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THE EFFECTS OF METEOROLOGICAL FACTORS ON URBAN BUTTERFLY FAUNA: INSIGHTS FROM A LIGHT TRAP STUDY

Abstract. During our research, we collected moths using light traps in Mukachevo, one of the largest cities in the Carpathian Basin, with the aim of exploring the composition of the local moth fauna and examining the effects of meteorological factors (daily mean, minimum, and maximum temperatures, relative humidity, and daily precipitation) on the number of individuals collected. Using light traps, we recorded 51 moth species, including several that are well adapted to urban environments and are of notable agroecological importance (e.g., Cydia pomonella, Ostrinia nubilalis, Plutella xylostella).

The results of the ordination and variance analyses indicated that meteorological parameters explained a significant, albeit relatively small, proportion of the daily variability in the moth assemblages. Temperature-related factors, particularly minimum and maximum temperatures, proved to be the most influential, whereas the effects of relative humidity and precipitation were comparatively moderate.

Our findings confirm that the efficiency of light-trap sampling in urban environments is strongly influenced by prevailing weather conditions, which affect moth flight activity over both short- and medium-term timescales. This underscores the importance of considering the complex interactions between local microclimate and meteorological factors in ecological studies of urban moth fauna, particularly in the context of the growing impacts of climate change and urbanization.

Keywords: Lepidoptera, light trap, weather conditions, Mukachevo, Zakarpattia Region.

Introduction. During our research, we collected moths using light traps in Mukachevo, one of the largest cities in the Carpathian Basin. In addition to studying the local moth fauna, we were also interested in assessing the effectiveness of a light trap powered by a low-power household light bulb in an urban environment, and in examining how meteorological factors such as average daily temperature, daily minimum and maximum temperatures, relative humidity, and daily precipitation influence the number of specimens collected. Previous research has shown that, in addition to food availability and anthropogenic disturbances, weather conditions can significantly affect the flight activity of many insect species and, consequently, the efficiency of light-trap collections (Steinbauer, Haslem, & Edwards, 2011; Jonason, Franze, & Ranius, 2014). For many insect species, it is likely that the spectral composition of nighttime lighting is more biologically relevant than light intensity itself (Longcore & Rich, 2004), highlighting the importance of reducing light pollution in both urban and nature conservation areas.

We selected the city of Mukachevo as our study site because it is situated at the transition zone between the Carpathian Plain and the surrounding mountainous region. The Latorica River flows through the city, which is characterized by extensive forests adjacent to populated areas, as well as agricultural zones and urban park-like habitats.

Previously, Heriak, (2010, 2012, 2021), Popov (2004), Liashenko, (2009), Szanyi, Nagy, & Varga (2015), Szanyi, Nagy, & Varga (2018), Kanarsky, Geryak, & Lyashenko (2011), Matsiakh (2020), and Vass, Hadnagy, Kohut, & Kolozsvári (2023) examined the composition of the butterfly fauna in the region; however, current lepidopterological data for the city are lacking. The study of butterfly fauna inhabiting urban environments has recently gained increased attention, as evidence suggests that climate change, urbanization, and artificial light sources exert significant influences on butterfly population dynamics (Vass, Hadnagy, Kohut, & Kolozsvári, 2023).

The efficiency of light traps in capturing moths may be closely linked to prevailing meteorological conditions. Previous research has demonstrated that meteorological factors distinctly affect the number of moths captured in traps and that the population-level effects of these factors can be effectively traced in long-term datasets (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006). The local microclimate of urban environments may further intensify these influences.

In recent years, Vass and colleagues (2023) have conducted a detailed analysis of the role of weather factors in the Carpathian region, finding that fluctations in temperature and humidity were closely associated with trapping success. The combined interaction of these factors substantially affects the interpretability of catch data, particularly in urban settings. Therefore, in studies of urban butterfly fauna, it is essential to account for the complex impacts of meteorological conditions for drawing reliable ecological conclusions (Yela, & Holyoak, 1997).

Materials and methods.

Field work. Mukachevo is located in the central part of the Zakarpatska Region and covers an area of 27.9 km². The collection site (48.451493, 22.727805) lies near the Latorca River, which divides the city into two parts, and is adjacent to the 10.9-hectare Central Park. The park's woody vegetation comprises Japanese cherry (*Prunus serrulata*), magnolia (*Magnolia*), apple (*Malus*), tulip tree (*Liriodendron tulipifera*), birch (*Betula*), catalpa (*Catalpa*), and oak (*Quercus*) species. The surrounding gardens include additional fruit trees: cherry, sour cherry, apple, walnut (*Juglans*), plum (*Prunus*), and pear (*Pyrus*), as well as wild rose (*Rosa canina*).

