberry, yew, dogwoods, wild roses, viburnum, blackberry, and chokeberry. For planting along wide streets, species such as the Norway maple, red horse-chestnut, red oak, small-leaved lime, and London plane are appropriate. For narrower streets, suitable choices include the field maple, red maple, Japanese cherry, hawthorn, and common ash (Bocheński et al., 2013, pp. 106–107).

9. CONCLUSIONS

The coexistence of domesticated and wild animals in cities presents a range of challenges that require appropriate political, ecological, and societal solutions. In the cities under study, where animal life occurs in close proximity to humans, it is essential to implement measures aimed at protecting animal welfare and providing suitable living conditions for animals. The starting point for urban policy in this area should be expert studies as well as social and educational campaigns that promote proper attitudes. The survey presented highlights the need for such research to be carried out periodically and on a broader scale to monitor the attitudes and behaviours of city residents and to identify their needs.

The urban environment is a challenging habitat for animals, filled with noise, pollution, artificial lighting, and a lack of natural shelters. Animals may experience chronic stress, leading to reduced immunity and high mortality rates. They can feel threatened in the presence of humans, which may result in defensive or aggressive behaviours, particularly when there are limited hiding spaces in cities. Moreover, animals may cause fear or uncertainty among residents, especially in the case of larger species (e.g., wild boars, deer). Many wild animals in cities become accustomed to public areas, often foraging on waste, which exacerbates the issue of urban littering. The presence of wild animals in urban areas creates a range of challenges related to safety, health, ecology, and the quality of life for residents. Therefore, managing urban wildlife populations responsibly and sustainably is crucial.

One of the key actions to support urban biodiversity is the planting of native tree species, as they provide suitable habitats for the largest number of insects and birds, while taking into account habitat and climatic requirements. In addition to planting trees, leaving dead organic matter can also enhance species richness. However, this is much more challenging in urban environments and often requires informational and educational campaigns, as public perception frequently associates dead or withered trees, unmowed lawns, or fallen leaves with disorder. In the case of dead trees, safety concerns further complicate their retention in cities, highlighting the need for careful planning and communication with residents to balance ecological benefits with urban safety standards.

The ethics of human-animal relations are a crucial aspect, as they raise questions such as: How should animals be treated in urban spaces? What are the moral and social responsibilities of city residents toward other species? The argument for animal rights in the context of social and ecological justice in urban environments is particularly significant. Urban development must not come at the expense of biodiversity, and urban spaces should be designed to support the lives of animals. Examples include community gardens, green spaces, areas designated for

the protection of wildlife, urban forests, water bodies, and even urban nature reserves and protected zones for wild animals. Cities should become places where society not only adapts the environment to its own needs but also integrates with nature by fostering relationships with surrounding organisms – something that is particularly lacking in the invasive practices of the real-estate development economy. By promoting coexistence and designing inclusive urban spaces, cities can balance human demands with ecological sustainability, ensuring a harmonious relationship between residents and the natural world.

Increasing biodiversity and intensified synurbisation result in both positive and negative impacts on the urban environment. Wild animals often lack natural predators, leading to the uncontrolled population growth of certain species such as wild boars or moose. This can threaten local ecosystems and plant and animal species that are less adaptable to urban conditions. In particular, the presence of wild animals in cities can disrupt ecological balance, increase the number of road accidents, pose health risks, and create conflicts with residents. However, their presence can also bring benefits, such as enhanced biodiversity, the adaptation of urban spaces to meeting the needs of animals, and the establishment of new green areas.

Striking a balance between these effects requires careful management and planning to ensure that cities can coexist harmoniously with wildlife while maintaining ecological stability and the well-being of urban residents.

ENDNOTES

[1] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en, (access: 10.11.2024).

[2] The survey had 185 respondents from Krakow and Lublin, 67% were women, 30.8% were men, 4 people did not want to specify their gender. The survey covered different age groups (49% up to 26 years old, 18.4% 26–35, 28% 36–46, 15.7% 47–65, 1.6% over 66), was sent out via Google forms, anonymous. Respondents specified the type of current residence, which made it possible to estimate that the surveyed group resides in all its types (it may be interesting to explain the differences between the types of residence or urban configuration in order to understand better the results, from the urban and planning perspective)

[3] Examples of such actions in both surveyed cities included: mounting nest boxes on trees and buildings, installing hedgehog and insect 'houses', reducing lawn mowing or leaf raking. Activities were also aimed at educating residents and promoting appropriate attitudes towards wild animals.

