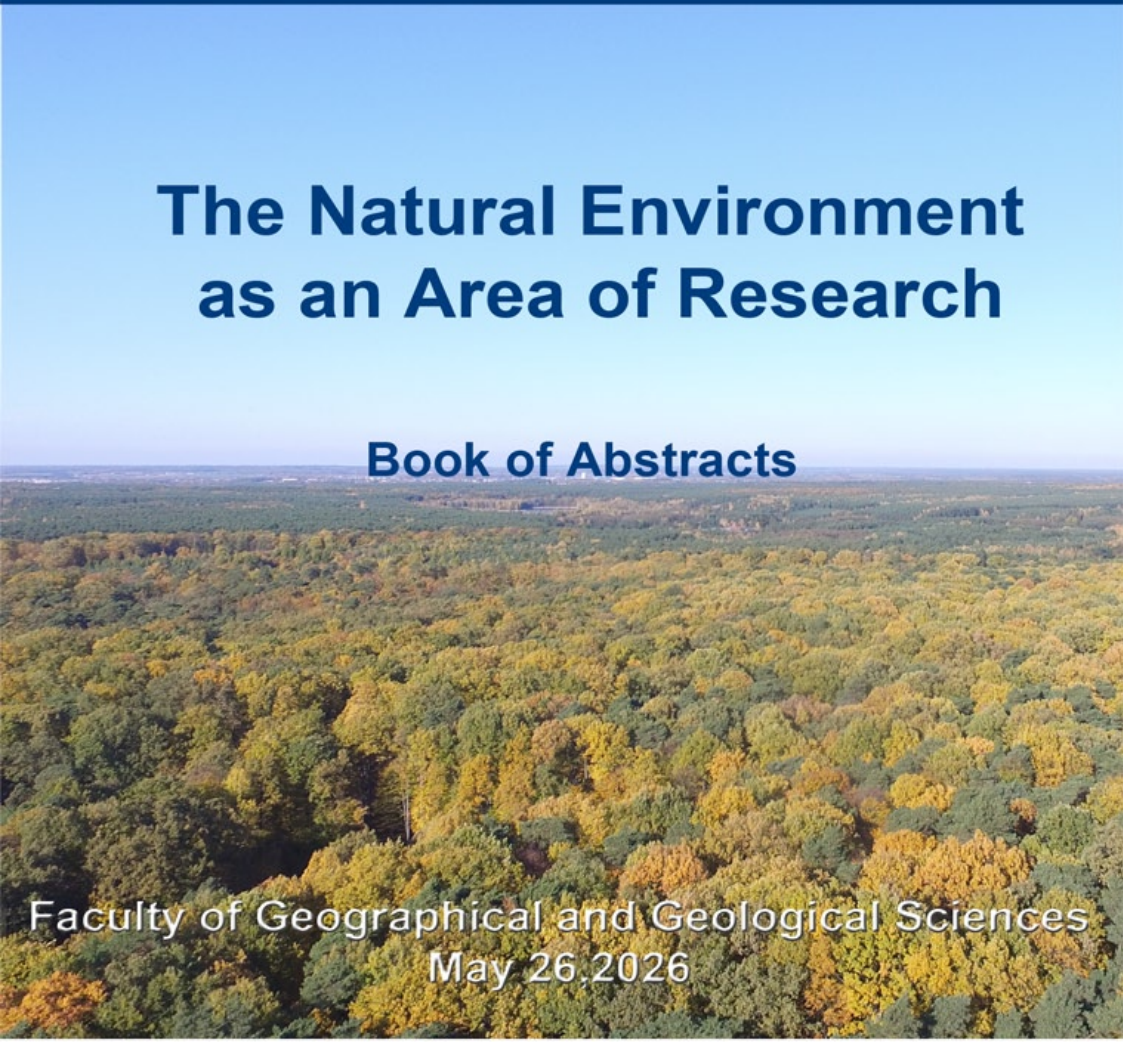
8th Conference

The Natural Environment as an Area of Research

Book of Abstracts



Faculty of Geographical and Geological Sciences
May 26,2026

Adam Mickiewicz University
Poznań

Higher School of Environment Management in Tuchola
Adam Mickiewicz University
Poznań University of Life Sciences
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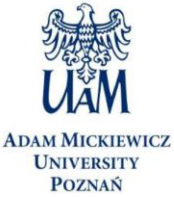

8th Conference

"The Natural Environment as an Area of Research"

under the honorary patronage

Marcello Coradini

Book of Abstracts

Poznań, May 26, 2026

This publication contains a collection of abstracts of papers presented by the participants of the 8th Conference titled "The Natural Environment as a Research Area", held on May 26, 2026, on the MS Teams platform.

konferencja.wngig@gmail.com

Typesetting was based on the texts provided by the Authors. The Authors of the abstracts bear full responsibility for the content and substantive value of their work. Abstract selection: Organizing Committee and Scientific Committee of the Conference Editor: Karolina Walczak Cover design: Karolina Walczak Cover photo: Adam Młynarczyk

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Karolina Walczak – Chairwoman of the Organizing Committee (Adam Mickiewicz University, Poland)

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09:00 – 09:05 Conference Opening - Rector of Higher School of Environment Management in Tuchola

09:05 – 09:25 **Keynote speaker:** Józef Antonowicz - Biogenic substances in the hydrosphere-atmosphere and hydrosphere-bottom sediments interfaces of four lakes differing in the degree of anthropopression.

Sesja 1 – Moderator: Krystyna Kannenberg

09:45 – 10:00 Maciej Grobelski - Fusion and reduction: modifications of the eye features of glossiphoniid leeches

10:00 – 10:15 Paula Milniczuk, Joanna Lech, Edyta Paczos-Grzęda - Analysis of genetic diversity of selected oat cultivars (*Avena sativa L.*) using ISSR markers

10:15 – 10:30 Anna Sobieraj-Betlińska, Piotr Szefer - From woody elements to grasslands: contrasting wild bee community patterns across semi-natural habitat types

10:30 – 10:45 Michał Kułakowski - Occurrence of stroma-forming *Epichloë* endophytes in grasses within Cytadela Park, Poznań, Poland

10:45 – 11:00 Diana Fiedorowicz, Marta Bełka - Variety of mycobiota on ash wood in an alder-ash forest

Sesja 2 – Moderator: Sławomir Królewicz

11:15 – 11:30 Adam Waśniewski, Bogdan Zagajewski, Agata Hościło - Transfer learning for land cover classification, assessing spatial and temporal transferability of Sentinel-2 models

11:30 – 11:45 Daria Dobrogowska, Joanna Pluto-Kossakowska - Detection of wet snow using Sentinel-1 SAR Data in the Hornsund Region, Svalbard

11:45 – 12:00 Grzegorz Górniak, Mieczysław Kunz - Application of Deep Learning Methods for Land Cover Change Analysis in the Northern Part of Toruń in the Years 2017–2025

12:00 – 12:15 Natalia Jasiak, Jakub Ceglarek, Jan Piekarczyk, Gabriela Woźniak - Assessment of the habitat potential of the Sośnica spoil heap using optical and LiDAR data

12:15 – 12:30 Adam Chudziński - The Historical Geoportal as a Digital Tool for Analysing Environmental Change

12:30 – 12:45 Karolina Walczak, Adam Młynarczyk, Monika Konatowska, Paweł Rutkowski - Automated Detection of *Actaea spicata L.* Using Deep Neural Networks: New Perspectives in the Inventory and Monitoring of Natural Forest Habitats

Sesja 3 – Moderator: Bożena Sikora

13:00 – 13:15 Maria Grzegorzek - Occurence of *Thelazia* spp. Nematodes in the Bieszczady population of European Bison (*Bison bonasus*) - Analysis of field material

13:15 – 13:30 Paulina Foremniak, Karolina Hoppe - Invisible Risk: How Mycotoxins Affect Fetal Development

13:30 – 13:45 Iga Szostak, Natalia Kiryluk, Zbigniew Bełkot, Joanna Pławińska-Czarnak - The European hare (*Lepus europaeus*) as a source of infection with bacteria from the *Campylobacter* family in the Lublin Upland

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14:00 – 14:15 Iga Szostak, Wiktoria Sikora, Anna Mężyk, Zbigniew Bełkot, Joanna Pławińska-Czarnak - Prevalence of bacterial pathogens in free-ranging European hares (*Lepus europaeus*)

14:15 – 14:30 Natalia Kiryluk, Witold Durczyński, Iga Szostak - The importance of standardizing the techniques of hemolymph collection and staining in *Tenebrio molitor* for the reliability and reproducibility of experimental results

14:30 – 14:45 Witold Durczyński, Natalia Kiryluk, Iga Szostak - Effects of deciduous tree bark and paper-based diets on body mass and hemolymph cellular composition in *Tenebrio molitor*

14:45 – 15:00 Marten Kiupel, Amelia Kurtys-Szukowska, Zihe Zhao, Yoshikazu Hasegawa, Paulina Cholewińska, Konrad Wojnarowski, Dušan Palić - Effects of Hormonal Exposure on Embryonic Development and Microbiome Composition in *Danio rerio*

15:00 – 15:15 Amelia Kurtys-Szukowska, Zihe Zhao, Yoshikazu Hasegawa, Marten Kiupel, Paulina Cholewińska, Konrad Wojnarowski, Dušan Palić - Hormones in Water: Effects of Estrone and Progesterone on Zebrafish Embryos Development and Microbiome

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15:30 – 15:45 Yoshikazu Hasegawa, Amelia Kurtys-Szukowska, Zihe Zhao, Marten Kiupel, Paulina Cholewińska, Konrad Wojnarowski, Dušan Palić - Microbiome Response of Zebrafish Embryos to Environmentally Relevant Estrone and Estriol Exposure

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10:00 – 10:15 Kacper Ślewicki, Mieczysław Kunz - Emotions and Noise During Speedway Races: Preliminary Results of Measurements Conducted on the University Campus in Toruń

10:15 – 10:30 Adam Szpiek, Mieczysław Kunz - Analysis of the color temperature of selected architectural objects of the Old Town Complex in Toruń

10:30 – 10:45 Dorota Kudlicka - Higher Education Institutions and the Environmental Goals of the 2030 Agenda: A Case Study of the University of Lodz

10:45 – 11:00 Paweł Druet - Fatal accidents in the Polish Tatra Mountains in 2021-2025

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11:30 – 11:45 Jagna Kosowska - Does the time of exposition can influence on assessment potential trees in arsenic remediation?