According to the Köppen–Geiger classification (Kottek et al. 2006), the region's climate is classified as warm-summer humid continental (Dfb). Based on the CarpatClim climate atlas (Szalai et al. 2013) and grid point data No. 1572 for the period 1961-2010, the mean annual temperature is 10.1 °C. The coldest month is January (-2.4 °C), and the warmest is July (20.4 °C). The summer and winter seasons are clearly distinct. On a multi-year average, mean temperatures in December, January, and February remain below 0 °C, while monthly mean temperatures from April to October exceed 10 °C. The average annual precipitation is 710 mm, distributed relatively evenly throughout the year. June is the wettest month (80 mm) and March the driest (48 mm). The growing season, defined by a daily mean air temperature of at least 5.5 °C, lasts approximately 245 days per year.

A Jermy-type light trap was used to collect specimens in the northeastern part of the city, an area characterized primarily by residential buildings and small gardens. The trap was positioned 2 meters above ground level and equipped with a 100 W conventional light bulb as the light source. It was operated nightly between 8:00 p.m. and 5:00 a.m. (CET). Moths captured in the collection container were anaesthetized with ethyl acetate and subsequently preserved by freezing until taxonomic identification. The sampling period extended from April to August 2024. In total, the trap was operated 67 times on the following dates: 04.01., 04.02., 04.02., 04.03., 04.03., 04.04., 04.04., 04.05., 04.06., 04.07., 04.09., 04.10., 04.11., 04.12., 04.12., 04.13., 04.16., 04.17., 04.19., 04.20., 04.20., 04.21., 04.23., 04.24., 04.24., 04.25., 04.26., 04.27., 04.28., 04.29., 04.28., 04.29., 04.29., 04.30., 05.01., 05.02., 05.02., 05.03., 05.05., 05.06., 05.06., 05.07., 05.09., 05.10., 05.10., 05.11., 05.11., 05.12., 05.12., 05.13., 05.22., 05.23., 05.23., 05.24., 05.25., 05.26., 05.26., 05.27., 05.27., 05.28., 06.01., 06.02., 06.02., 06.03., 06.06., 06.07., 06.07., 06.08., 06.13., 06.14., 06.16., 06.17., 06.17., 06.18., 06.19., 06.20., 06.22., 06.23., 06.26., 06.27., 07.07., 07.08., 07.09., 07.10., 07.10., 07.11., 07.12., 07.13., 07.13., 07.14., 07.14., 07.15., 07.15., 07.16., 07.18., 07.19., 07.19., 07.20., 07.20., 07.21., 07.22., 07.23., 07.23., 07.24., 07.27., 07.28., 07.28., 07.29., 07.29., 07.30., 08.03., 08.04., 08.04., 08.05., 08.06., 08.07., 08.16., 08.17., 08.17., 08.18., 08.20., 08.21., 08.21., 08.22., 08.23., 08.24., 08.24., 08.25., 08.25., 08.26., 08.28., 08.29., 08.29., 08.30.

Data analysis. Statistical analyses were performed using Microsoft Excel 2019 and PAST version 4.50 (Hammer, Harper, & Ryan, 2001). Meteorological data were obtained from measurements recorded at the meteorological station located in the József Szikura Botanical Garden of the II. Rákóczi Ferenc Carpathian Hungarian College in Nagybereg.

The relationships between environmental variables and variations in the abundance of individual butterfly species were analysed using redundancy analysis (RDA; Legendre & Legendre, 1998), canonical correspondence analysis (CCA), one-way analysis of variance (one-way ANOVA), and linear correlation tests. Temporal effects of environmental variables on fluctuations in the total number of butterfly species were examined through cross-correlation analyses.

