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WINTER BAT FLIGHT ACTIVITY IN URBAN LANDSCAPES OF UKRAINE

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Abstract

This study presents the results of research of winter flight activity of bats conducted during the winters of 2022 and 2024–2026. The aim of the study was to assess the extent of bat activity outside roosts during winter and to evaluate variation in activity in relation to meteorological conditions and local habitat characteristics. The study covered 25 sites in urban landscapes across different regions of Ukraine, with bat flight activity recorded at 15 of them. The surveyed sites included areas of high-rise urban development, low-rise residential areas dominated by detached houses, urban parks with water bodies, and artificial or anthropogenically modified water bodies. The results are based on the analysis of acoustic data on bat activity collected during stationary point surveys and combined route-and-point surveys. Bat calls were recorded using ultrasonic detectors and recorders. Only bat call sequences recorded during flight outside roosts were included in the analysis. In total, 292.9 GB of audio files were obtained and analysed, yielding 3785 bat passes. Winter flight activity was detected for five species and one species pair: *Nyctalus noctula*, *Eptesicus serotinus*, *Pipistrellus kuhlii*, *P. nathusii*, *P. pygmaeus*, and *Plecotus auritus/austriacus*. The maximum recorded activity was 109 bat passes per hour and 262 bat passes per night. We evaluated variation in winter bat flight activity in relation to meteorological conditions and local site characteristics. Higher flight activity was observed near ice-free water bodies and major hibernation sites, indicating the importance of such localities for maintaining winter activity in urban environments. The results confirm that winter bat flights in Ukraine are not an isolated phenomenon and may help clarify the seasonal status of particular species. It is suggested that the increasing frequency of winter activity in some bat groups may be associated with warmer winters, urbanisation, and the availability of local microclimatic refugia. The study provides important data for population monitoring and the development of conservation strategies, as it helps identify key winter habitats and supports the planning of measures for their protection.

Cite as

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Зимова політна активність кажанів в урболандшафтах України

Володимир Тищенко, Ігор Давиденко, Оксана Тищенко

Резюме. Представлено результати досліджень політної активності рукокрилих у зимові періоди 2022, 2024–2026 років. Метою роботи було оцінити масштаби позасховищної активності кажанів у зимовий період, зв'язок активності з метеорологічними умовами та локальними характеристиками середовища. Дослідженнями охоплено 25 локацій в урболандшафтах різних регіонів України, у 15 з них виявлено політну активність кажанів. Ділянки досліджень включали території багатоповерхової міської забудови, малоповерхової садибної забудови, міські парки з водоймами, а також штучні та антропогенно трансформовані водойми. Результати досліджень базуються на оцінці даних акустичної активності кажанів, які було зібрано під час точкових та маршрутно-точкових обліків. Реєстрація сигналів рукокрилих здійснювався з використанням ультразвукових детекторів та рекордерів. До аналізу включали лише політні серії сигналів кажанів, зареєстровані поза сховищами. Загалом отримано і проаналізовано 292,9 гБ аудіофайлів, у яких виділено 3785 реєстрацій кажанів. Виявлено зимову політну активність п'яти видів та однієї видової пари: *Nyctalus noctula*, *Eptesicus serotinus*, *Pipistrellus kuhlii*, *P. nathusii*, *P. pygmaeus*, *Plecotus auritus/austriacus*. Максимальні показники польотної активності сягали 109 реєстрацій/год та 262 реєстрації/ніч. Оцінено залежність політної активності кажанів у зимовий період від метеоумов та локальних особливостей місцевості. Вища політна активність спостерігалася поблизу незамерзаючих водойм та місць масової гібернації. Це свідчить про важливість таких осередків для підтримання зимової активності в урбанізованому середовищі. Отримані результати підтверджують, що зимові польоти кажанів в Україні не є поодиноким явищем і можуть мати значення для уточнення сезонного статусу окремих видів. Припущено, що зростання частоти зимової активності деяких груп рукокрилих може бути пов'язане з потеплінням зим, урбанізацією та наявністю локальних мікрокліматичних рефугіумів. Матеріали дослідження є важливими для моніторингу стану популяцій, розробки стратегій збереження кажанів, оскільки дозволяють визначити ключові середовища у зимовий період та планувати заходи з їх охорони.