11:45 – 12:00 Olga Baranowska, Barbara Klik- Assessment of Assisted Phytostabilization Efficiency of Copper Using Basalt Ash

12:00 – 12:15 Bożena Czech, Artur Sokołowski - Remediation of phthalate polluted soil with biochar

12:15 – 12:30 Mateusz Dudzik - Concrete with the addition of ash from municipal waste incineration

12:30 – 12:45 Oliwia Babacz, Marlena Baranowska, Sylwia Budzyńska - How much arsenic can trees accumulate?

Sesja 7 – Moderator: Karolina Lewińska

13:00 – 13:15 Agnieszka Zwierniak, Bartłomiej Woś, Marcin Pietrzykowski - Survival of alder species (black, grey and green alder) and their impact on the physicochemical properties of technosols in lignite combustion waste disposal site

13:15 – 13:30 Joanna Maier - Concentrations of heavy metals in suspension carried by the Odra river waters

13:30 – 13:45 Joanna Maria Gocka - Vegetation under pressure. Assessment of threats to the

vegetation cover of the shoreline zone – Lake Rgielskie in the context of the impact of anthropogenic and natural factors

13:45 – 14:00 Igor Śniady, Roksana Kruć-Fijałkowska, Zuzanna Krawczak, Wojciech Pryszcz, Krzysztof Dragon, Dariusz Dróżdżyński, Rafał Motała- Analysis of the spatial and vertical migration of pesticide residues into deep sections of soil profiles

14:00 – 14:15 Kamil Muszyński - Status and perspectives of protection of elm-ash floodplain forests

14:15 – 14:30 Łukasz Kruszewski, Iwona Dembicz, Adam Stebel - Biodiversity in the harsh and variable environment of post-coal-mining heaps encompassed by fires: mosses from Upper Silesia, Poland

14:30 – 14:45 Łukasz Kruszewski, Iwona Dembicz, Julia Pawłowska, Adam Stebel - Biodiversity in the harsh and variable environment of post-coal-mining heaps: higher plants and fungi of fumarolic sites, Upper Silesia, Poland

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10:00 – 10:15 Katarzyna Gołębiowska, Elżbieta Grządka - How selected factors affect nanoplastic flocculation efficiency

10:15 – 10:30 Zhouling Chen, Kangwei Hou, Paulina Cholewińska, Konrad Wojnarowski, Dušan Palić - Microbial Community Composition Across Multiple Tissues of Pinna nobilis Following Mass Mortality Events in the Mediterranean

10:30 – 10:45 Dongqing Zhao, Konrad Wojnarowski, Paulina Cholewińska, Tomasz Strzała, Peter Steinbauer, Dušan Palić - Transcriptomic Responses and Antimicrobial Resistance Gene Profiles of Outbreak-Associated *Aeromonas salmonicida* subsp. *salmonicida* Isolates from Salmonid Fish

10:45 – 11:00 Grace Azeez - Chemical Composition and Phytotoxic Effects of nanoemulsions of Caraway Essential Oil fractions on Early Growth of selected plants seedlings in a Sand-Based System

Sesja 9 – Moderator: Grzegorz Borkowski

11:15 – 11:30 Agnieszka Wesołowska - From processing to interpretation: applications supporting spectroscopic data analysis

11:30 – 11:45 Paulina Laskowska-Piekoszewska, Witold Paweł Alexandrowicz - Environmental diversity of the Kraków-Częstochowa Upland in the light of malacological analysis

11:45 – 12:00 Maciej Dysierowicz, Igor Śniady, Jerzy Borowicz, Weronika Orzechowska, Emilia Smardz - A Comparative Study on the Application of a Light Dynamic Probe and a Light Weight Deflectometer for Assessing Beach Sand Compaction

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12:15 – 12:30 Paulina Piskuła, Aleksander Astel - Occurrence of microplastic items in organs of freshwater and marine fish – an impact of habitat zones and feeding features

12:30 – 12:45 Katarzyna Tyszczuk-Rotko - Screen-printed sensors in trace analysis of selected biologically active compounds in environmental samples

Sesja 10 – Moderator: Jakub Ceglarek

13:00 – 13:15 Aleksandra Bartoszek, Jagna Letmańska, Maksym Łaszewski, Jarosław Suchożebrski - Hydrochemical Functioning of Streams under Strong Anthropogenic Pressure on the example of the Jeziorka River Catchment

13:15 – 13:30 Zuzanna Zając, Hanna Moniuszko, Mariia Pismanik, Arkadiusz Przybysz, Mariola Wrochna, Andrzej Zwoliński, Robert Popek - The influence of leaf structure on the retention and leaching of particulate matter during simulated rainfall

13:30 – 13:45 Wojciech Nadziałek - The Flash Flood in Ćmielów on 11 July 2024 in the Kielce Upland as an Example of an Extreme Weather Event

13:45 – 14:00 Tomasz Kalicki, Paweł Przepióra, Monika Żelezik, Piotr Biesaga - Results of geomorphological research near the megalithic site on Łyżka (Island Beskids, Poland)

14:00 – 14:15 Iga Telega, Karolina Walczak - Climate changes on Mount Śnieżka against the background of Poland's climate in the multiannual period 1990–2010

15:45 – 15:55 Zakończenie konferencji

Fusion and reduction: modifications of the eye features of glossiphoniid leeches

Maciej Grobelski

Department of Animal Morphology, Faculty of Biology, Adam Mickiewicz University

Corresponding author: macgro2@st.amu.edu.pl

The morphology of the visual system is an important diagnostic feature in leeches of the family Glossiphoniidae. However, the variability of eye characteristics, including fusion, reduction, and multiplication, remains poorly understood. The aim of this study was to assess the frequency and patterns of eye modifications in selected Glossiphoniidae species and to evaluate their potential taxonomic significance. A total of 282 individuals representing seven species were analyzed. Three types of eye modifications were identified: fusion, reduction, and multiplication. The frequency of modifications varied among species, with *Alboglossiphonia heteroclita* showing modifications in all examined individuals, while *Hemiclepsis marginata* showed none. Most individuals exhibited either no modifications or a single modification, whereas multiple modifications were rare. Statistical analyses revealed significant differences between species, indicating that eye variability is strongly species-specific. In contrast, no significant effect of environmental conditions was found in *Glossiphonia complanata*. The results suggest that eye morphology in Glossiphoniidae is highly variable and should be used with caution in taxonomic identification, serving rather as a supplementary than a primary diagnostic feature.

Analysis of genetic diversity of selected oat cultivars (*Avena sativa L.*) using ISSR markers

Paula Milniczuk*, Joanna Lech, Edyta Paczos-Grzęda

University of Life Sciences in Lublin, Faculty of Agrobioengineering, Student Molecular Biology Scientific Society "BioGen"
*Corresponding author: milniczukpaula@gmail.com

Common oat (*Avena sativa L.*) is a cereal crop of increasing economic importance, primarily due to the high nutritional value of its grain. Nowadays, maintaining the genetic diversity of oat cultivars is particularly important, as climate change, pathogen evolution, and agricultural intensification may lead to a reduction in the species' gene pool. In the face of these threats, maintaining high genetic diversity within the population allows for effective breeding programs and the preservation of high-quality seed material.

The aim of the study was to assess the genetic diversity of selected common oat cultivars registered in the COBORU (Research Centre for Cultivar Testing) register and their counterparts from field crops. The analysis was conducted using ISSR (Inter Simple Sequence Repeat) markers. As a result of the research, unique DNA banding profiles were obtained for each of the analyzed forms. Bioinformatic analyses confirmed a clear genetic differentiation between hull-less and husked cultivars and showed significant differences within the group of husked cultivars. Within this group, the greatest genetic distance was recorded for the cultivars 'Rodos' and 'Gniady'. Conversely, the cultivars 'Bingo', ‘Kozak’ and 'Agent' showed a higher degree of mutual similarity, while remaining fully distinguishable genotypes.

The results confirm that ISSR markers are an effective tool for assessing the genetic diversity of oats. Due to its precision, this method can be successfully utilized in modern breeding programs.

From woody elements to grasslands: contrasting wild bee community patterns across semi-natural habitat types

Anna Sobieraj-Betlińska*, Piotr Szefer

Kazimierz Wielki University
*Corresponding author: anna.sobieraj.betlinska@wp.pl

Semi-natural habitats are key components of agricultural landscapes, yet their role in shaping wild bee communities may vary among habitat types and across the season. Although these habitats are generally assumed to support pollinators, differences among them may remain undetected when relying solely on aggregated diversity metrics.

In this study, we examined wild bee communities across four types of semi-natural habitats – linear woody elements, woody patches, dry grasslands, and extensively managed meadows – within agricultural landscapes of Poland. Bees were sampled monthly from April to September, allowing us to assess both spatial and seasonal patterns. We analyzed total abundance, species richness, Shannon diversity, and community composition, as well as seasonal dynamics in relation to habitat type and environmental variables.

Total wild bee abundance, species richness, and Shannon diversity did not differ significantly among habitat types. However, community composition varied markedly, indicating that different habitats supported distinct species assemblages. Moreover, seasonal dynamics differed among habitat types, with a significant interaction between habitat type and month for both abundance and species richness, suggesting that habitat-specific trajectories shape bee communities throughout the season.

Local floral resources were important predictors of wild bee responses. In particular, plant species richness, floral cover, and the functional richness of flowering plants were positively associated with several bee community metrics, highlighting the role of both resource quantity and functional trait diversity.

Our findings demonstrate that semi-natural habitats differ in how they support wild bee communities, primarily through species turnover and seasonal dynamics rather than differences in overall diversity. These results highlight the importance of considering habitat heterogeneity, floral resource diversity, and temporal processes when evaluating the role of semi-natural habitats in agricultural landscapes.

