

## STATUS OF THE ORNITHOFAUNA IN URBAN AREAS

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### Abstract

*The study area is represented by the city of Varna, focusing on bird populations within this urban agglomeration. Varna's diverse urban landscape provides an important case for examining both the species composition and distribution of birds, as well as the mechanisms by which species spread and establish themselves within city limits.*

*This research employs transect sampling across test plots, which are uniformly sized squares distributed throughout the entire urban area. This systematic approach enables a comprehensive survey of the ornithofauna across different types of urban habitats, allowing for detailed mapping of species diversity and population density.*

*The paper presents the findings on species composition, emphasizing patterns of movement and settlement among various bird populations in response to the unique pressures and resources found in urban settings. By understanding these mechanisms, this research contributes to urban biodiversity conservation and sheds light on the adaptability and resilience of bird species in the face of urbanization.*

**Key words:** ornithology, birds, urban areas

### INTRODUCTION

Urban ecosystems are increasingly becoming critical habitats for a wide range of wildlife, including birds. These environments, shaped by human activity, provide a unique intersection between natural and anthropogenic factors that influence biodiversity. The concept of urban avifauna refers to the study of bird species that have adapted to life within urban settings, including cities, towns, and other heavily developed areas. As cities continue to expand globally, understanding the dynamics of urban bird populations has become crucial to inform both conservation efforts and urban planning (Marzluff, 2001; Beissinger & Snyder, 2005; Shochat et al., 2006).

While many species of birds are known to avoid urban environments due to the

challenges posed by human activity, a significant number of species have demonstrated remarkable resilience and adaptability. The factors contributing to the presence of birds in cities are multifaceted, including the availability of food sources, nesting opportunities, and shelter, as well as the relative safety from natural predators (Fuller & Gaston, 2009; Sol et al., 2014).

This research aims to explore the key characteristics of urban avifauna in Varna city, the mechanisms behind their adaptation to city, and the broader ecological implications of urbanization on bird species (Beissinger & Snyder, 2005; Shochat et al., 2006). In this study, we examine the composition, distribution, and behavioral adaptations of urban bird species on a territory of Varna city. We also investigate the ecological challenges faced

by urban birds and the potential strategies for mitigating the negative impacts of human development on avian populations.

## **MATERIALS AND METHODS**

### **Study Area:**

The study is conducted in the city of Varna (Bulgaria). The city's territory can be described as a typical Eastern European city with a population of just over 330,000 residents (according to the National Statistical Institute of Bulgaria, 2020). Essentially, it is one of the major cities along the Black Sea coast. The city presents a mix of neighborhoods with varying levels of urbanization, ranging from highly developed metropolitan areas to smaller districts, as well as areas with significant green spaces. The studied area includes parks, residential neighborhoods, commercial districts, and industrial zones, ensuring a comprehensive examination of urban bird populations in different urban environments.

### **Data Collection:**

Field observations have been conducted since 2021. Data collection includes both direct visual observations and acoustic methods for species identification. Audio-visual recording equipment was also used to document the bird species present in the urban environment. The surveys follow standard birdwatching approaches, including walking along predefined transects through the study area and recording bird observations by species, number of individuals, and time of observation. Additionally, the transect method is combined with dividing the study area into equally sized squares, which are distributed across the entire study site. Thus, each transect is specific and

corresponds to each square. The study also includes several species-specific methodologies for colonial nesting birds, raptors, and others. An important component of the studies is the collection of data on individual behaviors and their interactions with the urban environment.

For some species, identifying nesting sites through systematic surveys of trees, buildings, and other structures is feasible and does not require excessive effort. Such species include large gulls (*Larus cachinnans/michahellis*), semi-wild pigeons (*Columba livia domestica*), frequently observed starlings (*Sturnus vulgaris*), and house sparrows (*Passer domesticus*). For other species, such as the blackbird (*Turdus merula*), robin (*Erithacus rubecula*), and often the great tit (*Parus major*), locating nests is so difficult, particularly over a large area, that it becomes impractical, and they are instead categorized as having occupied breeding territories. Parameters such as nesting success, height characteristics, nesting materials, and others were not considered. For some species, nesting substrates were also not recorded.

### **Data Analysis:**

The collected data are being analyzed continuously to identify species distribution patterns, species diversity, and abundance across different urban conditions. Species richness and evenness will be calculated using standard ecological indices. Preliminary statistical analyses have been performed to assess the relationship between urbanization levels and bird diversity (Marzluff, 2001; Fuller & Gaston, 2009). Habitat preferences have also been examined by comparing the presence of bird species in various urban landscape types, including parks, industrial zones,

and residential areas (Shochat et al., 2006).

