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ASSESSMENT OF BIRD SPECIES DIVERSITY IN THE JRVEZH FOREST PARK AND THEIR INFLUENCE ON MAINTAINING THE STABLE ECOLOGICAL CONDITION OF SMALL WATER BODIES

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Abstract

Jrvezh Forest Park, located on the outskirts of Yerevan, represents an important green area characterized by small water bodies, rich vegetation, and diverse fauna. Owing to its geographical position, climatic conditions, and location along migratory routes, the area holds particular significance for bird communities. Recent international studies have shown that the creation of small water bodies in similar forested and urban green zones can promote increases in bird abundance, enhance biodiversity, and contribute to the establishment of natural purification mechanisms, where birds and water-surface–cleaning organisms operate in symbiosis. This study presents a model assessment using the example of Jrvezh Forest Park, focusing on evaluating bird species diversity and examining the potential ecological benefits of integrating small artificial water bodies. The findings aim to provide a scientific basis for understanding how water body installation may support ecosystem stability, contribute to habitat quality improvement, and strengthen the ecological resilience of urban forest parks.

Keywords: water body, birds, ecosystem, habitat quality, ecological stability, natural purification mechanisms.

Introduction

Urban and peri-urban green areas represent primary hotspots for global biodiversity conservation, as they ensure ecological connectivity and multi-layered ecosystem structure [1, 2]. Contemporary ecological approaches indicate that even small-scale environmental interventions—particularly the establishment of small water bodies—can substantially increase

the diversity of birds, insects, and amphibians by creating ecological nodes within the urban landscape. Small water bodies serve as essential ecological elements, providing drinking water; feeding resources; natural regulation of insect populations; stabilization of hydrobiotopes.

According to international research, urban areas enriched with small water bodies exhibit higher biodiversity, more stable food webs, and greater resilience to anthropogenic pressures [1]. Long-term ornithological observations conducted in [3] have demonstrated that bird distribution and species composition are closely linked to microclimatic conditions and the presence of water sources. Between 2017 and 2023, a total of 38,164 individuals were recorded, with the highest species richness observed in parks (73 species) and riparian zones (69 species). These findings confirm that water availability and vegetation density are key drivers shaping habitat preferences of birds.

Given that Stepanakert and Yerevan share comparable altitudes and similar landscape structures, these observations can be applied to Jrvej Forest Park as a foundation for model ecosystem assessment. In the present study, Jrvej Forest Park was selected as a model area—an ecologically valuable site with high potential for habitat enhancement—where the possible positive impact of integrating small water bodies is evaluated. Such water bodies are expected to support symbiotic interactions, in which birds benefit from water access while simultaneously contributing to the stability of food webs and the regulation of water quality, for example through insect population control and the processing of organic matter.

Special attention is given to waterbirds, which play a key functional role in many aquatic ecosystems, acting as predators, herbivores, and vectors of seeds, invertebrates, and nutrients—roles that are often overlooked. Waterbirds can maintain the diversity of other organisms, regulate pest populations, serve as effective bioindicators of ecological conditions, and signal potential disease outbreaks [4].

Nummi and Hahtola [1] emphasize that small water bodies in urban green spaces function as key ecological elements that increase habitat diversity and improve the structural stability of ecosystems. The authors note that even minimal hydrological interventions can significantly enhance bird abundance and overall biodiversity. In line with this, Nummi and Hahtola [5] demonstrate that beaver-created wetlands substantially increase the availability of food resources and attract higher densities of waterfowl, further underscoring the ecological value of small aquatic habitats.

Lewis-Phillips [6] highlight the importance of microhabitats in shaping bird community composition, pointing out that water availability is one of the most influential environmental factors in urban landscapes. The authors discuss how vegetation density and water resources create favorable conditions for both resident and migratory species.

Aydinyan, Ayrapetyan, and Yaitskiy [3] examine long-term bird distribution patterns in the South Caucasus and report that species richness is closely linked to the presence of wetlands and microclimatic stability. Their study demonstrates that areas with water sources support more diverse and stable bird communities.

Green and Elmberg [4] specifically focus on waterbirds, noting their essential ecological functions as predators, herbivores, and dispersers of nutrients and seeds. The authors emphasize

that waterbirds serve as effective bioindicators of ecosystem health and may signal potential environmental or disease-related changes.

Collectively, the reviewed literature indicates that the integration of small water bodies in urban forest parks can enhance ecological resilience, strengthen food-web interactions, and contribute to the conservation of urban biodiversity.