Occurrence of stroma-forming *Epichloë endophytes* in grasses within Cytadela Park, Poznań, Poland

Michał Kułakowski

Department of Systematic and Environmental Botany, Faculty of Biology, Adam Mickiewicz University
Corresponding author: mickul5@st.amu.edu.pl

The genus *Epichloë* comprises grass endophytic fungi that significantly influence host ecology, stress tolerance, and reproduction. Despite their worldwide distribution, there is limited information on their occurrence in urban green spaces. This study aimed to document the diversity and distribution of stroma-forming Epichloë fungi in grass species across Cytadela Park in Poznań. The study was conducted from April 2025 to May 2026 and was primarily based on field observations, with fungal species confirmed using molecular methods.

In total, three stroma-forming Epichloë species were identified. The most frequent association was *E. poae* on *Poa nemoralis*, recorded at 18 sites. *E. festucae* on *Festuca rubra* was the least frequent combination (3 sites), while *E. typhina* was found on *Poa trivialis* (10 sites) and *Dactylis glomerata* (4 sites). The results reveal that urban green areas harbor multiple Epichloë species, suggesting that such managed grasslands provide suitable habitat for these fungi. Further studies are needed to assess the role of grassland management and infected seed material in their distribution.

Variety of mycobiota on ash wood in an alder-ash forest

Diana Fiedorowicz*, Marta Bełka

Poznań University of Life Sciences
*Corresponding author: diana.fiedorowicz9@gmail.com

Despite its relatively low proportion in Polish forests and specific ecological requirements, ash (*Fraxinus excelsior*), and particularly its wood, has significant economic importance. Unfortunately, for many years this species has been exposed to numerous stress factors, among which the pathogen *Hymenoscyphus fraxineus* (T. Kowalski) plays a key role. These permanent circumstances are related to research aimed at characterizing the mycobiota of ash wood in its natural habitat, i.e. alder-ash forest, and assessing its source in relation to the health condition of trees.

The study was conducted in the Bolewiny Forest District, Babimost Forest Division (Regional Directorate of State Forests in Zielona Góra). In May 2024, ash wood samples were collected from 12 randomly selected trees representing different health conditions using a Pressler increment borer. For each tree, diameter at breast height (DBH) was measured, tree health status was assessed, and, in the case of dead trees, the degree of wood decay was determined. Subsequently, laboratory analyses were carried out, during which fungal species were identified using morphological keys for microscopic fungi.

The results indicate that the analysed wood samples were colonised by diverse assemblages of microscopic fungi, including saprotrophs (e.g. Cladosporium), potential opportunistic pathogens (e.g. Fusarium), as well as fungi typical of dead or weakened wood (e.g. Chaetomium). Species regarded as antagonists of *H. fraxineus*, such as *Cladosporium sp.*, *Fusarium sp*. and *Aureobasidium pullulans*, were also isolated. A total of 47 species of microscopic fungi were isolated, 18 of which were unidentified.

Both the number of fungal isolates and their diversity showed an increasing trend with the deterioration of tree health status; however, statistical analysis did not reveal significant relationships. This is probably due to too small a research sample

The obtained results highlight the importance of dead wood as a valuable habitat for diverse communities of microscopic fungi and indicate the role of tree health status in shaping the structure of these communities. At the same time, they emphasise the need for further research in this field.

Keywords: Fraxinus excelsior, mycobiota, alder-ash forest, tree health status

Transfer learning for land cover classification, assessing spatial and temporal transferability of Sentinel-2 models

Adam Waśniewski[1]*, Bogdan Zagajewski[1], Agata Hościło[2]

[1]University of Warsaw, Faculty of Geography and Regional Studies, Department of Geoinformatics, Cartography and Remote Sensing
[2]Institute of Environmental Protection-National Research Institute, National Centre for Emissions Management
*Corresponding author: adam.wasniewski@uw.edu.pl

Transfer learning (TL) has become an important approach in remote sensing, enabling the application of pretrained classification models to new spatial and temporal contexts where high-quality reference data are limited or unavailable. Despite the increasing use of Sentinel-2 imagery for land cover mapping, the spatiotemporal transferability of commonly used machine learning methods remains insufficiently explored. This study evaluates the transferability of three classification algorithms: Random Forest (RF), Support Vector Machine (SVM), and Convolutional Neural Network (CNN), for land cover classification based on Sentinel-2 imagery. The research was conducted using one source training area and multiple target areas located in Poland and Ukraine. Models were trained on Sentinel-2 granule 34UCC covering the city of Łódź (Poland) using imagery from 2020 and reference data derived from national geospatial databases. The classification scheme included eight land cover classes: sealed surfaces, broadleaved woodland, coniferous woodland, permanent herbaceous, periodically herbaceous, mosses and wetlands, non-vegetated areas, and water bodies. Three transferability scenarios were analysed: temporal transferability (same area, different year), spatial transferability (different areas, same year), and spatial-temporal transferability (different areas and years). Target regions included Warsaw, Lviv, and Kyiv, represented by Sentinel-2 granules 34UED, 34UGA, and 36UUA. Classification performance was evaluated using Overall Accuracy (OA), Kappa coefficient, F1-score, User's Accuracy (UA), and Producer's Accuracy (PA). In addition, Transferability Score (TS) and Class Transferability Score (CTS) were introduced to assess the stability of model performance after transfer. The results demonstrate that RF achieved the highest transferability and stability across all scenarios, reaching a mean CTS of 0.95 and TS of 0.97. SVM

showed moderate robustness, while CNN exhibited greater sensitivity to spatial and seasonal variability. Spectrally homogeneous classes, particularly water bodies and woodland classes, showed the highest transferability, whereas heterogeneous vegetation classes such as mosses and wetlands or herbaceous vegetation were more difficult to transfer reliably. The study confirms that RF remains the most operationally efficient and transferable approach for Sentinel-2 land cover classification in Central and Eastern Europe. The proposed TS and CTS metrics provide a useful framework for evaluating model robustness across spatial and temporal domains and may support the development of transferable large-scale land cover mapping workflows.

Detection of wet snow using Sentinel-1 SAR Data in the Hornsund Region, Svalbard

Daria Dobrogowska*, Joanna Pluto-Kossakowska

Warsaw University of Technology
*Corresponding author: daria.dobrogowska@gmail.com

Wet snow detection using SAR radar imagery is an important component of snow condition monitoring in polar and high-mountain regions, where the use of optical data is often limited by cloud cover and polar night conditions. This study presents the development of methods for wet snow detection using SAR data from the Sentinel-1 satellite for the Hornsund region in Svalbard during the 2022 and 2024 seasons. Two analytical approaches differing in the level of processing complexity were applied. The first approach was based on the analysis of individual radar polarizations, while the second incorporated the combined use of ascending and descending orbit data as well as the local incidence angle of the radar beam. The initial data preprocessing was carried out in the SNAP environment, whereas the main analysis was automated using Python scripts run in ArcGIS Pro and the Jupyter Notebook environment. Validation of the results was performed by comparing wet snow maps derived from SAR imagery with snow cover maps produced from optical data. For the 2022 season, PlanetScope Dove imagery was used, while for the 2024 season Sentinel-2 data were applied. A comparative analysis of results was also conducted between seasons within the same approach, as well as between individual radar polarizations. The analysis showed a clear dependence of the results on the type of polarization used. Co-polarized channels (HH and VV) exhibited similar performance patterns, as did cross-polarized channels (HV and VH). The largest differences between the compared detection methods were observed in coastal zones and glacierized areas, particularly in the Hansa Glacier region. The obtained results indicate a significant influence of polarization selection on the effectiveness of wet snow detection, while the automation of the processing workflow confirms the potential of this approach for monitoring snow conditions and providing valuable information for hydrological and climatic research.

Application of Deep Learning Methods for Land Cover Change Analysis in the Northern Part of Toruń in the Years 2017–2025

Grzegorz Górniak*, Mieczysław Kunz

Nicolaus Copernicus University in Toruń, Faculty of Earth Sciences and Spatial Management

*Corresponding author: ggorniak@doktorant.umk.pl

Land use/cover changes constitute one of the most important indicators of urban spatial transformation. The dynamic expansion of residential development leads to the gradual conversion of open areas and wastelands, which can be effectively analysed using remote sensing data and GIS methods. In recent years, Sentinel-2 satellite imagery and cloud computing platforms enabling multi-temporal analyses on large spatial datasets have gained particular importance. At the same time, GeoAI methods supporting automated land cover classification and spatial change detection are being increasingly developed.

The aim of this study is to evaluate the applicability of available GeoAI tools by analyzing land cover changes in the northern part of Toruń, including three residential neighborhoods: Wrzosy, Bielawy, and JAR, during the period 2015–2025. The research focuses on identifying the expansion of built-up areas and determining the main directions of spatial transformation occurring within a zone of intensive urban densification. Particular attention is given to changes associated with new residential development and the reduction of open and forested areas.

The research is based on multispectral Sentinel-2 imagery processed within the Google Earth Engine environment. The analysis was conducted using the Dynamic World model based on the U-Net architecture and probabilistic land cover classification. Change detection was performed using the post classification comparison method supported by transition analysis between land cover classes.

The obtained results indicate a clear expansion of built up areas in the northern part of Toruń between 2015 and 2025. The most intensive changes were

identified within newly developed residential zones and previously undeveloped areas. The analysis confirms the usefulness of Sentinel-2 imagery and GeoAI methods for monitoring urbanisation processes and land cover transformations at the local scale. This study is part of the current trend in research that uses satellite data and machine learning methods to monitor urban spatial development.