[4] https://ulublin.eu/projekty/ogolnomiejskie/green-connection/ (access: 10.12.2024).

[5] The Study was created under the direction of Z. Ziobrowski in 1999.

[6] In accordance with Article 31 of the Law on Nature Protection of October 16, 1991 (Journal of Laws No. 114, item 492).

[7] It distinguishes itself with educational and informational activities. Policies for green space management are outlined in the annex to Order No. 2282 by the President of Krakow, dated 29 September 2019.

[8] Based on data from the City of Kraków.

[9] Based on an interview at the Krakow City Hall with the Inspector of the Nature, Agriculture, Forestry and Animals Department, Ms Monika Giermala, on 29.12.2024.

[10] Information obtained on the basis of GIS spatial data from the Krakow City Hall, Nature, Agriculture, Forestry and Animals Department.

[11] https://zzm.krakow.pl/zielen-dla-klimatu/ekostrefy.html (access: 30.12.2024).

[12] www.zanurzsie.pl/zalew-bagry, (access: 30.12.2024).

[13] https://edziennik.lublin.uw.gov.pl/WDU_L/2024/2124/oryginal/akt.pdf (access: 30.12.2024).

[14] https://lublin.eu/mieszkancy/srodowisko/ochrona-zwierzat/pomozmy-dzikim-zwierzetom, (access: 12.12.2024).

[15] https://kurierlubelski.pl/tag/dzikie-zwierzeta-w-lublinie (access: 12.12.2024).

[16] https://dzielnice.lublin.eu/gfx/dzielnice/userfiles/_public/slawin/aktualnosci/odpowiedz_um_na_pismo_rd_w_sprawie_dzikow.pdf, (access: 12.12.2024).

[17] Based on data from the Lublin City Hall.

[18] The number of these animals in the forests located within the range of the Regional Directorate of State Forests in Lublin in 2015 was about 5,000, in 2024 more than 7,500. Based on data from the RDSF. https://www.lublin.lasy.gov.pl/aktualnosci/-/asset_publisher/H9HmG48Tuos2/content/losie-w-lubelskich-lasach-policzone, https://www.lublin.lasy.gov.pl/aktualnosci/-/journal_content/56/10635/50199646?p_p_auth=PQ46L1fu.

[19] https://lublin.eu/mieszkancy/srodowisko/zielony-lublin/uroczyska/, (access: 10.12.2024).

[20] Based on: Statistics Poland for 2020, https://lublin.geoportal-krajowy.pl/statystyki-gus, (access: 01.12.2024); https://lublin.geoportal-krajowy.pl/natura-2000#formy-ochrony-przyrody, (access: 01.12.2024), https://otwartedane.lublin.eu/dataset/tereny-zieleni-parki-spacerowo-wypoczynkowe-zielence-zielen-uliczna-powierzchnia/resource/1d8337a1-ee9c-4ff9-bfe8-96b2432c4804?inner_span=True, (access: 01.12.2024).

BIBLIOGRAPHY

[1] Andrzejewski, R., Babińska-Werka, J., Gliwicz, J., Goszczyński, J., 1978, Synurbization Processes in Population of Apodemus agrarius I. Characteristics of Populations in an Urbanization Gradient. Acta Theriologica, Springer, 23(20), s. 341–358.

[2] Apfelbeck, B., Snep, R., Hauck, T., Ferguson, J., Holy, M., Jakoby, Ch., MacIvor, J.S., Schär, L., Taylor, M., Weisser, W., 2020, Designing wildlife-inclusive cities that support human-animal co-existence, Landscape and Urban Planning, 200, s. 103817. https://doi.org/10.1016/j.landurbplan.2020.103817.

[3] Balana, M., Czarniawski W., Czepiel K., Gosik R., Ptaszyńska A., 2004, Walory przyrodnicze projektowanego rezerwatu Górki Czechowskie w Lublinie – stan aktualny i perspektywy ochrony, Chrońmy Przyrodę Ojczystą, 60 (1), s. 67–77.

[4] Bekessy, S.A., White, M., Gordon ,A., Moilanen, A., Mccarthy, M. A., Wintle, B. A., 2012, Transparent planning for biodiversity and development in the urban fringe, Landscape and Urban Planning, 108(2), pp. 140–149. https://doi.org/10.1016/j.landurbplan.2012.09.001.