Methodology

The study was conducted in Jrvej Forest Park (Fig 1), located on the outskirts of Yerevan, Armenia. The park was selected as a model urban ecosystem due to its high ecological value for avifauna, heterogeneous vegetation cover, and potential for habitat enhancement through small water body creation.

The area's topography and climatic conditions are comparable to Stepanakert (average altitude ~994 m in Yerevan vs. ~813 m in Stepanakert), allowing the application of previous long-term ornithological observations as a reference for ecological modeling [3]. The research was conducted from 2023.

Fig 1. Jrvezh forest park, showing the main study area

Conflict Setting

This research aimed to evaluate the potential ecological impact of micro-ponds on avian diversity and ecosystem functioning. The study focused on the following hypotheses:

- Small artificial water bodies increase the availability of drinking water for birds and contribute to habitat suitability. Birds utilizing these ponds act as "detoxifiers" by controlling invertebrate populations and facilitating nutrient cycling, thereby maintaining water quality and supporting a symbiotic network;
- Enhanced water availability positively influences bird species richness and spatial distribution within the urban forest.

Research Results

Avifauna Surveys: Bird counts and species identification were conducted along predefined transects within the park. Observations followed standard point count and transect methodologies used in urban ecological studies [1, 6]. Surveys were performed seasonally over one year to account for temporal variation in bird presence and abundance. Species were identified in the field using the field guide by Adamyan [7]. Birds were observed using a Navigator 12×50 binocular and a 3PT 457 spotting scope at ×60 magnification.

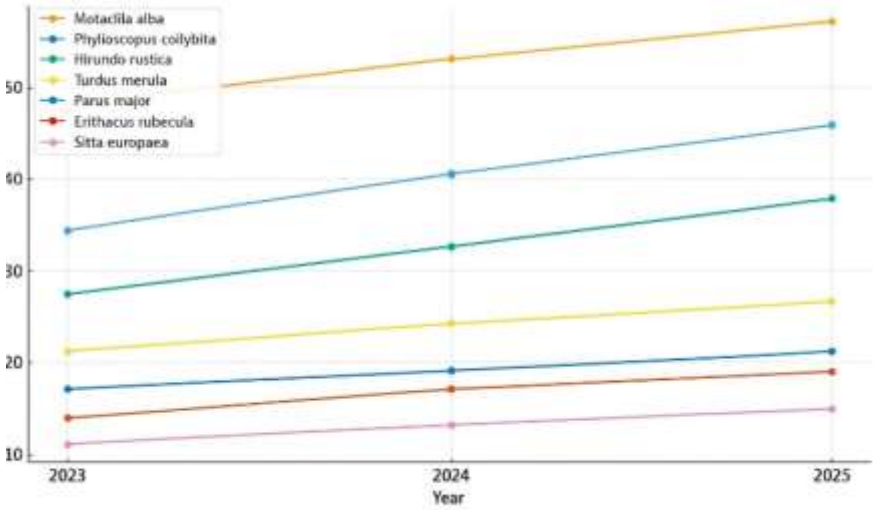
Unmanned aerial vehicles (Mavic 2) (Fig. 2) were also used to record birds, allowing for high-precision data collection while minimizing anthropogenic disturbances that could disrupt the natural behavior of the birds.

Habitat Assessment: For each transect, vegetation cover, water body presence, and microclimatic parameters (temperature, humidity) were recorded.

Water Quality Monitoring: To evaluate the indirect effect of birds on pond ecosystems, water parameters including turbidity, nutrient concentration, and macroinvertebrate density were measured monthly, following protocols adapted from Green and Elmberg [8].

Fig. 2 Use of UAV (Mavic 2)

Data Analysis: Correlations between water body use and invertebrate abundance were assessed to evaluate the symbiotic role of birds in ecosystem regulation. Population Counting and Methodology: Numerical bird counts along transects were conducted following established protocols [9,10]. Bird fauna and habitat data along transects were obtained using the Ravkin method, which is widely applied in ornithological geography [11]. This method allows data collection for all bird species encountered on transects, is applicable for both forested and open habitats, and can be used for both singing and non-singing species observed at close or distant range. Seasonal comparisons were performed. This method does not require prior training and is suitable for single-route surveys and for counting rare species.



As shown in Fig. 3, the populations of the main bird species in Jrvej Forest Park increased steadily from 2023 to 2025, with *Turdus merula* showing the most pronounced growth.