Keywords: GeoAI, deep learning, Google Earth Engine, Dynamic World, land cover, Sentinel-2

Assessment of the habitat potential of the Sośnica spoil heap using optical and LiDAR data

Natalia Jasiak[1]*, Jakub Ceglarek[1], Jan Piekarczyk[1], Gabriela Woźniak[2]

[1]Adam Mickiewicz University
[2]University of Silesia in Katowice
*Corresponding author: natjas11@st.amu.edu.pl

Post-mining spoil heaps, often perceived as degraded and unused landforms, may represent valuable components of natural landscapes when their habitat potential is properly assessed. This study presents an integrated approach for predicting the physicochemical properties of the Sośnica spoil heap substrate and identifying habitat classes using remote sensing data. WorldView-3 imagery (eight bands in the visible and near-infrared range) and LiDAR-derived products (DTM, DSM, Canopy Height Model – CHM, and land-cover classes) were combined with *in situ* soil measurements. Spectral and topographic predictors, including NDVI, slope, and aspect were used in Random Forest regression models and cluster analysis. The obtained models showed good predictive performance with the highest coefficient of determination recorded for available magnesium (R^2 = 0.84). High predictive accuracy was also achieved for pH measured in H_2O (R^2 = 0.77) and KCl (R^2 = 0.75) whereas the lowest performance was observed for electrical conductivity (EC; R^2 = 0.58). Cluster analysis identified four habitat classes differing in physicochemical and vegetation characteristics providing a basis for reclamation planning and environmental monitoring. The results confirm the usefulness of integrating remote sensing and field data for habitat assessment of post-mining areas and support the planning of reclamation and conservation measures. The proposed workflow can be applied to other post-mining sites with comparable environmental and spatial data.

The Historical Geoportal as a Digital Tool for Analysing Environmental Change

Adam Chudziński

University Library in Poznań
Corresponding author: adam.chudzinski@amu.edu.pl

The historical geoportal is a modern digital tool designed for sharing, browsing, and analysing old maps and city plans. Its main objective is to increase access to historical cartographic materials and enable their use in research on changes in geographical space, the natural environment, and the cultural landscape.

The presentation will discuss the key functionalities of the historical geoportal, with particular emphasis on working with georeferenced maps. Users can display historical maps against contemporary cartographic basemaps, which makes it possible to compare past and present spatial structures. An important feature is the layer transparency tool, which enables users to observe changes in land use, transport networks, watercourses, and green areas. The geoportal also includes a measurement tool, allowing users to carry out basic distance measurements directly in the web browser.

A significant element of the geoportal is the provision of data through WMS and WFS web services. The WMS service enables the display of raster map layers, while the WFS service provides access to vector data that can be used for further spatial analysis, for example in GIS software. The portal is also equipped with a filtering system that allows users to search for materials according to selected criteria, such as date, author, object type, or spatial extent. Particularly useful is the option of searching for historical maps using a contemporary map, which makes it easier to find materials related to a specific location.

The historical geoportal is addressed to researchers of the natural environment, geographers, cartographers, historians, urban planners, regionalists, teachers, students, and all those interested in spatial changes over time. It can be used in scientific research, education, the popularisation of cartographic heritage, and

analyses concerning urban development, landscape transformation, and the relationship between the natural environment and human activity.

Keywords: historical geoportal, historical maps, WMS, WFS, georeferencing, GIS, natural environment, digital cartography, cartographic heritage.

Automated Detection of *Actaea spicata L.* Using Deep Neural Networks: New Perspectives in the Inventory and Monitoring of Natural Forest Habitats

Karolina Walczak[1]*, Adam Młynarczyk[2], Monika Konatowska[3], Paweł Rutkowski[3]

[1]Adam Mickiewicz University
[2]Higher School of Environment Management in Tuchola
[3]Poznań University of Life Sciences
*Corresponding author: kw90328@st.amu.edu.pl

The protection and sustainable management of forest ecosystems require precise tools for assessing their naturalness. In Europe, a key bioindicator of old and stable deciduous stands is the baneberry (*Actaea spicata* L.). Its presence indicates the ecological continuity of the forest, making it an invaluable taxon in designating High Conservation Value Forests (HCVF). Since traditional field inventories are costly and time-consuming, the aim of the presented research was the development and evaluation of a multi-model computer vision system for the automatic detection and classification of this species' organs. The hypothesis that deep neural network architectures can effectively recognize *A. spicata* in photographs was verified. Photographs from the GBIF/iNaturalist database were used and subjected to expert annotation in five classes: whole plant, leaf, fruit, flower, and bark/stem. Five object detection architectures were selected for comparative analysis: YOLOv8, Faster R-CNN, RetinaNet, SSD, and FCOS. The research confirmed the high effectiveness of the models in extracting the plant's morphological features. The YOLOv8 model demonstrated exceptionally fast convergence, achieving an mAP50 score of over 0.51 as early as the 2nd epoch. In turn, Faster R-CNN was characterized by the highest precision in delineating small, densely clustered fruits. Automated detection using artificial intelligence provides an objective method for monitoring fertile forest habitats. The high performance of the YOLOv8 algorithm predisposes it for deployment on edge devices (Edge AI), such as drones and mobile applications, while the stable Faster R-CNN can serve as the foundation for the post-processing of large photo databases.

Occurence of Thelazia spp. Nematodes in the Bieszczady population of European Bison (*Bison bonasus*) - Analysis of field material

Maria Grzegorzek

University of Life Sciences in Lublin, Student Scientific Club of Game and Free-Living Animal Diseases
Corresponding author: marysicaa58@gmail.com

The European bison, European bison, in Poland is a species rescued from extinction. All bison currently living in the Bieszczady Mountains descend from a restored population of only 12 individuals reintroduced in the 1960s. After decades of effort dedicated to restoring this valuable species, scientists and foresters encountered another serious threat: the parasitic disease thelaziosis caused by nematodes of the genus *Thelazia*.

European representatives of this genus include *Thelazia gulosa*, *T. skrjabini*, and *T. rhodesi*. These parasites inhabit the eyeballs of cattle, bison, and European bison, mechanically irritating the lacrimal ducts, conjunctival sac, and cornea. As a result, infected animals may develop blindness, movement disorders, aggression, neurological dysfunction, and eventually die after prolonged fear, disorientation, severe pain, and exhaustion. The intense pain associated with thelaziosis often leads animals to attempt self-inflicted eye removal by rubbing against branches or striking their heads against trees.

Clinical signs of the disease are easily recognizable. The most characteristic symptom is the so-called “white eye” effect caused by severe corneal opacity, deep ulceration, and progressive emaciation. The disease is highly invasive because it is transmitted by flies of the Muscidae family, which cannot realistically be eliminated from the environment. Adult female nematodes release numerous larvae into the conjunctival sac of the host. These larvae are ingested by flies during feeding, develop to the invasive stage inside the insect, and later migrate to the fly’s proboscis, from where they are transferred into the eye of another host. In addition to mechanical damage, the nematodes produce toxic metabolites that intensify the disease process.

Thelaziosis is also a zoonosis. In 2011, a 17-year-old girl in Spain was diagnosed with ocular infection, and a copulating pair of male and female nematodes was removed from her eye.

Unfortunately, treatment of free-ranging bison is practically impossible, and the only effective method of disease control is the elimination of infected individuals. The first clinical case of thelaziosis in a European bison in the Bieszczady Mountains was recorded in 2013. By 2021, the situation had become so serious that the Polish General Directorate for Environmental Protection authorized the culling of 40 infected animals, which generated significant controversy among local residents.

This presentation was prepared using archival materials, including scientific studies, field observations, and photographs obtained directly from the archives of the Baligród Forest District in the Bieszczady region, where the largest outbreak of this parasitic disease was identified.

The aim of this work is to present the epidemiological situation of thelaziosis affecting the European bison population in the Bieszczady Mountains. The presentation highlights the remarkable biology and transmission strategy of this parasite while emphasizing that the European bison, a species successfully reintroduced after near extinction, is once again under threat. In addition, the work demonstrates the challenges associated with treating wild animals and serves as a warning to cattle breeders to consider thelaziosis in the differential diagnosis of ocular diseases.

Invisible Risk: How Mycotoxins Affect Fetal Development

Paulina Foremniak[1]*, Karolina Hoppe[2]

[1]Poznań University of Life Sciences, Faculty of Agriculture, Horticulture and Bioengineering

[2]Poznań University of Life Sciences, Faculty of Forestry and Wood Technology

*Corresponding author: paulinaf2024@wp.pl

Contamination of food with mycotoxins has long posed a serious risk to human and animal health and has been widely studied. Consumption of contaminated cereal products can lead to mycotoxicosis and may cause a range of adverse effects, including hemorrhage, kidney and nervous system damage, hormonal disturbances, teratogenic effects, immunosuppression, as well as mutagenic and carcinogenic changes. Mycotoxins are harmful even at low concentrations, and their impact depends on many factors, such as age, sex, diet, body weight, as well as the presence of other substances and infections.

Although numerous studies have examined the occurrence of mycotoxins in food and the environment and assessed their harmfulness (mainly in animal models or cohort studies), there is still limited information on their effects on the health of pregnant women and fetal development. Therefore, this presentation will focus on the latest scientific findings on this topic. In addition, preliminary research results will be presented.

The European hare (*Lepus europaeus*) as a source of infection with bacteria from the Campylobacter family in the Lublin Upland

Iga Szostak[1]*, Natalia Kiryluk[3], Zbigniew Bełkot[1], Joanna Pławińska-Czarnak[2]

[1]University of Life Sciences in Lublin, Department of Food Hygiene of Animal Origin oraz Student Scientific Association of the game and free-ranging animals
[3]University of Life Sciences in Lublin, Department of Epizootiology and Clinic of Infectious Diseases, Interdepartmental Student Scientific Circle of Pathology and Breeding of Edible Invertebrates
[2]Warsaw University of Life Sciences, Department of Preclinical Sciences
*Corresponding author: Iszostak@op.pl

Campylobacter spp. is one of the most frequently isolated bacterial agents that cause gastrointestinal infections in humans and animals. Wild animals, including hares, can serve as a natural reservoir for these microorganisms. The aim of this study was to assess the occurrence of *Campylobacter* bacteria among wild hares harvested in the Lublin Upland. The study material consisted of swabs from selected sections of the gastrointestinal tract during a hunt during the designated hunting season. Bacterial identification was performed using microbiological methods. A total of 120 European hares were examined for various bacterial pathogens. Swabs for *Campylobacter* testing were collected from various parts of the gastrointestinal tract. Microbiological testing revealed 21 positive results for this family. The obtained results indicate the presence of *Campylobacter bacilli* in the population of wild hares occurring in the eastern regions of the Lublin Voivodeship, confirming the possibility that these animals contribute to maintaining and spreading pathogens in the natural environment. The presence of bacteria in free-ranging hares may be related to contact with contaminated environments or other wildlife species. These results highlight the importance of microbiological monitoring of free-ranging animals, particularly in areas with intensive agricultural and hunting use. Hares can be used as an indicator of the presence of zoonotic pathogens in the environment, and their observation can be an important element of preventive measures for the health of the ecosystem and the human population.