[5] Bocheński, M., Ciebiera, O., Dolata, P.T., Jerzak, L., Zbyryt, A., 2013, Ochrona ptaków w mieście, Regionalna Dyrekcja Ochrony Środowiska w Gorzowie Wielkopolskim.

[6] Boguszewska, K., Przesmycka, N., 2019, Spatial Planning in Environmentally Valuable Areas in the Context of Public Participation on the Example of Czechów Hills in Lublin, Regional Barometer. Analyses & Prognoses, 16(4), s. 141–152. doi: 10.56583/br.55.

[7] Böhm A., 2001, Parki Rzeczne w krajobrazie Krakowa, Architektura Krajobrazu, 23, s. 17-22.

[8] Chmielewski S., Łukasik A., Owczarek P., 2013. Ekologiczny System Obszarów Chronionych Miasta Lublin a miejscowe plany zagospodarowania przestrzennego. Teledetekcja Środowiskowa, 48, s. 7–14.

[9] Dudkiewicz, M., Kopacki M., Iwanek, M., Hortyńska, P., 2021, Problemy zachowania bioróżnorodności na przykładzie wybranych miast Polski, Agronomy Science, 76(1), pp. 67–84. https://doi.org/10.24326/as.2021.1.5.

[10] Granai, G. et al., 2024, Animals and Cities: A Reflection on Their Potential in Innovating Nature-Based Solutions, Animals, 14(5), p. 680. https://doi.org/10.3390/ani14050680.

[11] Gurowska, M., Rosińska, M., Szydłowska, A., (red.), 2020, ZOEpolis. Budując wspólnotę ludzko-nie-ludzką, Wydawca: Fundacja Bęc Zmiana.

[12] Jakubowski, K., 2020, Czwarta przyroda. Sukcesja przyrody i funkcji nieużytków miejskich, Fundacja Dzieci w Naturę.

[13] Jurkowski, A., 2021, Jeże dostaną od miasta „ochronny parasol". Na czym to będzie polegać?, Kurier Lubelski. https://kurierlubelski.pl/jeze-dostana-od-miasta-ochronny-parasol-na-czym-to-bedzie-polegac/ar/c1-15572619 (dostęp: 23.11.2024).

[14] Kamieniak, J., Mazurkiewicz, T., Tietze, M., 2016, Obecność zdziczałych kotów domowych jako czynnik zagrażający światowej bioróżnorodności, Życie Weterynaryjne, 91(2), s. 96-98.

[15] Kita, P., Frymus, T., 2004, Zakażenie wirusem niedoboru immunologicznego kotów w Warszawie i okolicach, Medycyna Weterynaryjna, 60(1), s. 53-56.

[16] Kowal, M., Karaś, S., 2016, Przejścia dla zwierząt na odcinku S17 między węzłami „ Kurów Zachód „ a „ Lublin Felin „, Budownictwo i Architektura, 15, s. 71–80.

[17] Lachowicz M., Podhorecki A., 2012, Budowa przepustów i przejść dla zwierząt w warunkach zrównoważonego rozwoju, Nowoczesne Budownictwo Inżynieryjne, IX-X, 5, s. 74-77.

[18] Lange Ł., 2022, Ku jakiej zmierzamy przyszłości relacji międzygatunkowych w mieście?, W: M. Burchard-Dziubińska, red., W poszukiwaniu zielonego ładu, Wydawnictwo Uniwersytetu Łódzkiego, Łódź, s. 199-211.

[19] Levy, J.K., Crawford, P.C., 2004, Humane strategies for controlling feral cat populations, J. Am. Vet. Med. Assoc., Nov 1;225(9):1354-60. doi: 10.2460/javma.2004.225.1354. PMID: 15552308.

[20] Lewandowski P., 2019, Proces urbanizacji miast w Polsce a rodzinne ogrody działkowe, Przegląd Budowlany, 9/2019, 83-87.

[21] Lubiarz, M. Mackoś-Iwaszko, E. Solski, M. Kulesza P., 2014, Znaczenie wąwozów leśnych Lublina w migracji zwierząt/The importance of forest ravines in Lublin in animal migration, In: Wąwozy i suche doliny Lublina. Potencjał i zagrożenia, Red. Trzaskowska E., Wyd. Urząd Miasta Lublin.