Ключові слова: рукокрилі, зимова політна активність, акустичний моніторинг, урболандшафти, Україна.

Introduction

Winter has traditionally been regarded as a period of minimal activity in hibernating bats, characterised by torpor and prolonged occupancy of winter roosts. However, recent data from acoustic monitoring indicate that winter flight activity is a more widespread and complex phenomenon than previously assumed [Arndt *et al.* 2020; Blomberg *et al.* 2021; Laurence *et al.* 2024; Toshkova *et al.* 2025]. The first records of winter flight activity of bats outside roosts date back to the 1980s [Avery 1985], and subsequent studies have documented such activity in boreal, temperate, and Mediterranean regions [Barros *et al.* 2017; Blomberg *et al.* 2021, Laurence *et al.* 2024; Nouioua *et al.* 2025]. The energy budget of hibernating bats depends on the alternation between torpor and normothermia, with the balance between these states largely shaped by ambient temperature [Kravchenko *et al.* 2025]. Climate change may substantially alter the wintering range of migratory bats in Europe [Godlevska 2013, 2015a; Vlaschenko *et al.* 2023; Kravchenko *et al.* 2025].

Winter flight activity is often associated with air temperature and atmospheric pressure: activity increases during brief warm spells, although individual flights may occur even at temperatures below 0 °C [Arndt *et al.* 2020; Andreozzi *et al.* 2024]. In addition to temperature, the availability of water and food resources, landscape structure, roost microclimate, and the degree of urbanisation may also be important factors [Mas *et al.* 2022].

Urban landscapes are of particular importance for winter bat activity because they provide winter roosts in buildings and warm microhabitats [Simon *et al.* 1999; Bashta 2016; Mas *et al.* 2022]. Urban green spaces and water bodies may further support winter arousals, movements, and foraging by bats [Barros *et al.* 2017; Jansen *et al.* 2022; Laurence *et al.* 2024].

Winter flights are energetically costly for bats, but they may be associated with the need to drink, relocate, or forage [Klüg-Baerwald *et al.* 2016].

In Ukraine, winter records of bats in cities are frequent and well documented by data from bat contact centres and synthesis studies [Godlevska *et al.* 2022; Zagorodniuk *et al.* 2001, 2003; Godlevska 2012, 2015b; Zagorodniuk 2018]. Specialised and regional studies also document repeated winter records in urban environments in Ukraine [Prylutska *et al.* 2023; Kravchenko *et al.* 2017; Drebet 2018; Panchenko *et al.* 2018; Hukov *et al.* 2020]. Most records are of bats found in winter roosts, although some individuals have been recorded outside roosts, thereby confirming winter flight activity [Hukov *et al.* 2020].

Despite the growing number of studies, data on winter bat flight activity in urban environments remain limited, highlighting the relevance of studying this phenomenon in the urban landscapes of Ukraine. Overall, the published evidence demonstrates a shift from viewing winter as a period of near-complete bat inactivity towards understanding winter activity as a regular, ecologically significant and climate-sensitive phenomenon.

Materials and Methods

The study was based on data from active and passive acoustic monitoring of winter bat flight activity. Surveys were conducted at 25 sites in urban landscapes across different regions of Ukraine (Fig. 1).

The surveyed sites comprised areas of high-rise urban development, low-rise residential areas dominated by detached houses, urban parks with water bodies, and artificial or anthropogenically modified water bodies. Brief descriptions of the acoustic monitoring sites and routes, including approximate coordinates and recorded bat taxa, are provided below. Structural habitat descriptors are given in square brackets after site names (multiple codes where applicable):

HR—high-rise residential development; LR—low-rise residential development; UG—non-park urban green space; UP—urban park; WB—water body or shoreline; AC—artificial channel; RC—river corridor; IND—industrial area. The abbreviations St., Ave., Blvd., and Obl. denote Street, Avenue, Boulevard, and Oblast, respectively.