Results and Discussion. During the light-trap sampling, a total of 336 individuals representing 51 butterfly species were collected: (1) *Acrocercops brongniardella* (Fabricius, 1798), (2) *Achroia grisella* (Fabricius, 1794), (3) *Agrotis exclamationis* (Linnaeus, 1758), (4) *Agriphila inquinatella* (Denis & Schiffermüller, 1775), (5) *Anania verbascalis* (Denis & Schiffermüller, 1775), (6) *Anticlea derivata* (Denis & Schiffermüller, 1775), (7) *Apotomis lacunana* (Denis & Schiffermüller, 1775), (8) *Argyresthia spinosella* (Stainton, 1849), (9) *Catoptria falsella* (Denis & Schiffermüller, 1775), (10) *Celypha striana* (Denis & Schiffermüller, 1775), (11) *Clepsis rurinana* (Linnaeus, 1758), (12) *Cydia pomonella* (Linnaeus, 1758), (13) *Ephestia kuehniella* Zeller, 1879, (14) *Epermenia iniquella* (Wocke, 1867), (15) *Hedya ochroleucana* (Frölich, 1828), (16) *Hypsopygia costalis* (Fabricius, 1777), (17) *Idaea dimidiata* (Hufnagel, 1767), (18) *Idaea politaria* (Hübner, 1799), (19) *Idaea seriata* (Schrank, 1802), (20) *Macdunnoughia confusa* (Stephens, 1850), (21) *Macrochilo cribrumalis* (Hübner, 1793), (22) *Mesoligia furuncula* (Denis & Schiffermüller, 1775), (23) *Monopis obviella* (Denis & Schiffermüller, 1775), (24) *Nomophila noctuella* (Denis & Schiffermüller, 1775), (25) *Notocelia cynosbatella* (Linnaeus, 1758), (26) *Ochropleura plecta* (Linnaeus, 1761), (27) *Oligia latruncula* (Denis & Schiffermüller, 1775), (28) *Oncocera semirubella* (Scopoli, 1763), (29) *Orthotaenia undulana* (Denis & Schiffermüller, 1775), (30) *Ostrinia nubilalis* (Hübner, 1796), (31) *Ostrinia scapulalis* (Walker, 1859), (32) *Pandemis heparana* (Denis & Schiffermüller, 1775), (33) *Parectopa robiniella* (Clemens, 1863), (34) *Patania ruralis* (Scopoli, 1763), (35) *Pelosia muscerda* (Hufnagel, 1766), (36) *Peribatodes rhomboidaria* (Denis & Schiffermüller, 1775), (37) *Phalonidia contractana* (Zeller, 1847), (38) *Phragmatobia fuliginosa* (Linnaeus, 1758), (39) *Platyedra subcinerea* (Haworth, 1828), (40) *Plutella xylostella* (Linnaeus, 1758), (41) *Pyrausta despicata* (Scopoli, 1763), (42) *Pyrausta purpuralis* (Linnaeus, 1758), (43) *Rivula sericealis* (Scopoli, 1763), (44) *Spilosoma lubricipeda* (Linnaeus, 1758), (45) *Syndemis musculana* (Hübner, 1799), (46) *Thisanotia chrysonuchella* (Scopoli, 1763), (47) *Timandra comae* (Schrank, 1802), (48) *Tineola bisselliella* (Hummel, 1823),
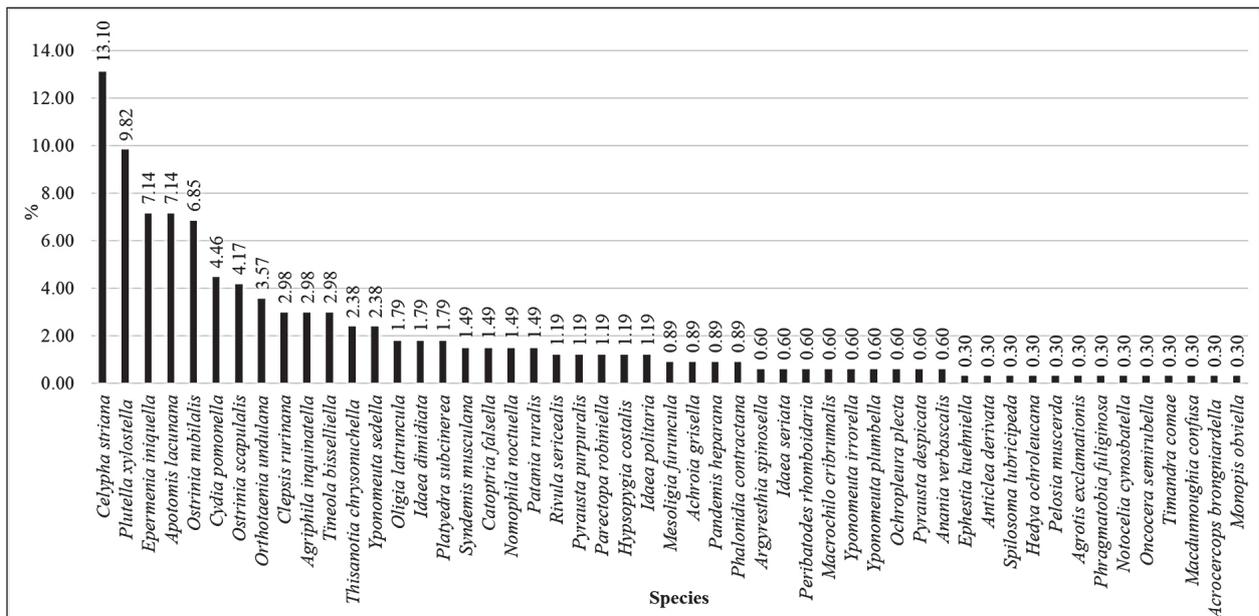
*Fig. 1. **Quantitative ratios of members of the Lepidoptera species identified in the samples.***