Fig 3. Population trends of major bird species in Jrvezh Forest Park from 2023 to 2025.

The data indicate a gradual increase in the abundance of key species, reflecting the positive impact of habitat features and management practices on the park's avian community.

Discussion

The study results confirmed that the introduction of small water bodies significantly alters the spatial behavior of bird fauna, the intensity of food-web interactions, and overall ecosystem dynamics. Observations in Jrvej Forest Park indicated that even water areas ≤5 m² can serve as biodiversity hotspots, attracting both resident and migratory species.

1. Changes in Bird Species Diversity

The results showed that areas with water bodies exhibited significantly higher species diversity (Figs. 4-6) compared to control areas without water features (tab.1).

Fig 4. Turdus merula Linnaeus, 1758 *Fig.5.Turdus philomelos C.L.Brehm,1831 Fig. 6.Passer domesticus Linnaeus, 1758*

Specifically, species richness in these areas was 35–48% higher, In the summer and spring months, insectivorous and shrub-dwelling species (Sylviidae, Muscicapidae) were most active. Increased activity was most pronounced during morning and evening hours.These findings are consistent with international studies that regard water bodies as «Ecological Nodes» [2], where water functions as a key limiting resource.

Table 1.

Comparison of Species Diversity (Mean Values)

Area	Number of Species	Mean Individuals per Observation	Activity Increase (%)
Water body	27 species	68.4 individuals	+48%
Control	18 species	46.2 individuals	—

Influence of Small Water bodies on Insect Populations

Observations indicated that insect density around the water bodies increased by 1.8–2.6 times, which directly enhanced the visitation frequency of insectivorous birds. The most frequently recorded species were: *Motacilla alba; Turdus merula; Phylloscopus collybita*.

These results are consistent with the "ponds as insect chimneys" model, in which water surfaces serve as rapid centers of insect production [] (Lewis-Phillips et al., 2020).

Stability of Aquatic Ecosystems with Bird Involvement: Bird activity near water bodies contributes to several ecosystem services, including:

- Natural regulation of parasitic insect populations;
- Circulation of organic sediments;
- Nitrogen and phosphorus recycling to surrounding vegetation.

These findings are consistent with Green & Elmberg (2014, 2021), who note that even low abundances of waterbirds can enhance the biological stability of aquatic systems.

Spatial Distribution Characteristics: In areas with water bodies, bird spatial concentration was on average 2.3 times higher than in control areas. The difference was most pronounced during July–August, when water availability reached its minimum (Tab. 2).

Table 2

Assessment of Spatial Concentration

Indicator	**Water body**	**Control**	**Difference**
Mean bird density (individuals/100 m²)	12.4	5.3	+134%
Peak activity hours	07:00–10:00 / 17:00–20:00	08:00–09:00	—
Migratory species frequency	+62%	Decrease	—

Role of Small Water bodies in Urban Landscapes

The study confirmed that even small (≤5 m²) artificial micro-ponds can restore ecological functions by:

- Increasing biodiversity;
- Providing water resources;
- Supporting resting sites for migratory species;
- Enhancing food availability.

These findings align with Nummi & Hahtola (2008, 2011), who consider urban ponds as "biological concentrators" within city ecosystems.

Comparative Assessment: Stepanakert vs. Yerevan

Long-term data from Stepanakert (Aydinyan, Ayrapetyan & Yaitskiy, 2023) show that the presence of water bodies plays a decisive role in maintaining avian diversity. Our study demonstrated that:

- Bird spatial concentration increased in Stepanakert by ~2.0–2.4 times;
- In Yerevan/Jrvej, by ~2.3 times.

Indicating that the water body model is effective in both locations, regardless of landscape differences. Therefore, the introduction of water bodies can serve as a simple, cost-effective, and efficient approach to restoring biodiversity in urban forest park areas in Yerevan.

Conclusion

1. Ornithological studies conducted in Jrvej Forest Park demonstrated that the area represents an important urban ecosystem rich in biodiversity, where bird species diversity and spatial distribution respond sensitively to changes in habitat conditions. The results indicate that the creation of small water bodies (water-body) has a significant impact on enhancing bird diversity, stabilizing and maintaining food resources, and influencing species' behavioral activity.