Fig. 1. Distribution of monitoring points and sites for recording bat flight activity during the winter periods of 2022–2026 across Ukraine.

Рис. 1. Розподіл пунктів обліку та місць реєстрацій політної активності кажанів у зимові періоди 2022–2026 років на території України.

Kyiv:

1. **Akademmistechko** [HR, UG] (50.45028° N, 30.50854° E). Stationary survey on Academician Palladin Ave. Records: ESER, NNOC, PKUH, PNAT, NNOC/NLEI, PKUH/PNAT, and NYC/EPT/VES.
2. **Bortnychi** [AC] (50.384746° N, 30.670075° E). Stationary and route-based point surveys along the drainage channel of the Bortnychi Aeration Station, which discharges warm treated wastewater into the Dnipro River. In winter, water temperature near the outlet is approximately +17 °C. Records: ESER, NNOC, PKUH, PNAT, PPYG, PKUH/PNAT, PAUR/PAUS, and NYC/EPT/VES.
3. **Dobrokhotov St.** [HR] (50.462232° N, 30.361296° E). Route-based point survey. Records: ESER, NNOC, and NYC/EPT/VES.
4. **Irpinska St.** [HR] (50.459033° N, 30.351670° E). Route-based point survey. Records: ESER, NNOC, and NYC/EPT/VES.
5. **Nyvky Park** [UP, WB] (50.45972° N, 30.40982° E). Route-based point survey around ponds in the western part of the park. Records: NNOC, NNOC/NLEI, PKUH/PNAT, and NYC/EPT/VES.
6. **Palladin Ave.** [HR] (50.460351° N, 30.358068° E). Route-based point survey. No bats were recorded.

7. **Palladin route** [HR] (50.473631° N, 30.360284° E). Route-based point survey along the northern section of Palladin Ave., Oleh Mudrak St., and Vasyl Stepanchenko St. No bats were recorded.
8. **Peremoha Park** [UP, WB] (50.463162° N, 30.604401° E). Route-based point survey along park paths and around a pond. Record: NNOC.
9. **Popovych St.** [HR] (50.459139° N, 30.362907° E). Route-based point survey. Record: NYC/EPT/VES.
10. **Pushyna Square** [UG] (50.456165° N, 30.352803° E). Route-based point survey. Records: NNOC and NNOC/NLEI.
11. **Rylskyi Park** [UP, WB] (50.39657° N, 30.51027° E). Route-based point survey around a pond in the northern part of the park. Records: ESER, NNOC, PNAT, PKUH, NNOC/NLEI, PKUH/PNAT, and NYC/EPT/VES.
12. **Stus Square** [UG] (50.454525° N, 30.358182° E). Route-based point survey. Records: ESER, NNOC, NNOC/NLEI, and NYC/EPT/VES.
13. **Stus St.** [HR] (50.460306° N, 30.361786° E). Route-based point survey. No bats were recorded.
14. **Sviatoshyn Pond** [WB] (50.45724° N, 30.33836° E). Route-based point survey along the north-eastern shore of Pond No. 15 within the Sviatoshyn pond cascade. Records: NNOC, PNAT, PKUH/PNAT, and NYC/EPT/VES.
15. **Vaskul St.** [HR] (50.457383° N, 30.350024° E). Route-based point survey along its western section. No bats were recorded.
16. **Vernadskyi Blvd.** [HR] (50.464827° N, 30.366918° E). Route-based point survey. No bats were recorded.

Other regions of Ukraine:

17. **Bar, Vinnytsia Obl.** [LR] (49.07003° N, 27.67764° E). Stationary survey in an area of two- to three-storey residential buildings on Shpakovych St. Record: PKUH/PNAT.
18. **Berehove, Zakarpattia Obl.** [RC, LR] (48.205074° N, 22.646034° E). Route-based point surveys conducted mainly along the channel of the Verke River and through adjacent residential areas, extending to the site where thermal water from a swimming pool is discharged into the river. Records: NNOC, PNAT, PKUH, PPYG, PKUH/PNAT, PAUR/PAUS, and NYC/EPT/VES.
19. **Dolynska, Kirovohrad Obl.** [HR] (48.11604° N, 32.78032° E). Stationary and route-based point surveys near unoccupied buildings on Nova St. that may serve as winter roosts. Records: NNOC, NNOC/NLEI, and NYC/EPT/VES.
20. **Kropyvnytskiy, Kirovohrad Obl.** [IND] (48.517388° N, 32.200371° E). Stationary survey on Vystavkova St. No bats were recorded.
21. **Soniachne, Kropyvnytskyi, Kirovohrad Obl.** [LR] (48.46460° N, 32.29581° E). Route-based point survey along the Kropyvnytskyi Ring Road. No bats were recorded.
22. **Lviv, Lviv Obl.** [UP, WB] (49.84692° N, 23.98536° E). Route-based point surveys near Levandivske Lake. No bats were recorded.
23. **Novoarkhangelsk, Kirovohrad Obl.** [LR] (48.661308° N, 30.809763° E). Route-based point survey along Ivan Franko St. and Kozatska St. No bats were recorded.
24. **Stebliv, Cherkasy Obl.** [LR] (49.406574° N, 31.084885° E). Stationary surveys in an area of one-storey residential housing. No bats were recorded.
25. **Zhashkiv, Cherkasy Obl.** [LR] (49.24629° N, 30.10515° E). Route-based point survey in an area of one- and two-storey residential housing along Shevchenko St. No bats were recorded.

Ultrasonic signals were recorded during route-based point and stationary surveys using three types of detectors: Song Meter SM4BAT FS Ultrasonic Recorder, Song Meter Mini Bat Ultrasonic-Acoustic Recorder, and Echo Meter Touch 2 PRO Bat Detector. Acoustic monitoring covered evening, full-night, and multi-day recording periods during the winter months of 2022 and 2024–2026. All recordings were made in WAV format. Only sequences of ultrasonic signals consistent with bat flight activity were included in the analysis. In total, 292.9 GB of audio files were obtained.

Recordings were initially processed using the licensed software Kaleidoscope Pro (version 5.6.5). The results of automated identification were manually verified by visual inspection of spectrograms and echolocation call parameters. Acoustic recordings were identified to species level only when ultrasonic-call parameters allowed reliable species assignment. Records with insufficiently diagnostic or overlapping acoustic characteristics were assigned to species pairs or acoustic groups. *Plecotus auritus* and *P. austriacus* could not be reliably distinguished from the available recordings and were therefore treated as a species pair.

Route-based point surveys were conducted during the first 2–3 hours after sunset. These surveys combined recording during movement along the route and stationary recording at survey points spaced approximately 200–300 m apart. Recording duration at each point was 5–10 min. During full-night stationary surveys, ultrasonic signals were recorded autonomously and continuously from sunset to sunrise.

Meteorological data were obtained from local weather stations and the *Meteopost.com* resource. For each survey, mean air temperature and atmospheric pressure were calculated for the corresponding recording period. The occurrence of precipitation was also recorded. Wind speed did not exceed 4 m s^{-1} during any survey. Only mean air temperature was included in the correlation analyses reported here.

Bat activity was standardised by recording effort and expressed as the number of acoustic registrations, interpreted as bat passes per recording hour. The relationship between bat activity and air temperature was assessed using Spearman's rank correlation in LibreOffice Calc 24.2.7.2. Spearman's ρ was used to quantify the direction and strength of the association, and statistical significance was assessed using p-values. For graphical presentation, bat activity was transformed as log10(x + 1), where x is the number of registrations per recording hour.

Taxon and acoustic-group abbreviations used in the study are as follows: ESER—*Eptesicus serotinus* (Schreber, 1774); NLEI—*Nyctalus leisleri* (Kuhl, 1817); NNOC—*Nyctalus noctula* (Schreber, 1774); PAUR—*Plecotus auritus* (Linnaeus, 1758); PAUS—*Plecotus austriacus* (Fischer, 1829); PKUH—*Pipistrellus kuhlii* (Kuhl, 1817) sensu lato; PNAT—*Pipistrellus nathusii* (Keyserling & Blasius, 1839); PPYG—*Pipistrellus pygmaeus* (Leach, 1825); NYC/EPT/VES—a species belonging to the genera *Nyctalus*, *Eptesicus* and *Vespertilio*; VGSP—a species of the family Vespertilionidae.