(49) *Yponomeuta irrorella* (Hübner, 1796), (50) *Yponomeuta plumbella* (Denis & Schiffermüller, 1775), (51) *Yponomeuta sedella* (Treitschke, 1832).

During the sampling period, the highest frequencies of occurrence were recorded for *Celypha striana*, *Plutella xylostella*, *Epermenia iniquella*, *Apotomis lacunana*, *Ostrinia nubila*, *Cydia pomonella*, and *Orthotaenia undulana* (Fig. 1). Light-trap sampling was not conducted throughout the entire vegetation period; therefore, additional species active in autumn may also occur in the study area.

We analysed the effects of environmental variables on the efficiency of light-trap sampling of butterfly species from multiple perspectives. Based on daily individual counts per species, the results of redundancy analysis (RDA) indicated that the examined meteorological variables (daily mean, minimum, and maximum temperatures, relative humidity, and daily precipitation) significantly, though only to a limited extent, explained the daily variability of the butterfly fauna (R^2 = 0.1453; R^2adj = 0.07409; F = 2.04; Perm. *p* = 0.002). Figure 2 clearly demonstrates that certain species—such as *(7) Apotomis lacunana*, *(10) Celypha striana*, *(31) Ostrinia scapulalis*, *(40) Plutella xylostella*, and *(51) Yponomeuta sedella* are more distinctly separated in the ordination space, suggesting that their occurrence and activity are more sensitive to fluctuations in meteorological parameters. In contrast, most species are clustered near the centre of the coordinate system, indicating a more moderate response to environmental variation, at least with respect to the variables analysed.

The trend in individual abundance shows correlation with temperature extremes (minimum and maximum) and relative humidity; however, the proportion of explained variance remains relatively low (R^2 = 0.1453; R^2adj = 0.07409; F = 2.04; Perm. *p* = 0.002). This suggests that, in addition to meteorological factors, other ecological and biotic variables (e.g., food source availability, predation, population dynamics, and anthropogenic influences) may also exert a significant impact on the composition and development of butterfly fauna during sampling.