Prevalence of bacterial pathogens in free - ranging European hares (Lepus europaeus)

Iga Szostak[1]*, Wiktoria Sikora[1], Anna Mężyk[1], Zbigniew Bełkot[1], Joanna Pławińska-Czarnak[2]

[1]University of Life Sciences in Lublin
[2]Warsaw University of Life Sciences
*Corresponding author: Iszostak@op.pl

The European hare (*Lepus europaeus*), a member of the Leporidae family, is one of the most important small game species in Poland, and its numbers have declined significantly in recent decades. Various environmental, anthropogenic, and health-related factors are contributing to the population decline. Infectious bacterial diseases may be a significant factor contributing to the decline. The aim of the study was to assess the level of infection with selected bacterial agents in European hares (*Lepus europaeus*) inhabiting hunting grounds in the Lublin region. The study was conducted on hares obtained through hunting in accordance with hunting regulations. The animals underwent anatomical and pathological dissection, during which samples were collected for laboratory testing. The study included 120 hares from three hunting districts located in the Lublin Voivodeship. Seventy hare carcasses were selected for testing for the detection of bacteria of the *Pasteurella* and *Yersinia genera*. The study showed that *Pasteurella multocida* was detected in almost all 70 samples (68), while Yersinia pseudotuberculosis, a gram-negative bacillus, was isolated in 31,67% of the samples. Tests for *Campylobacter* bacteria were conducted on all hare carcasses. Four samples were collected from each hare: liver, muscles, cecum, and a swab from the terminal parts of the gastrointestinal tract . Positive results were obtained in 21 cases, detecting the presence of *Campylobacter* bacteria. Diseases caused by the microorganisms detected during the tests are considered dangerous zoonoses. The presence of the tested bacteria highlights the role of the European hare as a natural reservoir of pathogens in the environment and a potential threat to consumer health and safety. This conducted research has significant implications for wildlife diseases and public health.

The importance of standardizing the techniques of hemolymph collection and staining in *Tenebrio molitor* for the reliability and reproducibility of experimental results

Natalia Kiryluk[1]*, Witold Durczyński[1], Iga Szostak[2]

[1] University of Life Sciences in Lublin, Department of Epizootiology and Clinic of Infectious Diseases, Interdepartmental Student Scientific Circle of Pathology and Breeding of Edible Invertebrates

[2] University of Life Sciences in Lublin, Department of Food Hygiene of Animal Origin, Student Scientific Circle of Diseases of Game and Free-Living Animals

*Corresponding author: natalka.kiryluk@gmail.com

The growing importance of *Tenebrio molitor* as a model organism in experimental biology, toxicology, and food safety research necessitates the development of reliable and reproducible analytical methods. One of the most informative tools for assessing the physiological and immunological status of this species is the analysis of hemolymph, a dynamic tissue responsible for transport, homeostasis, and immune defense. However, the quality and interpretability of data are highly dependent on the techniques used for collection and staining.

Hemolymph is particularly sensitive to external factors such as mechanical damage, stress, and exposure to air, which may lead to rapid coagulation, melanization, or activation of immune responses. Improper sampling techniques can significantly alter its biochemical and cellular composition, thereby introducing experimental bias. Similarly, the lack of standardized protocols for anticoagulant use, buffering conditions, and sample preparation further contributes to variability between studies.

Equally critical is the staining process, which enables the identification and differentiation of hemocytes. Variations in staining methods can lead to inconsistencies in cell visualization and classification. These discrepancies hinder accurate comparisons across experiments and research centers.

Standardization of both hemolymph collection and staining procedures is therefore essential to minimize technical variability, improve data quality, and ensure reproducibility. Establishing unified protocols would facilitate cross-study comparisons, enhance the reliability of experimental outcomes, and support the broader application of *Tenebrio molitor* in scientific research and industry.

Effects of deciduous tree bark and paper-based diets on body mass and hemolymph cellular composition in *Tenebrio molitor*

Witold Durczyński[1]*, Natalia Kiryluk[1], Iga Szostak[2]

[1] University of Life Sciences in Lublin, Department of Epizootiology and Clinic of Infectious Diseases, Interdepartmental Student Scientific Circle of Pathology and Breeding of Edible Invertebrates

[2] University of Life Sciences in Lublin, Department of Food Hygiene of Animal Origin, Student Scientific Circle of Diseases of Game and Free-Living Animals

*Corresponding author: witolddurczynski@gmail.com

The yellow mealworm, *Tenebrio molitor*, is a widely studied model organism in insect physiology and an increasingly important species in sustainable biomass production. Its ability to exploit nutritionally poor and structurally complex substrates makes it a valuable system for investigating dietary effects on growth and internal homeostasis. This study aimed to assess the influence of diets based on deciduous tree bark and processed paper on body mass changes and hemolymph cellular composition in *T. molitor* larvae

Larvae were assigned to experimental groups receiving either deciduous tree bark or paper as exclusive dietary substrates, alongside a control group maintained on a standard diet. Body mass was monitored throughout the experimental period to evaluate growth performance under different nutritional conditions. Hemolymph samples were collected and examined using light microscopy to determine the relative proportions of hemocyte types, providing insight into physiological and immune status.

The results revealed that individuals reared on a bark - based diet exhibited significantly reduced growth rates or weight loss, when larvae fed on paper showed limited but measurable weight gain

Microscopic analysis of hemolymph demonstrated diet dependent shifts in cellular composition. Paper fed larvae maintained a relatively balanced distribution of hemocyte types, although subtle changes suggested mild physiological stress. Conversely, larvae fed on bark displayed altered hemocyte ratios, including a relative increase in cells associated with stress response and immune activation, potentially indicating compromised physiological condition. These findings suggest that diets have influence on internal cellular dynamics, reflecting adaptive or stress - induced responses.

In conclusion, both deciduous tree bark and paper represent suboptimal dietary substrates for *T. molitor*, with tree bark exerting a more pronounced negative effect on growth and hemolymph homeostasis. The observed changes in hemocyte composition highlight the sensitivity of insect physiological systems to dietary quality and underscore the importance of balanced nutrition in insect rearing. This study contributes to a better understanding of how unconventional, lignocellulosic feed sources affect insect biology and may inform future applications in waste bioconversion and sustainable insect production systems.

Effects of Hormonal Exposure on Embryonic Development and Microbiome Composition in *Danio rerio*

Marten Kiupel[1]*, Amelia Kurtys-Szukowska[1,2], Zihe Zhao[1], Yoshikazu Hasegawa[1], Paulina Cholewińska[1], Konrad Wojnarowski[1], Dušan Palić[1]

[1]Ludwig-Maximilians-Universität München, Tierärztliche Fakultät Lehrstuhl für Fischkrankheiten und Fischereibiologie

[2]University of Wrocław, Faculty of Biotechnology

*Corresponding author: m.kiupel@campus.lmu.de

Danio rerio is widely used in developmental biology and ecotoxicology because of its rapid embryonic development, transparent embryos, and sensitivity to environmental stressors. This study investigated the effects of hormonal exposure on zebrafish embryo development, focusing on hatching success, mortality, and microbiome composition. Effects of a progesterone+17α-ethinylestradiol (P4+EE2) mixture on *D. rerio* embryo development was studied with emphasis on hatching success, mortality, and microbiome composition. Embryos were maintained under controlled laboratory conditions and monitored throughout embryogenesis. The embryos were kept in Petri dishes (n = 30) with 3 embryos/ group. Treatment with 10 ng/L P4 and 1 ng/L EE2 was applied for 4 days, while the control had embryo water. The hormone treatment resulted in no statistically significant differences in cumulative hatching rates compared to the control group. The P4+EE2 treatment produced a statistically significant increase in mortality rate compared to the water control group. These findings suggest that these hormone combinations do not affect hatching rate whereas the combination P4+EE2 increases the mortality rate. Preliminary Oxford Nanopore Technologies (ONT)-based microbiome analyses revealed high variability in microbial diversity among samples. Co-occurrence analyses identified complex positive and negative associations between bacterial taxa; however, no statistically significant differences in overall microbial community composition were detected between treatment and control groups.

Hormones in Water: Effects of Estrone and Progesterone on Zebrafish Embryos Development and Microbiome

Amelia Kurtys-Szukowska[1,2]*, Zihe Zhao[1], Yoshikazu Hasegawa[1], Marten Kiupel[1], Paulina Cholewińska[1], Konrad Wojnarowski[1], Dušan Palić[1]

[1]Ludwig-Maximilians-Universität, Chair for Fish Diseases and Fisheries Biology, Faculty of Veterinary Medicine
[2]University of Wrocław, Faculty of Biotechnology
*Corresponding author: amelia.kurtys.szukowska@gmail.com

The aim of this study was to assess the impact of endocrine-disrupting compounds (EDCs) on the rate of zebrafish (*Danio rerio*) embryonic development and microbiome. Zebrafish are an established model organism with evolutionary relationship to higher vertebrates, widely used to study the genetic basis of human diseases, including responses to environmental factors. The zebrafish model offers several advantages, including ease and low cost of maintenance, rapid development, high fecundity, and optical transparency of embryos, which supports phenotypic screening. In our study, two female sex hormones, estrone and progesterone, were applied to zebrafish embryos at environmentally relevant concentrations and their hatching rates and mortality were monitored for four days. On day 4, the embryos were anesthetized, and the obtained biological material was sequenced using PromethION (Oxford Nanopore technology). The results showed no significant differences between the estrone and progesterone-treated group compared with the control group. Nevertheless, it is worth noting that environmental concentrations of these compounds are variable and should continue to be monitored.