Results and Discussion

The surveys covered 25 sites in urban landscapes across Kyiv and five oblasts—Zakarpattia, Lviv, Vinnytsia, Cherkasy, and Kirovohrad (see: Fig. 1). Five species and one species pair were identified, while additional recordings were assigned to acoustic groups (Table 1).

A total of 3785 bat passes were verified during the winter months (December–February) of 2022 and 2024–2026. Mean air temperature during the surveys ranged from −14.6 °C to +8.6 °C. Most acoustic recordings were obtained in different districts of Kyiv. The largest numbers of identified bat passes were assigned to taxa in genera *Nyctalus* and *Pipistrellus*. The highest early-evening flight activity rate was 109 bat passes h^{-1} at Dolynska on 2 January 2026 (mean air temperature, +1.8 °C; Table 2 in Appendices). The highest full-night total was 262 bat passes at Bortnychi on the night of 07–08 February 2022, corresponding to 17.4 bat passes h^{-1} (mean air temperature, +1.4 °C; Table 3 in Appendices).

The highest number of winter bat passes was recorded for NNOC (n = 807), whereas the lowest totals were recorded for PPYG (n = 62) and the PAUR/PAUS pair (n = 63) (Fig. 2). NNOC was recorded at the greatest number of sites (n = 12), followed by ESER (n = 6), whereas PPYG (n = 3) and the PAUR/PAUS pair (n = 2) were the least widespread (Fig. 3). Bat flight activity was also confirmed visually at several localities, including Berehove, Bortnychi, and Dolynska. No bats were detected acoustically at 10 survey sites.

Early-evening bat activity during the first 2–3 hours after sunset was significantly associated with mean air temperature. Spearman's rank correlation indicated a moderately strong positive relationship, with bat activity increasing at higher mean air temperatures (Spearman's $\rho = 0.652$, $p = 0.00003$, $n = 34$; Fig. 4). For graphical visualisation of this relationship, bat activity was transformed as log10(x + 1), where x is the number of bat passes per recording hour.

A statistically significant positive relationship between mean air temperature and bat activity was also detected in the full-night recordings, with greater bat activity at higher mean air temperatures (Spearman's $\rho = 0.675$, $p < 0.000001$, $n = 62$; Fig. 5).

Table 1. Relative acoustic activity of bat species and species groups at the main survey sites

Таблиця 1. Відносна акустична активність видів та груп кажанів на основних ділянках дослідження

Locality	ESER	NNOC	PNAT	PAUR/PAUS	PKUH	PPYG	NNOC/NLEI	PKUH/PNAT
Kyiv, Bortnychi*	+++	+**	++	+	+	++	–	+
Kyiv, other	+	+++	+	–	++	+	+	–
Dolynska	–	+++	–	–	–	–	+	–
Bar	–	–	–	–	–	–	–	+
Beregove	–	+	++	+	+++	+	–	+

* The Bortnychi locality is considered separately because bat activity there is likely to be influenced by the elevated water temperature in the drainage channel; ** relative acoustic activity based on the distribution of verified bat passes across sites: +, low activity; ++, moderate activity; +++, high activity; – no records.

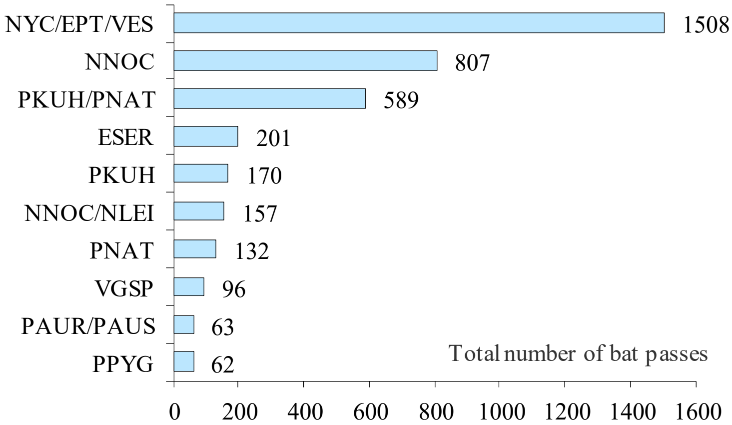

Fig. 2. Total number of acoustic bat passes by species and species groups. Bars show the total number of acoustic registrations rather than the number of individuals, as the same individual may have been recorded multiple times.