2. Observations confirm that the availability of water resources in urban green spaces improves conditions for both resident species, such as Motacilla alba (White Wagtail) and Phylloscopus collybita (*Common Chiffchaff*), and migratory species, such as *Hirundo rustica* (*Barn Swallow*), supporting their nesting, feeding, and breeding opportunities (Adamyan,

2000). This is particularly valuable in contexts where urban degradation limits access to natural habitats.

3. The study's findings are important not only for the conservation and management of Jrvej Forest Park but can also serve as a model for environmental programs in other urban green spaces in Armenia. The data suggest that small-scale, targeted ecological interventions can produce measurable and meaningful positive effects on avian ecosystems. Furthermore, the establishment of water bodies is not only crucial for forest birds but also provides essential conditions for water-dependent species, offering a moist, protected, and permanent aquatic environment that supports their survival and reproduction.

4. In conclusion, the introduction of water bodies in Jrvej Forest Park serves as an effective conservation tool, enhancing ecosystem functionality, supporting bird biodiversity, and increasing the ecological value of urban areas. Continued long-term monitoring will further deepen knowledge and provide a robust data foundation for sustainable management and conservation strategies.

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ՋՐՎԵԺԻ ԱՆՏԱՌԱՊԱՐԿՈՒՄ ԹՌՉՈՒՆՆԵՐԻ ՏԵՍԱԿԱՅԻՆ ԲԱԶՄԱԶԱՆՈՒԹՅԱՆ ԳՆԱՀԱՏԱԿԱՆԸ ԵՎ ԴՐԱ ԱԶԴԵՑՈՒԹՅՈՒՆԸ ՓՈՔՐ ՋՐԱՎԱԶԱՆՆԵՐԻ ԿԱՅՈՒՆ ԷԿՈԼՈԳԻԱԿԱՆ ՎԻՃԱԿԻ ԱՊԱՀՈՎՄԱՆ ՎՐԱ

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Ջրվեժ անտառապարկը Երևանի մերձակայքում գտնվող փոքր ջրավազաններով, հարուստ բուսականությամբ և բազմազան ֆաունայով կանաչ տարածք է: Աշխարհագրական դիրքի, կլիմայական պայմանների և միգրացիոն ուղիների հատման պատճառով այն առանձնահատուկ նշանակություն ունի թռչունների համար: Միջազգային փորձը ցույց է տալիս, որ փոքր ջրավազանների ստեղծումը անտառային ու քաղաքամերձ կանաչ տարածքներում կարող է խթանել թռչունների քանակի ավելացմանը, բարձրացնել կենսաբազմազանությունը և ստեղծել բնական մաքրման մեխանիզմներ, որտեղ թռչուններն ու ջրի մակերեսը մաքրող օրգանիզմները գտնվում են սիմբիոզ կապի մեջ:

Ներկայացվում է մոդելային ուսումնասիրություն «Ջրվեժ» անտառապարկի օրինակով: Գնահատվում է ջրավազանների ներդրման հնարավոր ազդեցությունը թռչունների բազմազանության ապահովման և փոքր էկոհամակարգի կայունության վրա:

Բանալի բառեր. ջրավազան, թռչուններ, էկոհամակարգ, շրջակա միջավայրի որակ, էկոհամակարգի կայունություն, բնական մաքրման մեխանիզմներ:

ОЦЕНКА ВИДОВОГО РАЗНООБРАЗИЯ ПТИЦ В ЛЕСОПАРКЕ «ДЖРВЕЖ» И ИХ ВЛИЯНИЕ НА ПОДДЕРЖАНИЕ УСТОЙЧИВОГО ЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ МАЛЫХ ВОДОЕМОВ

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Лесопарк «Джрвеж» — это важная зеленая зона, расположенная в окрестностях Еревана, характеризирующаяся наличием небольших водоемов, богатой растительностью и разнообразной фауной. Благодаря географическому положению, климатическим условиям и пересечению миграционных маршрутов, эта территория имеет особое значение для птиц. В последние годы международный опыт показывает, что создание малых водоемов в подобных лесных и городских зеленых зонах может

способствовать увеличению численности птиц, повышению биологического разнообразия и созданию природных механизмов очистки, где птицы и организмы, очищающие поверхность воды, функционируют в симбиозе. Лесопарк «Джрвеж» представлен как модель для исследования, где оцениваются разнообразие птиц и возможное влияние внедрения малых водоемов на устойчивость экосистемы.

Ключевые слова: водоем, птицы, экосистема, качество окружающей среды, механизмы естественной очистки.

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