Mixed Estrogen Exposure Alters the Embryo-Associated Microbiome of *Danio rerio*

Zihe Zhao[1]*, Amelia Kurtys-Szukowska[1,2], Yoshikazu Hasegawa[1], Marten Kiupel[1], Paulina Cholewińska[1], Konrad Wojnarowski[1], Dušan Palić[1]

[1]Ludwig-Maximilians-Universität, Chair for Fish Diseases and Fisheries Biology, Faculty of Veterinary Medicine
[2]University of Wrocław, Faculty of Biotechnology
*Corresponding author: zihe.zhao@campus.lmu.de

This study investigated the effects of mixed hormone exposure on the embryo-associated microbial communities of *Danio rerio*. Zebrafish embryos were exposed for four days to a mixture of estrone (E1, 4 ng/L) and 17α-ethinyl estradiol (EE2, 1 ng/L), while a water-only group served as the control. Each group consisted of 40 embryos distributed across three replicates. After exposure, DNA was extracted and sequenced on the PromethION platform (Oxford Nanopore Technologies). The resulting sequencing data were then analyzed bioinformatically to assess microbial diversity and taxonomic composition. Microbiome analysis revealed a significant difference in Shannon diversity between the E1 + EE2 treatment group and the control group ($p = 0.029$). Genus-level relative abundance profiles further indicated compositional differences between groups. DESeq2 analysis identified two taxa that were significantly enriched in the treatment group ($p < 0.05$). Overall, mixed exposure to E1 and EE2 was associated with detectable changes in the embryo-associated microbial community of zebrafish embryos. These findings suggest that environmentally relevant concentrations of estrogenic compounds may influence early-life microbiome composition in zebrafish embryos.

Microbiome Response of Zebrafish Embryos to Environmentally Relevant Estrone and Estriol Exposure

Yoshikazu Hasegawa[1]*, Amelia Kurtys-Szukowska[1,2], Zihe Zhao[1], Marten Kiupel[1], Paulina Cholewińska[1], Konrad Wojnarowski[1], Dušan Palić[1]

[1]Ludwig-Maximilians-Universität, Chair for Fish Diseases and Fisheries Biology, Faculty of Veterinary Medicine

[2]University of Wrocław, Faculty of Biotechnology

*Corresponding author: Yoshikazu.Hasegawa@fisch.vetmed.uni-muenchen.de

Zebrafish (*Danio rerio*) are widely used as vertebrate animal model in genetics, developmental biology, and ecotoxicology due to its easy maintenance, high fecundity, rapid sexual maturation, and transparent embryos, which enable direct observation of development. Because zebrafish share many biological pathways with other vertebrates, they are well suited for studying the effects of endocrine-disrupting compounds (EDCs) in aquatic environments. Estrone (E1) and estriol (E3) are natural estrogens that can enter rivers and lakes through wastewater discharge and may interfere with endocrine regulation in aquatic organisms. The aim of this study was to evaluate the effects of environmentally relevant concentrations of E1 and E3 on zebrafish embryonic development and microbiome composition. For exposure experiments, 40 zebrafish eggs were placed in each Petri dish containing a mixture of estrone (4 ng/L) and estriol (10 ng/L). Hatching rate and mortality were monitored for four days at 27°C. More than 60% of the exposure solution was replaced daily, and oxygenation was provided by pipetting. After exposure, embryos were anesthetized, DNA was extracted, and libraries were prepared using the Native Barcoding Kit 96 (v14, Oxford Nanopore Technologies). Sequencing was performed on a PromethION (Oxford Nanopore platform), and data were processed using Python v3.11. No statistically significant differences were detected between control and exposed groups in alpha diversity, beta diversity, or DESeq2-based differential abundance analysis. Although relatively high inter-individual variation was observed, particularly for the Observed and Chao1 indices, overall E1/E3 exposure was not associated with detectable shifts in microbiome composition under the tested conditions.

Daily noise levels and the life cycle of the local community on the example of the Nicolaus Copernicus University campus in Toruń

Wójcik Aleks*, Mieczysław Kunz

Nicolaus Copernicus University in Toruń, Faculty of Earth Sciences and Spatial Management

*Corresponding author: aleksieejj@gmail.com

Noise is one of the main factors to degrade geographic enviroment and is important pollution, which impact negatively on health and human functioning also on the entire biosfer. To main sources of this kind of the noise includes excessive traffic movment, rail, and air traffic. Also the shortage of obstacles and accustic screens impacts how noise is recived. The constant comunication noise in local comunity can cause array of systemic disorders like problem with falling asleep and regeneration, irritation, stress and lead to damaging acoustic and equlibrium organ.

Main campus of Nicolaus Copernicus University in Toruń, composed of administration buildings, building belonging to different scientific facilities and lodging facility. NCU lies in western part of city, in Bielany estate and it takes around 80 ha of Surface. External boundadies are not only important local communication roads – Gagarina i Szosa Okrężna which leads a tram line but also a forest complex. In its immediate vicinity is located local civilian airport of the Pomerian Flying Club.

Noise intensity studies on the Nicolaus Copernicus University campus in Toruń were conducted using certified VOLTCRAFT class 2 sound level meter and a sound calibrator. Measurments were conducted in March of 2026 at fours different stations located both on borders near main traffic routes and within study area. At each station, the sound intensity at frequency of 1 Hz were determinated for 10 consecutive minutes in six time windows, both on weekdays and weekends. The following measurment windows were adopted: 05:00-06:00am, 08:00-09:00 am, 12:00-01:00 pm, 04:00-05:00 pm, 10:00-11:00 pm, and from 12:00-1:00, which correspond to the generallhy accepted rythm of life of urban residents: quiet nights, waking up and first means of transport, accumulation of commuting, staying at work, returnig home and evening going quiet. Aim of the study was to determine whether noise levels on NCU campus exhibited daily and weekend variability resulting from the rythm of life of urban residents.

Emotions and Noise During Speedway Races: Preliminary Results of Measurements Conducted on the University Campus in Toruń.

Kacper Ślewicki*, Mieczysław Kunz

Nicolaus Copernicus University in Toruń, Faculty of Earth Sciences and Spatial Management

*Corresponding author: kacy2003@wp.pl

Noise is one of the main elements of speedway competitions, significantly affecting the comfort of the immediate and wider surroundings of the sports arena. Its main sources are not only specially designed motorcycles but, above all, the emotional behavior of fans—the event's participants. The study aimed to determine how the course of speedway competitions affects noise levels and their temporal distribution, and whether this can be linked to fans' observed emotions during the competitions. The measurement station was set up on the campus of Nicolaus Copernicus University in Toruń, approximately 1,500 meters from the Marian Rose Motoarena Toruń, a speedway arena used by the leading Speedway Ekstraliga team—KS Toruń. A certified Class 2 decibel meter from VOLTCRAFT and a sound calibrator were used to record noise levels. Measurements were taken from April to May 2026 during three events: two rounds of the PGE Ekstraliga regular season and the final of the Polish Individual Speedway Championships. A preliminary analysis of the recorded data shows that at a measurement station outside the speedway stadium, it is possible to identify differences in noise levels associated with more decisive moments of the competition. Attendance and weather conditions during recording, especially wind direction, also significantly impact the measured values. The noticeable differences in fan emotions were linked to key moments in the match (races)—such as when the home team or one of its players took the lead, won a decisive race, or the entire match, as well as when they unexpectedly lost.

Analysis of the color temperature of selected architectural objects of the Old Town Complex in Toruń

Adam Szpiek*, Mieczysław Kunz

Nicolaus Copernicus University in Toruń, Faculty of Earth Sciences and Spatial Management

*Corresponding author: 322756@stud.umk.pl

The exterior lighting of architectural structures, especially in historic old town complexes, attracts interest and often serves as a magnet from afar, drawing observers to approach and explore the area. Lighting displays for historic monuments are often specifically designed to enhance the form of their structure, the architectural framework, and the visual experience during evening and nighttime hours. Various design and technical solutions are employed in these projects, including the use of point and linear light sources with different color temperatures, often for a single structure. Today, lighting systems based on LED technology are used, which can produce light colors ranging from a cozy and relaxing warm hue, through neutral, to a vivid and contrasting cool one. In this way, it is also possible to emphasize the function of a given building or mask its imperfections in terms of condition. Observations of solutions used in practice show that, in the case of historic buildings, warm (yellow) illumination is usually applied, whereas for modern structures, quite the opposite – a cool-white hue, bordering on the blue spectrum, is used. Urban greenery is highlighted with a white color, which is closest to the daylight perception of light. The aim of the conducted research was to determine the color temperature of the exterior illumination of selected architectural structures within the Old Town Complex in Toruń. For the analysis, buildings characterized by various functional purposes were selected: the Wilam Horzyca Theatre, Collegium Maximum of the Nicolaus Copernicus University (UMK), as well as the Church of St. Catherine, the Church of St. John the Baptist, and the Church of St. James. The measurement was conducted during the 2025/2026 winter season using a handheld colorimeter – a light meter capable of measuring color temperature and brightness. The obtained measurement results were presented, utilizing GIS software, on three-dimensional building models created at the LoD2 level of detail.

Higher Education Institutions and the Environmental Goals of the 2030 Agenda: A Case Study of the University of Lodz

Dorota Kudlicka

Faculty of Economics and Sociology, University of Lodz
*Corresponding author: dorota.kudlicka@uni.lodz.pl

Contemporary environmental problems - related, among other things, to climate change, overexploitation of resources, and growing human pressure on the natural environment - highlight the need to engage various institutions in efforts to promote sustainable development. Higher education institutions play a special role in this regard, as they can influence the achievement of the United Nations Sustainable Development Goals (SDGs) through their research, teaching, organizational, and community engagement activities. Tools for assessing universities' engagement in sustainable development efforts, including the Times Higher Education Impact Rankings, are also gaining increasing importance.

The purpose of this article is to identify and describe the actions taken by the University of Lodz to implement the environmental Sustainable Development Goals, with a particular focus on organizational, infrastructural, educational, and research initiatives.