Рис. 2. Розподіл загальної кількості акустичних реєстрацій кажанів за видами і групами видів. Стовпчики показують загальну кількість акустичних реєстрацій, а не кількість особин, оскільки одна особина могла бути зареєстрована кілька разів.

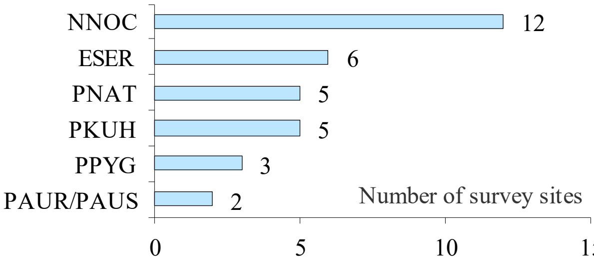

Fig. 3. Number of survey sites with bat records by species.

Рис. 3. Кількість пунктів реєстрації кажанів за видами.

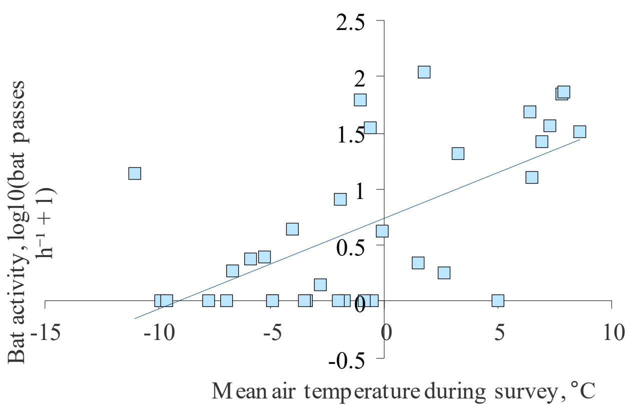

Fig. 4. Relationship between mean air temperature and early-evening bat activity during the first 2–3 hours after sunset (n = 34).

Рис. 4. Зв'язок між середньою температурою повітря та ранньовечірньою активністю кажанів у перші 2–3 години після заходу сонця (n = 34).

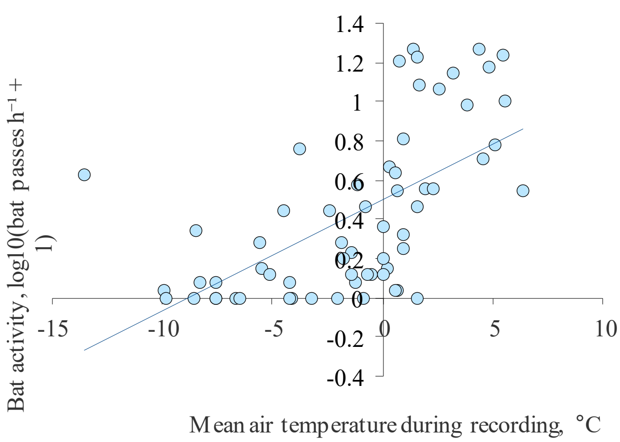

Fig. 5. Relationship between air temperature and full-night bat activity based on full-night recordings (n= 62).

Рис. 5. Зв'язок між температурою повітря та нічною активністю кажанів за даними повнонічних записів (n = 62).

Winter bat flight activity was also associated with local habitat characteristics. In particular, high flight activity was observed at sites with ice-free water bodies, including Beregove, Bortnychi, Sviatoshyn Pond, Rylskyi Park, and Nyvky Park.