Based on the results of canonical correspondence analysis (CCA) conducted on the same dataset, the composition of species assemblages exhibited a similarly strong relationship with meteorological variables. The first axis (eigenvalue = 0.322; *p* = 0.042) primarily reflected the negative effects of precipitation, mean temperature, and minimum temperature. This axis likely represents a gradient ranging from wet and cool to dry and warm conditions, along which several species were differentiated. *Pelosia muscerda* and *Macrochilo cribrumalis* were associated with drier, warmer periods, whereas *Spilosoma lubricipeda* and *Ephestia kuehniella* occurred in greater numbers during cooler, wetter periods.
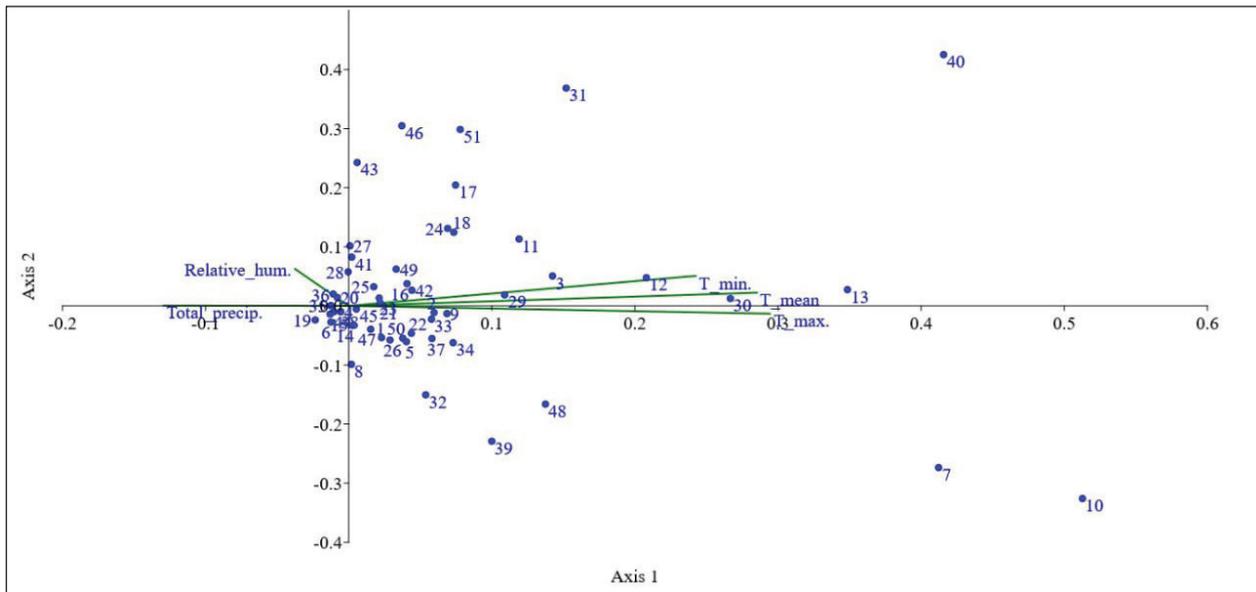
*Fig. 2. **Result of the redundancy analysis on the number of Lepidoptera species and the 5 meteorological variables studied (T_mean – Mean daily temperature, T_max. – daily maximum temperature, T_min. – daily minimum temperature, Relative_hum. – relative humidity, Total_precip. – total precipitation).***

The second axis (eigenvalue = 0.308; p = 0.001) showed a strong correlation with minimum temperature, mean temperature, and relative humidity. This axis represents a gradient from warm and humid to cool and dry conditions. Species responding more favourably to higher nighttime temperatures and greater humidity (e.g., *Idaea dimidiata*, *Yponomeuta sedella*) were positioned on the positive side of the axis, while those located closer to the negative side (e.g., *Anticlea derivata*, *Argyresthia spinosella*) were associated with cooler, less humid nights.

The third axis (eigenvalue = 0.283; p = 0.001) exhibited a weaker and more complex pattern in relation to the environmental vectors, which may indicate that the organization of species assemblages is influenced not only by the main climatic gradient variables but also by other factors that were not examined in the present study.

In addition to the ordination analysis of daily individual numbers per species, we also compared the daily total numbers of collected butterfly species with the values of the examined meteorological parameters using a one-way analysis of variance (ANOVA). The ANOVA revealed a significant difference in the mean numbers of individuals among the groups (F = 1113, df = 5.264, p < 0.001). The relationship was also found to be significant in this approach (ω^2 = 0.954), indicating that more than 95% of the variance in individual numbers is explained by weather variables (Vargroup = 581.7, Varerror = 23.5, p < 0.001; Levene's test). Daily temperature fluctuations, relative humidity, and precipitation significantly influence the flight dynamics of moths. This finding is consistent with the well-established ecological observation that temperature and humidity fundamentally determine the nocturnal activity of insects, while precipitation frequently acts as a direct limiting factor on flight and, consequently, on trapping efficiency. All these findings suggest that local climatic conditions exert a pronounced influence on the composition of butterfly communities even in the short term, which may represent an important factor when interpreting the results of population dynamics research and long-term monitoring studies.