This study is based on original research into the implementation of the SDGs at the University of Lodz. The study was based on an analysis of materials prepared for the university's reporting to the Times Higher Education Impact Rankings, strategic documents, and observations of the work of the University of Lodz's informal Sustainable Development Team. As part of this study, approximately 620 activities, projects, and initiatives carried out by the university in 2022 were identified. The analysis covered the activities of faculty and administrative units related to, among other things, environmental protection, environmental education, raising environmental awareness, and resource management.

The study revealed significant variation in the environmental initiatives carried out by the University of Lodz, both in terms of their scale and their degree of

institutionalization. The largest number of projects focused on SDG 15 “Life on Land,” while the least represented area remained SDG 14 “Life below Water.” The results indicate that despite the growing number of environmental initiatives, activities related to sustainable development remain somewhat fragmented and require greater integration at the institutional level.

Fatal accidents in the Polish Tatra Mountains in 2021-2025

Paweł Druet

University of Gdańsk
*Corresponding author: pawel.druet@ug.edu.pl

The Tatra Mountains are the highest mountain range in the Carpathian Mountains. They are characterized by Alpine-type terrain and the presence of numerous rare and valuable natural, cultural, and landscape assets. Millions of tourists visit them each year. This large number of tourists results in accidents, including fatalities. The purpose of this study is to conduct a statistical and spatial analysis of fatal accidents that occurred in the Polish Tatra Mountains between 2021 and 2025, including the number, types, and causes of these events, as well as locations and months in which they occurred. This was done based on a query of the intervention chronicle and communications of the Tatra Volunteer Search and Rescue Service. Based on the findings, recommendations were formulated for tourism-related institutions and organizations in this area, regarding education and field activities aimed at accident prevention.

Application of the Trophic Soil Index (SIG) in the Assessment of Soil Diversity and Transformations in the Middle Odra River Valley

Daria Szuk*, Dorota Kawałko

Wrocław University of Environmental and Life Sciences
*Corresponding author: 121288@student.upwr.edu.pl

River valleys constitute a mosaic of terrestrial and aquatic environments, where flood dynamics and related soil-forming processes play a key role. In the Middle Odra River Valley, contemporary hydrological transformations resulting from river regulation and reduced flood frequency have led to significant changes in soil properties and the functioning of forest habitats.

The aim of this study was to demonstrate the diversity of the morphology and properties of alluvial soils and to assess their transformations under anthropogenic pressure. Research sites were selected based on soil moisture conditions and plant community types. The study was conducted in the Miękinia Forest District (SW Poland) and included five forest habitat types: riparian forest, oak-hornbeam forest, alder swamp forest, moist forest, and fresh mixed coniferous forest. The research involved field investigations of soil profiles and laboratory analyses of samples collected from all genetic horizons, using standard soil science methods. Habitat assessment was performed using the Trophic Soil Index (SIG).

The analyzed soils were classified as Fluvisols, organic soils, and Arenosols. The results revealed considerable variability in soil and habitat properties, with a predominance of eutrophic and mesotrophic habitats (broadleaved and mixed forests). The Trophic Soil Index (SIG)-based assessment indicated inconsistencies in habitat classification, suggesting possible habitat degradation related to anthropogenic pressure.The findings highlight the significant role of hydrological processes in shaping soil properties and the functioning of forest ecosystems in the Odra River Valley. The results have both scientific and practical relevance, as they may support the updating of habitat maps and contribute to the development of guidelines for sustainable forest management and nature conservation in the region.

Does the time of exposition can influence on assessment potential trees in arsenic remediation ?

Jagna Kosowska

Poznań University of Life Sciences, Faculty of Agronomy, Horticulture and Bioengineering, Faculty of Forestry and Wood Technology
Corresponding author: jagna.kosowska@gmail.com

Arsenic contamination remains one of the major environmental challenges associated with mining activity, industrial emissions, and the long-term transformation of contaminated soils and sediments. Although phytoremediation is considered a promising, low-impact approach for the restoration of polluted sites, the use of trees in arsenic remediation remains poorly understood, particularly regarding early developmental stages and time-dependent plant responses. This is especially important because arsenic toxicity, mobility and bioavailability depend strongly on its chemical form.

Previous studies on young tree species have shown that plant responses to arsenic may differ depending on the form of arsenic added to the growth medium and on the tree species tested. Earlier experiments also indicated that arsenic forms are not necessarily stable during plant growth; transformations may occur both in the medium and in plant organs. Therefore, the response of trees exposed to a single arsenic form should not always be interpreted as the effect of that form alone, but rather as a dynamic process involving uptake, translocation, and possible transformation over time.

The planned research focuses on young forest tree species exposed to selected arsenic forms, including inorganic As(III) and As(V), as well as methylated forms such as monomethylarsonic acid and dimethylarsinic acid. The main objective is to evaluate whether exposure duration influences arsenic uptake, translocation, accumulation, and transformation in the plant–substrate system. Particular attention will be given to the earliest stages of plant development, from seed germination to the growth of young seedlings, because these phases may determine further plant adaptation and survival under metalloid stress.

The research will combine biometric observations with elemental analysis, arsenic speciation, and assessment of selected physiological and biochemical parameters related to plant stress responses. Such an approach may help to distinguish short-term reactions from longer-term adaptation processes and to identify which developmental stages are most sensitive to arsenic exposure. The comparison of different forms of arsenic is also essential, as their toxicity, mobility, and bioavailability may differ substantially.

The expected outcome of the study is a better understanding of how young trees respond to arsenic contamination over time. This knowledge may inform the selection of tree species with greater potential for dendroremediation and contribute to a more realistic assessment of phytoremediation strategies in arsenic-contaminated environments.

Key Words. accumulation; bioconcentration; phytoremediation; speciation; woody plants

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Assessment of Assisted Phytostabilization Efficiency of Copper Using Basalt Ash

Olga Baranowska[1*], Barbara Klik[2]

[1]Faculty of Civil and Environmental Engineering, Warsaw University of Life Sciences

[2]Institute of Environmental Engineering, Warsaw University of Life Sciences

*Corresponding author: olgabaranowska02@gmail.com

Soil contamination with heavy metals is a major environmental issue, particularly in post-industrial areas. The aim of this study was to evaluate the effect of basalt ash on the efficiency of copper (Cu) phytostabilization in contaminated soil and to assess copper accumulation in plants.

The experiment was conducted under greenhouse conditions using heavy metal-contaminated soil and a grass mixture consisting of red fescue (*Festuca rubra L.*) and perennial ryegrass (*Lolium perenne L.*). A control treatment and a treatment amended with basalt ash were compared. Copper concentrations were determined in soil, roots, and aboveground plant tissues after the phytostabilization process.

The results demonstrated that basalt ash reduced copper mobility in soil and limited its translocation to the aboveground parts of plants. Increased Cu accumulation in roots indicated improved phytostabilization efficiency. The findings confirm the potential of basalt ash as an effective amendment supporting heavy metal stabilization in contaminated soils.

Remediation of phthalate polluted soil with biochar

Bożena Czech*, Artur Sokołowski

Department of Radiochemistry and Environmental Chemistry, Faculty of Chemistry, Maria Curie-Sklodowska University in Lublin
*Corresponding author: bozena.czech@mail.umcs.pl

Phthalic acid esters (PAEs) are recognized as toxic pollutants connected with microplastic pollution. They may be introduced into the soil during plastic agricultural foils application. Biochar is a carbonaceous material obtained from biomass thermally converted under oxygen-limited conditions. Its properties are determined both by the type of feedstock used and the pyrolysis conditions. Biochar has numerous applications, including sorption of many environmental inorganic and organic pollutants; it's applied as a catalyst or its support. The main application, however, is as a soil additive to improve soil quality and productivity. The addition of biochar into soil offers many benefits: biochar is a source of nutrients (C, N, P, K), regulates soil physicochemical properties (bulk density, water holding capacity), including the cycling of toxic substances, influences soil microbiological activity, and consequently, soil fertility and yield. The study aimed to determine the effect of biochar on soil properties, including the fate of emerging contaminants present in soil (phthalates). The results indicate that despite numerous positive effects associated with the use of biochar, long-term studies are necessary to confirm its safety, especially in contact with food.

Concrete with the addition of ash from municipal waste incineration

Mateusz Dudzik

Faculty of Environmental Engineering, Doctoral School of Warsaw University of Technology, Warsaw University of Technology
Corresponding author: mateusz.dudzik.dokt@pw.edu.pl

Nowadays, more and more municipal waste is being generated. This waste must be managed and disposed of in designated landfill sites. Polish law states that landfilling is permitted only when no other method of waste management is available. Moreover, new regulations provide that from 2035, no more than 10% of municipal waste may be stored in landfills. As a result, alternative methods of municipal waste treatment are increasingly being used. One such method is the thermal treatment of municipal waste. This process produces by-products such as ash and slag from waste incineration. Scientists are investigating various ways to utilize these materials. One of these approaches is the use of ash from municipal waste incineration in construction, as a component of concrete or mortar.

This study examined the effect of ash from municipal waste incineration, sourced from the municipal waste incineration plant in Poznań, on the properties of both fresh concrete mix and hardened concrete. The research began with the design of a reference concrete. The designed mix contained CEM III cement, sand, and gravel with a grain size of 2–32 mm. Subsequently, three additional mixtures were prepared in which cement was partially replaced with municipal waste incineration ash in amounts of 10%, 15%, and 20%. The basic properties of the fresh concrete mix and hardened concrete after 56 days were tested for all mixtures. For concrete containing 10% ash, a slight increase in strength was observed compared to the reference sample. In contrast, for concrete containing 15% and 20% ash, a significant decrease in strength was observed relative to the reference sample.

How much arsenic can trees accumulate?

Oliwia Babacz*, Marlena Baranowska, Sylwia Budzyńska

[1]Faculty of Forestry and Wood Technology, Poznań University of Life Sciences

*Corresponding author: oliwia-babacz-2002@wp.pl

Arsenic contamination of soils and waters is a serious environmental problem associated with both natural processes and human activities, particularly mining, smelting, industrial waste disposal, and the historical use of arsenic-containing compounds. Due to its toxicity, persistence, and ability to migrate within ecosystems, arsenic poses a significant threat to environmental quality, biodiversity, and human health. Conventional remediation methods are often costly, technically demanding, and disruptive to ecosystems. For this reason, increasing attention is being paid to nature-based solutions, including dendroremediation, defined as the use of trees for the remediation and stabilisation of contaminated environments.