## RESULTS AND DISCUSSIONS

### Species Composition

To date, a total of 56 species of breeding birds have been identified within the city of Varna. Significant differences in species composition were observed between highly urbanized areas and those with greater green space presence. Among the most widespread species found in the highest number of habitats are the house sparrow (*Passer domesticus*) and the feral pigeon (*Columba livia domestica*). These species are known for their high degree of adaptability to urban environments and were found to be abundant in all study sites, including highly developed commercial and residential zones (Beissinger & Snyder, 2005; Shochat et al., 2006).

In areas with more green spaces, such as urban parks and riverside zones, a more diverse range of species was recorded. It was also noted that these areas attract and sustain large numbers of migrant species, including songbirds, thrushes, warblers, flycatchers, and many others. The kestrel (*Falco tinnunculus*) stands out as the primary raptor species in the urban environment. It shows clear preferences for occupying territories that combine tall buildings—over 12 stories high—with fragmented urban landscapes featuring a high percentage of green spaces. These areas must include open (non-forested) habitats, such as park meadows or significant open grasslands with characteristics similar to prairies. The distribution of this raptor species is positively correlated with the availability of a variety of prey species, such as small

birds and rodents, which are abundant in certain urban areas.

The study also identifies the expansion of some species into the synanthropic environment. For instance, the wood pigeon (*Columba palumbus*) has been encroaching and densifying its breeding population in all the larger green zones of the city, which consist of islands of tree vegetation with heights above 15 meters. Similar processes are occurring with the hooded crow (*Corvus cornix*) in the same types of habitats. Concurrently, there has been a decline in the populations of some species associated with shrubland and shrubland-forest plant communities. An example of this is the rapid disappearance of the common nightingale (*Luscinia megarhynchos*) following vegetation management activities aimed at reducing shrub cover in parks and spaces between buildings. A similar situation was observed with the wren (*Troglodytes troglodytes*) and, to a lesser extent, with the robin (*Erithacus rubecula*).

### Behavioral Adaptations

Urban birds exhibit a range of behavioral adaptations that allow them to exploit available resources in city environments. Opportunistic foraging behavior has been observed in many species, particularly among those that thrive on food sources generated by humans, such as food waste. A notable example in this regard is the yellow-legged (caspien) gull (*Larus cachinnans/michahellis*). Birds of this species concentrate in areas of the city where they have access to food waste or the opportunity to scavenge food scraps. Such areas include street food stalls, restaurants near the beach, as well as urban zones with "open-type" waste

containers. Another type of "attractive center" for the concentration of this species are areas with high densities of feral pigeons (*Columba livia domestica*). The young of these semi-wild pigeons are a secondary, but significant, food source for the large gulls (*Larus cachinnans/michahellis*) in the urban environment of Varna. Over the past two years, large gulls have started to experience competition in these spaces from hooded crows (*Corvus cornix*). House sparrows (*Passer domesticus*), as well as feral pigeons (*Columba livia domestica*), for example, are often seen in frequent congregations in order to forage in urban squares and the open areas of city parks. In contrast, some raptor species, such as the common kestrel (*Falco tinnunculus*), demonstrate highly specialized hunting strategies, utilizing only those parts of the urban environment that most closely resemble their natural habitats.

Nesting behavior has also been modified in response to the urban environment. Species like the common swift (*Apus apus*) nest in building crevices. With this nesting behavior, they replace their wild nesting substrate, where they traditionally use vertical rock faces in mountainous areas for nesting. High-rise buildings, over 12 stories tall, also serve as nesting habitats for kestrels (*Falco tinnunculus*) within the city of Varna. All established breeding pairs have been located on such buildings. A similar, but even more dramatic, nesting adaptation is observed in the yellow-legged (caspien) gull (*Larus cachinnans/michahellis*). This species has shifted from ground-based colonial nesting in the wild to solitary nesting on the rooftops of urban buildings. This shift is likely due to the absence of terrestrial predators and reduced nest vulnerability. The availability of artificial nesting structures, such as

cornices and ventilation pipes, has enabled many species, such as the great tit (*Parus major*), house sparrow (*Passer domesticus*), starling (*Sturnus vulgaris*), and others, to expand their range in urban areas, leading to the establishment of stable breeding populations in cities. At the same time, species such as the blackbird (*Turdus merula*), common nightingale (*Luscinia megarhynchos*), robin (*Erithacus rubecula*), and others remain noticeably conservative in their choice of nesting habitats, which has led to sharp fluctuations in their breeding populations and a general decline in urban environments.