In the correlation analysis, among the meteorological variables examined, daily average temperature (r = 0.466, p < 0.01), maximum temperature (r = 0.455, p < 0.01), and minimum temperature (r = 0.425, p < 0.01) exhibited significant positive correlations with the total number of individuals captured in light traps. From this, it can be concluded that butterfly activity increases on warmer days, resulting in higher trap catches. A weak, non-significant positive correlation was observed between relative humidity and the number of individuals (r = 0.085, p = 0.58). In contrast, a significant negative correlation was detected between daily precipitation and total daily catches (r = -0.334, p < 0.05), indicating that the number of individuals captured decreases on rainy days.
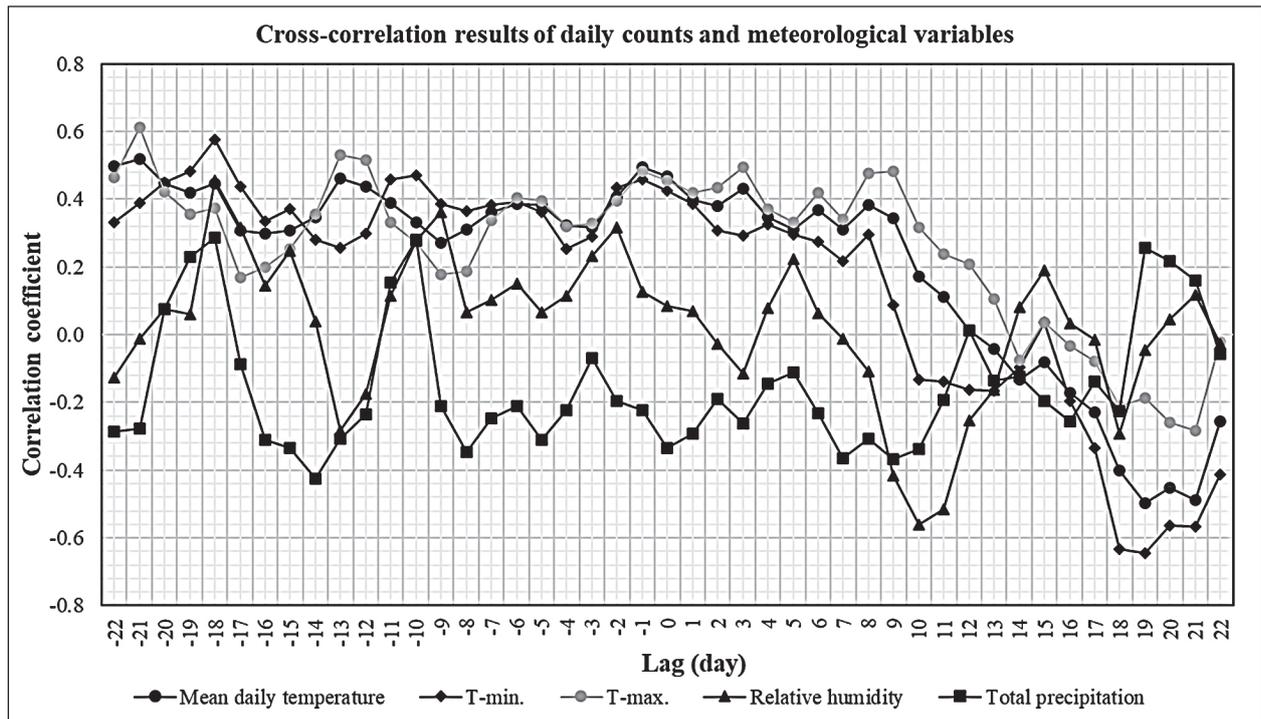
Fig. 3. ***Cross correlation results of daily counts and meteorological variables.***

We also sought to determine whether the measured meteorological variables influenced the development of individual numbers over a longer period. To address this question, we conducted cross-correlation analyses; however, due to the relatively short sampling period, these results should be regarded as preliminary and are presented for informational purposes only.

The daily total count and the daily minimum and maximum temperatures emerged as the most significant influencing factors. Higher temperatures markedly increased butterfly flight activity in the short term (minimum temperature: $r = 0.576$, lag = –18 days, $p < 0.01$; maximum temperature: $r = 0.611$, lag = –21 days, $p < 0.01$). Relative humidity exhibited a moderate stimulating effect on moth abundance in the short term ($r = 0.456$, lag = –18 days, $p < 0.05$), whereas delayed negative correlations ($r = –0.561$, lag = 10 days, $p < 0.01$) suggested a suppressive effect of sustained humidity. Precipitation inhibited flight activity, with the strongest negative correlations observed during the immediately preceding days ($r = –0.424$, lag = –14 days, $p < 0.05$).

Conclusions. As a result of our light trap collections of butterflies conducted in the city of Mukachevo (Zakarpattia region, Ukraine) in 2024, we identified 336 individuals representing 51 species. The light trap, powered by a household light source, proved effective in revealing the fundamental structure of the local moth community; however, our findings also demonstrated that the trap's efficiency was strongly influenced by meteorological conditions. Ordination and variance analyses confirmed that temperature parameters, particularly daily minimum and maximum temperatures, were closely and significantly associated with the daily activity of moths. Based on cross-correlation analyses, we conclude that local microclimatic conditions also affect the long-term flight dynamics of moth species.