[22] Lubiarz, M., Solski, M., Mackoś-Iwaszko, E., 2015, Problemy związane z występowaniem zwierząt w obrębie osiedli mieszkaniowych Lublina, In: Problems related to the presence of wild animals within housing estate areas in Lublin, red. E. Trzaskowska, P. Adamiec, s. 117–132.

[23] Madej, A., Wójcik, J., Warwas, A., Trzaskowska, E., Adamiec, P., 2014, Uroczyska w lubelskich wąwozach – część I. Koszańska, M., Krzysiak, M., Czeżyk M., Trzaskowska,

E., Adamiec, P., 2014, Uroczyska w lubelskich wąwozach – część II W: E. Trzaskowska (red.), Wąwozy i suche doliny Lublina. Potencjał i zagrożenia, Wyd. Urząd Miasta Lublin, p. 108-124.
[24] Marinelli, J. 2021, Urban Refuge: How Cities Can Help Solve the Biodiversity Crisis, Yale E360. Available at: https://e360.yale.edu/features/urban-refuge-how-cities-can-help--solve-the-biodiversity-crisis (dostęp: 24. 11. 2024).
[25] Milczarek, S., 1993, Notatki Płockie, Kwartalnik Towarzystwa Naukowego Płockiego, 38 3(156), s. 42-43.
[26] Netczuk, Ł., 2016, Historia ogrodnictwa i ruchu działkowego na ziemiach polskich. Zarys problematyki badań i studiów źródłowych, Biuletyn informacyjny – Krajowa Rada Polskiego Związku Działkowców, http://pzd.pl/uploads/1aga/netczuk/Bibliografia%20polskiego%20ruchu%20dzia%C5%82kowego11_Artyku%C5%82.pdf
[27] Niećko, J. 2024, Lublin: Wiosenna akcja ratowania żab. Każdy może pomóc, Lublin24.pl – Najszybszy portal w mieście. https://lublin24.pl/z-lublina/lublin-wiosenna--akcja-ratowania-zab-kazdy-moze-pomoc/PJgzjogYgjizrZbC6gIF (dostęp: 23.11.2024).
[28] Ozimkowska L., Wojtatowicz J., 2020, Metoda waloryzacji drzew ze względu na ich wartości biocenotyczne, Mazowsze Studia Regionalne, nr 32, Mazowieckie Biuro Planowania Regionalnego w Warszawie s. 123-136.
[29] Pietrzykowski T., 2016, Opinia prawna w przedmiocie dopuszczalności kastracji (sterylizacji) kotów wolno żyjących i jej finansowania w ramach programów, o których mowa w art. 11a ust. 2 ustawy o ochronie zwierząt, [w:] Pietrzykowski T., Bielska-Brodziak A., Gil K., Suski M. (red.), Urzędnik jako strażnik realizacji ustawowych obowiązków wobec zwierząt, Wydawnictwo Uniwersytetu Śląskiego, Katowice, s. 191-196.
[30] Przesmycka, N. and Strojny, R., 2018, Allotment gardens in the Lublin downtown in the spatial and urban planning context – origins and issues concerning their preservation, Teka Komisji Architektury, Urbanistyki i Studiów Krajobrazowych, 14(2), s. 43–58. doi: 10.35784/teka.1777.
[31] Radziejowski J., 2011, Obszary chronionej przyrody – historia, stan obecny, wyzwania przyszłości, Wszechnica Polska, Szkoła Wyższa Towarzystwa Wiedzy Powszechnej, Warszawa.
[32] Reese, L.A. (red.), 2021, Animals in the City. London, Routledge, dostępne: https://doi.org/10.4324/9780429264429.
[33] Rosińska, M., Szydłowska, A., 2017, Zoepolis. W stronę dizajnu poza paradygmatem antropocentrycznym, Kultura popularna, Warszawa, 2(53), s. 67-68.
[34] Schneeberger, D., 2024, Envisioning a Better Future for Nonhuman Animals, Towards Future Animal Rights Declarations (no date), https://link.springer.com/book/9783031753312 (dostęp: 24.11.2024).
[35] Shingne, M.C., 2022, The more-than-human right to the city: A multispecies reevaluation, Journal of Urban Affairs, 44(2), s. 137–155, odstępne: https://doi.org/10.1080/07352166.2020.1734014.
[36] Sims, V., Evans K.L., Newson, S.E., Tratalos, J.A., Gaston, K.J., 2008, Avian assemblage structure and domestic cat densities in urban environments, Diversity and Distrubutions, 14, s 387-299.
[37] Spasowska-Czarny, H. M., 2021. Protection of Animals Living in the Wild. Studia Iuridica Lublinensia 30: 173–194. https://doi.org/10.17951/sil.2021.30.3.173-194.
[38] Strumińska, M., 2004, Etyka biocentryczna i antropocentryczna z perspektywy zrównoważonego rozwoju. Prakseologia,144. s.169-174.
[39] Szczerbak, H., 2013, Pałac w Krakowie-Prokocimiu, Modus. Prace z historii sztuki, XII-XIII, s. 105-134.
[40] Trzaskowska E. (red.), 2014, Wąwozy i suche doliny Lublina. Potencjał i zagrożenia, Wyd. Urząd Miasta Lublin.
[41] Trzaskowska E., Adamiec P., 2014. Park miejski jako forma ochrony wąwozów Lublina. In: E. Trzaskowska (red.), Wąwozy i suche doliny Lublina. Potencjał i zagrożenia. Wyd. KUL, Lublin, 195–210.
[42] Weismann, S., 2021, Odorogenne zwierzęta w międzywojennym Lublinie, W: Alamanach Antropologiczny. Communicare. Warszawa: Wydawnictwa Uniwersytetu Warszawskiego (Miasta/Zwierzęta).
[43] Wischermann, C., Steinbrecher, A., 2018, Animal History in the Modern City: Exploring Liminality. Bloomsbury Academic, Available at: https://library.oapen.org/handle/20.500.12657/45802 (accessed: 24.11.2024).
[44] Wolch, J. 2021 Anima urbis, in Miasta/ Zwierzęta., Almanach Antropologiczny. Communicare, Warszawa: Wydawnictwa Uniwersytetu Warszawskiego pp. 9–24.
[45] Zachariasz A., 2022, Greenery design in areas under heritage conservation, on the example of selected Krakow sites, Przestrzeń i Forma, 50, s. 289-314.