The use of ice-free water bodies by bats during winter is consistent with previous studies suggesting that the need to restore water balance during hibernation as one of the drivers of winter emergence during arousals [Speakman *et al.* 1989; Ben-Hamo *et al.* 2013; Vanderwolf *et al.* 2017; Mas *et al.* 2022]. Winter emergence does not necessarily occur only after severe dehydration, but may form part of regular water-balance maintenance [Hays *et al.* 1992]. Access to free water and drinking during periodic arousals may therefore be an important factor for the survival of hibernating bats [Klüg-Baerwald *et al.* 2021].

In addition, the positive relationship between bat activity and air temperature may partly reflect the increased availability of flying insects on warmer winter evenings. Although insect activity in temperate regions is generally reduced during the cold season, several groups, including winter-active moths, chironomids and stoneflies, are capable of activity or flight at low temperatures [Heinrich *et al.* 1985; Soszyńska-Maj *et al.* 2016; Vebrová *et al.* 2018]. Winter warm spells may therefore create temporary foraging opportunities for bats.

Against the background of ongoing climate change, winter bat flight activity may increase. In northern and eastern Ukraine, the most pronounced winter warming during 1990–2021 was observed in December, reaching up to +1.2 °C per decade [Boychenko *et al.* 2025]. This trend is also reflected in the declining frequency and intensity of winter cold waves in Ukraine, as well as in the reduced number of both short-term and prolonged cold spells [Balabukh *et al.* 2025]. Projections further indicate that the number of frost days will continue to decline and that, by the end of the twenty-first century, some parts of the country may no longer experience days with below-zero temperatures [Wilson *et al*. 2021].

The acoustic dataset included some variation in detector type, recording duration, and survey replication among sites. Expressing activity as the number of bat passes per recording hour allowed differences in recording duration to be taken into account and facilitated comparisons among surveys. The broad spatial coverage and substantial number of verified bat passes provide a valuable baseline for documenting winter bat activity in urban landscapes across Ukraine.

Continued acoustic monitoring of winter bat flight activity is therefore important for monitoring winter activity, assessing population status and developing bat conservation strategies, as it can help identify key winter habitats and support the planning of measures for their protection.

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Declarations

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Conflict of interest. The authors declare no conflict of interest relevant to the content of this article.

Handling of materials: The study did not involve the use of live or collected material.

Use of artificial intelligence. No generative artificial intelligence tools were used in the preparation of the manuscript; only basic language editing tools were applied. All scientific results, interpretations, and text are original contributions of the authors.

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Appendices

Table 2. Bat activity (bat passes h⁻¹) and mean air temperature during route-based point surveys conducted within the first 2–3 hours after sunset

Таблиця 2. Активність кажанів (реєстрацій за годину) і середня температура повітря на маршрутно-точкових обліках у перші 2–3 години після заходу сонця

Region	Location	Date	Bat activity	°C
Kyiv	Bortnychi	2025-01-26	35.3	+7.3
—	—	2025-02-06	0	-1.8
—	—	2026-01-20	0	-7.8
—	—	2026-01-22	0	-4.9
—	—	2026-02-27	0.4	-2.8
—	—	2026-02-28	34.5	-0.6
Kyiv	Rylskyi Park	2025-01-29	70	+7.8
—	Irpinska St.	2025-02-07	3.5	-4.1
—	—	2025-02-02	1.2	+1.5
—	—	2025-02-08	1.5	-5.3
—	—	2025-01-18	19.7	+3.3
—	—	2026-01-18	12.8	-11.0
—	Peremoha Park	2025-02-01	0.8	+2.6
—	Stus Square	2025-01-30	48.3	+6.4
—	Sviatoshyn Pond	2025-01-27	61.5	-1.1
—	Nyvky Park	2025-02-28	11.8	+6.5
—	Pushyna Square	2025-02-11	0.9	-6.7
Kyiv	Popovych St.	2025-02-12	1.4	-5.9
—	Dobrokhotov St.	2025-02-13	7.0	-1.9
—	Vaskul St.	2026-01-19	0	-9.9
—	Palladin Ave.	2025-02-07	0	-3.4
—	Stus St.	2025-02-04	0	-0.5
—	Palladin route	2025-01-31	0	+5.0
—	Vernadskyi Blvd.	2025-02-09	0	-7.0
Zakarpattia Obl.	Beregove	2025-01-04	3.3	-0.1
—	—	2025-01-07	71	+7.9
—	—	2024-01-04	32	+8.6
—	—	2024-01-05	26	+7.0
Lviv Obl.	Lviv	2026-01-06	0	-3.5
—	—	2026-01-07	0	-4.9
Kirovohrad Obl.	Dolynska	2026-01-02	109	+1.8
—	Kropyvnytskyi_1	2026-01-04	0	-0.9
—	Novoarkhanhelsk	2026-02-07	0	-9.6
Cherkasy Obl.	Zhashkiv	2026-01-03	0	-2.0