Our results align with previous studies indicating that temperature and humidity play primary roles in determining the nocturnal activity of insects, whereas precipitation can directly constrain flight and light trapping. Nevertheless, beyond meteorological factors, other ecological and anthropogenic influences, such as the availability of food sources, light pollution, and habitat characteristics, may also significantly contribute to population dynamics. In the context of light trap collections conducted in urban environments, temperature factors appear to be the principal determinants of population dynamics, while humidity and precipitation exert secondary effects.

REFERENCES

Hammer, Ø., Harper, D. A. T., & Ryan, P. D. (2001). PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica*, 4, 1-9.

Heriak, Yu. M. (2010). Luskokryli nadrodyny Noctuoidea (Insecta, Lepidoptera) Zakarpatskoi oblasti [Lepidoptera of the super-family Noctuoidea (Insecta, Lepidoptera) in the Zakarpattia region]. *Naukovyi visnyk Uzhhorodskoho universytetu. Seriia: Biolohiia* [Scientific Bulletin of Uzhhorod University. Series: Biology], 29, 126-139. Retrieved from https://www.research-gate.net/publication/322677496_The_Noctuoidea_Insecta_Lepidoptera_of_the_Transcarpathian_region_in_Ukrainian [in Ukrainian].

Heriak, Yu. M. (2012). Novi ta malovidomi vydy Noctuoidea (Lepidoptera, Insecta) Ukrainskykh Karpat [New and little-known species of Noctuoidea (Lepidoptera, Insecta) of the Ukrainian Carpathians]. *Naukovyi visnyk Uzhhorodskoho universytetu. Seriia: Biolohiia* [Scientific Bulletin of Uzhhorod University. Series: Biology], 33, 105-119. Retrieved from http://nbuv.gov.ua/UJRN/Nvuu_2012_33_18 [in Ukrainian].

Heriak, Yu. M. (2021). *Ekolohichni kompleksy noktuoidnykh luskokrylykh (Lepidoptera, Noctuoidea) Ukrainskykh Karpat* [Ecological complexes of Noctuoidea Lepidoptera (Lepidoptera, Noctuoidea) of the Ukrainian Carpathians]. (PhD dissertation). State Natural History Museum of the National Academy of Sciences of Ukraine, Lviv. Retrieved from https://ecoinst.org.ua/pdf/Heriak-Yurii-dysertatsiia.pdf [in Ukrainian].

Jonason, D., Franze, M., & Ranius, T. (2014). Surveying Moths Using Light Traps: Effects of Weather and Time of Year. *PLoS One*, 9 (3), e92453. DOI: 10.1371/journal.pone.0092453

Kanarskyi, Y., Geryak, Y., & Lyashenko, E. (2011). Ecogeographic structure of the moth fauna (Lepidoptera, Drepanoidea, Bombycoidea, Noctuoidea) in upper Tisa river basin and adjacent areas (Ukraine). In *The Upper Tisa River Basin: Transylvanian Review of Systematic and Ecological Research* (Vol. 11, pp.143-168). Sibiu. Retrieved from https://www.researchgate.net/publication/322677140_Ecogeographic_structure_of_the_moth_fauna_Lepidoptera_Drepanoidea_Bombycoidea_Noctuoidea_in_upper_Tisa_river_basin_and_adjacent_areas_Ukraine

Kottek, M., Grieser, J., Beck, Ch., Rudolf, B., & Rubel, F. (2006). World Map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift*, 15 (3), 259-263. DOI: 10.1127/0941-2948/2006/0130

Legendre, P., & Legendre, L. (1998). *Numerical Ecology* (2nd English ed.). Amsterdam ; Boston; London: Elsevier.

Liashenko, Ye. K. (2009). Vydovyi sklad, chyselnist ta biotopichnyi rozpodil brazhnykiv (Lepidoptera, Sphingidae) Zakarpattia [Species composition, abundance, and biotopic distribution of hawk moths (Lepidoptera, Sphingidae) in Transcarpathia]. *Naukovyi visnyk Uzhhorodskoho universytetu. Seriia: Biolohiia* [Scientific Bulletin of Uzhhorod University. Series: Biology], 25, 167-170. Retrieved from https://dspace.uzhnu.edu.ua/jspui/handle/lib/7631 [in Ukrainian].