INTERNET SOURCES

[1] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en, (dostęp: 10.11.2024).
[2] https://dzielnice.lublin.eu/gfx/dzielnice/userfiles/_public/slawin/aktualnosci/odpowiedz_um_na_pismo_rd_w_sprawie_dzikow.pdf, (dostęp: 12.12.2024).
[3] https://edziennik.lublin.uw.gov.pl/WDU_L/2024/2124/oryginal/akt.pdf (dostęp: 30.12.2024).
[4] https://kurierlubelski.pl/tag/dzikie-zwierzeta-w-lublinie (dostęp: 12.12.2024).
[5] https://lublin.eu/mieszkancy/srodowisko/ochrona-zwierzat/pomozmy-dzikim--zwierzetom/, (dostęp: 12.12.2024).
[6] https://lublin.eu/mieszkancy/srodowisko/zielony-lublin/uroczyska/, (dostęp 10.12.2024).
[7] https://lublin.geoportal-krajowy.pl/natura-2000#formy-ochrony-przyrody, (dostęp 01.12.2024),
[8] https://lublin.geoportal-krajowy.pl/statystyki-gus, (dostęp 01.12.2024),
[9] https://otwartedane.lublin.eu/dataset/tereny-zieleni-parki-spacerowo-wypoczynkowe-zielence-zielen-uliczna-powierzchnia/resource/1d8337a1-ee9c-4ff9-bfe8--96b2432c4804?inner_span=True, (dostęp 01.12.2024).
[10] https://ulublin.eu/projekty/ogolnomiejskie/green-connection/ (dostęp 10.12.2024).
[11] https://www.lublin.lasy.gov.pl/aktualnosci/-/asset_publisher/H9HmG48Tuos2/content/losie-w-lubelskich-lasach-policzone, (dostęp 10.12.2024).
[12] https://www.lublin.lasy.gov.pl/aktualnosci/-/journal_content/56/10635/50199646?p_p_auth=PQ46L1fu. (dostęp 10.12.2024).
[13] https://zzm.krakow.pl/zielen-dla-klimatu/ekostrefy.html (dostęp: 30.12.2024).
[14] Ustawa z dnia 16 października 1991 roku o ochronie przyrody Dz.U. Nr 114, poz. 492.
[15] www.zanurzsie.pl/zalew-bagry, (dostęp: 30.12.2024).
[16] Zarządzenie nr 2282 Prezydenta Miasta Krakowa z dnia 29 września 2019 r.