Table 3. Full-night acoustic activity of bats (bat passes h⁻¹) expressed as bat passes per recording hour and mean air temperature

Таблиця 3. Активність кажанів (реєстрацій за годину) протягом нічного періоду і середня температура повітря

Location	Date	Bat activity	°C	Date	Bat activity	°C
Akademmistechko	2025-01-27/28	16.2	+5.7	2025-12-18/19	1.3	0.0
	2025-01-28/29	2.5	+6.4	2025-12-19/20	0.6	0.0
	2025-01-29/30	14.0	+4.8	2025-12-20/21	1.9	-0.8
	2025-01-30/31	17.4	+4.4	2025-12-21/22	1.9	+1.6
	2025-01-31/02-01	5.0	+5.1	2025-12-22/23	15.9	+1.6
	2025-02-01/02	0.8	+0.9	2025-12-23/24	4.8	-3.8
	2025-02-02/03	0.3	0.0	2025-12-24/25	0.1	-9.9
	2025-02-03/04	0.3	-0.7	2025-12-25/26	1.8	-4.5
	2025-02-04/05	0.3	-1.4	2025-12-26/27	1.1	+0.9
	2025-02-05/06	0.6	-1.8	2026-01-01/02	0.2	-8.3
	2025-02-07/08	0.3	-5.1	2026-01-02/03	0.9	-1.9
	2025-02-08/09	0	-6.7	2026-01-03/04	1.8	-2.4
	2025-02-09/10	0	-7.6	2026-01-04/05	0.2	-4.2
	2025-02-10/11	0	-7.6	2026-01-05/06	0.4	-5.5
	2025-02-28/03-01	15.2	+0.8	2026-01-06/07	0.3	-0.5
	2025-12-17/18	2.6	+2.3	2026-01-09/10	0	-8.6
Bortnychi	2022-01-28/29	2.5	+0.7	2022-02-08/09	5.4	+0.9
	2022-01-29/30	0	-2.0	2022-02-09/10	1.0	+3.2
	2022-01-30/31	0.1	+0.7	2022-02-10/11	8.6	+3.8
	2022-01-31/02-01	0	-0.9	2022-02-11/12	2.6	+1.9
	2022-02-01/02	0	-3.2	2022-02-12/13	0.2	-1.2
	2022-02-02/03	0.4	+0.2	2022-02-13/14	2.8	-1.1
	2022-02-03/04	0	-4.1	2022-02-14/15	0.7	-1.4
	2022-02-04/05	0.9	-5.6	2022-02-15/16	3.6	+0.3
	2022-02-05/06	0.1	+0.6	2022-02-16/17	0.0	+1.6
	2022-02-06/07	11.2	+1.7	2022-02-17/18	4.1	+4.6
	2022-02-07/08	17.5	+1.4	2022-02-18/19	10.6	+2.6
Bar	2025-02-22/23	0	-9.8	2025-02-23/24	0.2	-7.6
Novoarkhanhelsk	2025-02-16/17	0	-9.5			
Kropyvnytskyi	2025-02-17/18	0	-14.6			
Dolynska	2025-02-18/19	3.2	-13.5	2025-02-19/20	1.2	-8.5
Stebliv	2025-02-24/25	0	-6.5	2025-02-25/26	0	-4.2