Longcore, T., & Rich, C. (2004). Ecological light pollution. *Frontiers in Ecology and the Environment*, 2, 191-198. DOI: 10.1890/1540-9295(2004)002[0191:ELP]2.0.CO;2

Matsiakh, I. P. (2021). Invaziini chuzhoridni patoheny yak zahroza hlobalnomu bioriznomanittiu [Invasive alien pathogens as a threat to global biodiversity]. *Naukovi pratsi Lisivnychoi akademii nauk Ukrainy* [Scientific Works of the Forestry Academy of Sciences of Ukraine], 22, 11-26. DOI: https://doi.org/10.15421/412101 [in Ukrainian].

Popov, S. H. (2004). Vydy dennykh metelykiv (Lepidoptera: Hesperioidea, Papilionoidea), shcho potrebuiut okhorony v Zakarpatskii oblasti [Species of butterflies (Lepidoptera: Hesperioidea, Papilionoidea) that need protection in the Zakarpattia region]. *Naukovyi visnyk Uzhhorodskoho universytetu. Seriia: Biolohiia* [Scientific Bulletin of Uzhhorod University. Series: Biology], 15, 98-101. Retrieved from https://dspace.uzhnu.edu.ua/jspui/handle/lib/58299 [in Ukrainian].

Steinbauer, M. J., Haslem, A., & Edwards, E. D. (2012). Using meteorological and lunar information to explain catch variability of Orthoptera and Lepidoptera from 250 W Farrow light traps. *Insect Conservation and Diversity*, 5, 367-380. DOI: 10.1111/j.1752-4598.2011.00170.x

Szanyi, Sz., Nagy, A., & Varga, Z. (2018). Diversity and concordance in the composition of butterfly assemblages of the Transcarpathian (Bereg) plain (SW Ukraine). *Biologia*, 73, 951-964. DOI: https://doi.org/10.2478/s11756-018-0102-x

Szanyi, Sz., Nagy, A., & Varga, Z. (2015). Butterfly assemblages in fragmented meadow habitats of the Pre-Carpathian lowland (Bereg plain, SW Ukraine). *Applied Ecology and Environmental Research*, 13 (3), 615-626. DOI: 10.15666/aeer/1303_615626

Vass, G., Hadnagy, I., Kohut, E., & Kolozsvári, I. (2023). Experience from a light trap Lepidoptera survey in a populated settlement: effects of meteorological factors and changes in lunar. *GEO&BIO*, 25, 121-133. DOI: https://doi.org/10.53452/gb2509

Yela, J. L., & M. Holyoak. (1997). Effects of Moonlight and Meteorological Factors on Light and Bait Trap Catches of Noctuid Moths (Lepidoptera: Noctuidae). *Environmetal Entomology*, 26 (6), 1283-1290. DOI: 10.1093/ee/26.6.1283

ВПЛИВ МЕТЕОРОЛОГІЧНИХ ЧИННИКІВ НА МІСЬКУ ФАУНУ МЕТЕЛИКІВ: ДОСВІД ДОСЛІДЖЕННЯ З ВИКОРИСТАННЯМ СВІТЛОВОЇ ПАСТКИ

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Анотація. *У ході нашого дослідження ми проводили відлови метеликів за допомогою світлопасток у одному з найбільших міст Закарпатської низовини Мукачеві. Метою було виявити склад місцевої лепідоптерофауни та дослідити вплив метеорологічних факторів (середньодобова, мінімальна та максимальна температура, відносна вологість повітря, добова кількість опадів) на кількість зібраних особин. За допомогою світлопастки вдалося зібрати 51 види метеликів, серед яких кілька добре пристосованих до міського середовища, а також види, що мають важливе агроекологічне значення (Cydia pomonella, Ostrinia nubilalis, Plutella xylostella). Результати ординаційного та дисперсійного аналізів показали, що метеорологічні параметри мали статистично значущий, хоча відносно помірний вплив на щоденну мінливість лепідоптерофауни. Найбільш визначальними факторами виявилися*

температурні показники, особливо мінімальна та максимальна температура, тоді як вплив відносної вологості та кількості опадів був менш вираженим. Наші результати підтверджують, що ефективність відловів метеликів світлопастками у міському середовищі суттєво залежить від актуальних погодних умов, які впливають на динаміку льоту як у коротко-, так і в середньостроковій перспективі. Це підкреслює важливість комплексного врахування локального мікроклімату та метеорологічних факторів під час екологічних досліджень міської лепідоптерофауни, особливо в умовах посилення впливу змін клімату та урбанізації.

Ключові слова: *Lepidoptera, світлова пастка, погодні умови, Мукачево, Закарпатська область.*