### Ecological Challenges

Despite their adaptability, urban birds face a number of ecological challenges. One of the primary threats to urban avifauna is habitat fragmentation. The increasing construction of buildings, roads, and other infrastructure reduces the availability of adjacent natural habitats, often leading to a decrease in bird diversity. In Varna, old buildings are frequently replaced by new, high-rise structures. These new buildings inevitably become "black holes" in terms of urban avifauna. The facades of these new structures are almost always smooth, tightly sealed, with no joints. In some cases, they are glass or have curtain-wall facades. This makes them virtually unusable by birds. They cannot perch on the facades, nor can they use them as nesting substrates. The only exception may be the roof structures of new buildings, which after 2-3 years might be occupied by a pair of yellow-legged (caspien) gulls (*Larus cachinnans/michahellis*) for nesting.

Species that rely on large, continuous wooded-shrubby areas or waterlogged

habitats for breeding or feeding, such as the common nightingale (*Luscinia megarhynchos*), robin (*Erithacus rubecula*), or blackbird (*Turdus merula*), are experiencing rapid population declines due to the conversion of these urban areas into construction sites for new buildings or the expansion of road networks.

Another significant challenge is pollution, particularly air pollution and light pollution. Birds are particularly sensitive to environmental pollutants, and elevated levels of air pollution in cities can negatively affect their health and reproductive success. Migratory birds, in particular, are highly sensitive to light pollution and glass facades. Light pollution disrupts the nocturnal behaviour of many species, including migratory birds, which can become disoriented by artificial lighting and land in unsuitable parts of the city or fatally collide with glass facades due to reflective surfaces caused by the light.

Invasive species, both plants and animals, also pose a significant threat to urban birds. Invasive plant species, such as the tree of heaven (*Ailanthus altissima*) and others, become unsuitable as nesting substrates. Invasive bird species, mainly parrots, and in particular the rose-ringed parakeet (*Psittacula krameria*), with several reports of individual birds observed during the study period in Varna, also pose a threat. These species compete with native birds for resources, including food and nesting sites. Their aggressive behavioral strategies often lead to the displacement of native bird populations, resulting in a reduction in biodiversity in urban areas.

### Conservation Strategies

Efforts to conserve urban avifauna should focus on mitigating the challenges posed by urbanization. Studies have statistically

shown that areas with a predominance of green spaces in the urban environment support a greater diversity and abundance of nesting birds. In this regard, one promising approach is the creation of more urban green spaces that can serve as critical habitats for birds. Equally important is the even distribution of micro-parks throughout the city of Varna. As demonstrated in other similar studies and publications, urban parks, public gardens, and green roofs increase bird species diversity in urban environments by providing refuge for both migratory and nesting birds.

Another important aspect, within the context of this study, is the identified shortage of water access points during the long and increasingly hot summers in the urban environment of Varna. Locations with access to fresh water during the post-breeding period (after June) show higher concentrations of birds compared to those lacking such resources.

Another effective strategy for maintaining high ornithological diversity is the implementation of bird-friendly building designs that can reduce the risk of bird collisions with glass facades and create conditions for re-colonization of buildings by birds. Installing bird-safe glass, designing bird-friendly facades, and constructing buildings that mimic natural environments can help reduce mortality and maintain bird populations in urban areas. An important contribution in this regard could be a regulatory requirement to install artificial nest boxes (for species such as the common swift (*Apus apus*) after façade renovations funded by public resources. Additionally, efforts to control invasive species through urban habitat restoration and management programs can help protect native bird populations.

## CONCLUSIONS

The study of urban avifauna in Varna highlights the complex and dynamic relationship between birds and the urban environment. Although urbanization presents numerous challenges for bird populations, many species have demonstrated exceptional adaptability to the altered landscapes of cities (Beissinger & Snyder, 2005; Shochat et al., 2006). Urban areas can support diverse bird communities, especially when green spaces are integrated and prioritized in urban planning, and when human activities are carefully managed to minimize their negative impact on wildlife.

In recent years, Varna has become one of the leading cities in Bulgaria in terms of new building construction and expansion of the urban road network. These processes have led to a noticeable decline in the city's avifauna—both in terms of species diversity and population numbers.

As the city continues to expand, the need for effective conservation strategies that promote biodiversity is becoming increasingly important. By understanding the behavioral adaptations, ecological needs, and challenges faced by urban birds, we can develop better strategies for urban planning and wildlife management

that ensure the coexistence of human populations and bird species within the urban landscape.

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