The aim of this presentation is to discuss how much arsenic trees can accumulate and whether woody species may be considered a realistic tool for the long-term management of arsenic-contaminated sites. Although trees are not typically classified as classical hyperaccumulators, their remediation potential should not be assessed only on the basis of arsenic concentration in plant tissues. Their key advantages include high biomass production, extensive root systems, longevity, tolerance to difficult environmental conditions, and the ability to stabilise degraded substrates. Therefore, even moderate arsenic concentrations in tree tissues may correspond to substantial total amounts of this metalloid retained in the biomass of mature individuals.

Available literature data indicate that several tree species show promising potential for arsenic accumulation, including *Ulmus laevis*, *Quercus robur*, *Acer platanoides*, *Acer pseudoplatanus*, *Betula pendula*, *Tilia cordata*, *Populus spp.*, and *Pinus sylvestris*. In some studies, arsenic concentrations in roots exceeded 1000 mg kg^{-1} dry weight, while estimated arsenic removal by mature trees ranged from several grams to more than one kilogram per individual. These values depend strongly on the

tree species, biomass, root system development, soil properties, contamination level, exposure time, and environmental conditions.

An important aspect of arsenic accumulation in trees is its uneven distribution within plant organs. In many species, the highest concentrations are observed in roots, which suggests that trees may play a particularly important role in contaminant immobilisation and reduction of arsenic mobility in polluted substrates. At the same time, some species are capable of transporting arsenic to above-ground organs, which may increase their potential for phytoextraction. The effectiveness of dendroremediation therefore depends not only on the ability of trees to accumulate arsenic, but also on their growth performance, stress tolerance, and long-term survival under contaminated conditions.

In conclusion, trees should not be evaluated only in comparison with herbaceous hyperaccumulators. Their main value lies in long-term arsenic retention, substrate stabilisation, erosion control, and support of ecological restoration in degraded landscapes. Dendroremediation may be particularly useful in post-industrial and mining-affected areas, where the objective is not rapid decontamination, but gradual reduction of contaminant mobility and restoration of ecosystem functions. Thus, selected tree species may represent an important component of sustainable strategies for managing arsenic-contaminated environments..

Key words: arsenate; arsenite; bioconcentration; dendroremediation; phytoremediation
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Survival of alder species (black, grey and green alder) and their impact on the physicochemical properties of technosols in lignite combustion waste disposal site

Agnieszka Zwierniak*, Bartłomiej Woś, Marcin Pietrzykowski

Department of Ecological Engineering and Forest Hydrology, Faculty of Forestry, University of Agriculture in Kraków

*Corresponding author: agnieszka.zwierniak@student.urk.edu.pl

Combustion waste disposal sites typically have unfavourable conditions for revegetation and are nitrogen deficient; therefore, introducing alders, which have nitrogen-fixing abilities, may be promising. We investigated the survival of alder species (black (*Alnus glutinosa*), grey (*A. incana*) and green alder (*A. albobetula*)) and their impact on the physicochemical properties (pH, soil organic carbon (SOC) content and nutrient content, and sorption complex parameters) of combustion waste technosols after twenty years of growth. The study was carried out at the 'Lubień' combustion waste disposal site, which belongs to the Bełchatów Power Plant. The experiment was fully randomised, comprising 24 study plots (area: 72 m²) and a combination of three alder species × two different soil treatments: combustion waste with lignite culm amendment in the planting hole, and pure combustion waste with no amendment. Pre-treatment of the disposal site involved initial stabilisation through hydro-seeding with sewage sludge and a mixture of grasses (*Dactylis glomerata L.* and *Lolium multiflorum Lam.*), as well as start-up mineral fertilisation (N: 60, P: 36 and K: 36 kg ha-1). The results showed that, in the long term, the addition of lignite culm did not affect tree survival or soil properties, but the effect of alder species was evident. After 20 years of growth, black alder exhibited the highest survival rate (39%), followed by grey alder (13%); green alder exhibited the lowest survival rate (6%). Black alder exhibited the greatest organic horizon mass, soil organic carbon (SOC) and nitrogen content, as well as the higher sorption complex parameters, compared to the other alder species. Green alder had the weakest impact on soil properties, including SOC and nitrogen content. Our results confirm previous research indicating that black alder is the most suitable species for the biological stabilisation and phytomelioration of lignite combustion waste. Due to their low survival, green and grey alder should be replaced by target tree species after 20 years of introduction.

Concentrations of heavy metals in suspension carried by the Odra river waters

Joanna Maier

Institute of Environmental Engineering and Biotechnology,
University of Opole
Corresponding author: joanna.maier@uni.opole.pl

The ongoing deterioration of surface water quality is one of the most significant environmental problems. Heavy metals pose a particular threat to aquatic ecosystems. Due to their persistence, toxicity, and bioaccumulation potential, they can cause long-term ecological and health impacts. Surface waters are polluted by numerous anthropogenic substances, such as synthetic chemicals, pharmaceuticals, pesticides, herbicides, DDT, and heavy metals. The main sources of these pollutants include industrial, mining, and smelting activities, as well as intensive agricultural production. The middle and upper Oder River basin is particularly vulnerable to such impacts, where long-term human activity has led to significant transformation of the natural environment. The development of the mining and smelting industries has contributed to the degradation of water quality, landscape, and ecosystems, and reduced biodiversity. The negative effects of human activity are visible in both the chemical state of waters and the functioning of aquatic organisms and the quality of natural habitats associated with the Oder Valley. For centuries, the Oder River has served an important economic and transport function. As settlements developed, the riverbed was regulated, embankments were built, and numerous hydraulic engineering works were carried out to protect agricultural and settlement areas from flooding. These activities led to significant changes in the hydrographic structure and landscape of the river valley. River regulation and development of riverside areas influenced the biotope and habitats of aquatic organisms, as well as the chemistry of the Oder River waters. Years of neglect in water and sewage management also posed a significant problem. Municipal and industrial sewage released into the environment contributed to the increased level of heavy metal pollution in surface and groundwater. In the aquatic environment, heavy metals can occur in both soluble and insoluble forms, and their concentration depends on, among other factors, physicochemical properties, oxidation-reduction potential, and the ability to form

soluble complexes. These compounds accumulate in bottom sediments, suspended solids, and the tissues of living organisms, posing a serious threat to the functioning of aquatic ecosystems. Particularly hazardous are priority substances listed in Directive 2013/39/EU of the European Parliament and of the Council, which include cadmium, lead, mercury, and nickel. These substances can cause acute and chronic toxicity to aquatic organisms and contribute to biodiversity loss.

The aim of the study was to assess the degree of heavy metal contamination of suspended solids in the Oder River and to analyze temporal changes in the concentrations of selected elements. The study included determining the concentrations of zinc (Zn), lead (Pb), copper (Cu), chromium (Cr), cadmium (Cd), iron (Fe), manganese (Mn), and nickel (Ni) in suspended solids samples collected from the Oder River at the Wróblin Lock. An additional goal of the study was to determine the degree of degradation of the aquatic environment by applying the LAWA classification, the pollution factor (CF), and the pollutant load index (PLI). The methods used enabled the assessment of the level of heavy metal enrichment in suspended solids and the impact of the studied elements on the aquatic environment. The study also aimed to fill a research gap regarding the qualitative aspect of suspended solids, which remains poorly understood in Poland. To date, most studies have focused primarily on the analysis of bottom sediments, where heavy metals are immobilized, while the role of suspended matter as a contaminant carrier has been examined much less frequently. The study results showed significant variation in the concentrations of the analyzed heavy metals over time, indicating the dynamic nature of contaminant transport processes in suspended matter. Based on the LAWA classification, cadmium posed a high risk to the aquatic environment and biocenosis. Metals such as zinc, copper, nickel, and chromium exhibited a lower level of risk to the aquatic environment. The obtained results confirmed that suspended matter is a significant carrier of heavy metals transported in the river current and may play a significant role in the spread of contaminants within the river ecosystem. The study also revealed linear relationships between iron concentration and the concentrations of the other analyzed heavy metals, which may indicate common sources of contaminants and similar mechanisms of transport and sorption of these elements. Comparison of the obtained results with archival data from the IOP project conducted for the Odra River between 1997 and 2000 showed that heavy metal concentration levels in suspended solids remain high and comparable to values recorded in previous decades. This indicates that, despite protective measures and modernization of the

water and sewage infrastructure, the problem of heavy metal contamination of the Odra River remains relevant.

The study confirmed the research hypothesis that suspended solids are a good indicator for monitoring and assessing water pollution with heavy metals. Analysis of the qualitative aspect of suspended solids provides valuable information regarding the transport of priority substances in the aquatic environment, which is not considered in standard water quality monitoring, which focuses primarily on determining total suspended solids concentrations. The study results are significant for managing the Odra River basin and planning measures to reduce pollutant inflows into the aquatic environment. In the context of the requirements of Directive 2013/39/EU of the European Parliament and of the Council, this research is particularly important for assessing ecological risk and protecting water resources. Heavy metals present in suspended solids can be transported long distances and then accumulate in bottom sediments and aquatic organisms, leading to disruptions in ecosystem functioning and posing a threat to human health. The obtained results indicate the need for further research on the role of suspended solids in the transport of pollutants and the need to expand environmental monitoring to include regular qualitative analyses of suspended solids in heavily anthropogenically altered rivers.

Keywords: heavy metals, suspended solids, Odra River, surface water quality

Vegetation under pressure. Assessment of threats to the vegetation cover of the shoreline zone – Lake Rgielskie in the context of the impact of anthropogenic and natural factors.

Joanna Maria Gocka

Faculty of Agriculture, Horticulture and Biotechnology, Scientific": Student Scientific Circle of Environmental Protection
Corresponding author: asiagocka@gmail.com

Vegetation constitutes an inseparable element of our everyday perception of the world, accompanying us both in urban spaces and in rural areas. It provides habitats for many organisms, supplies food and shelter, and at the same time enhances the aesthetics of the surroundings by diversifying the landscape. Due to its multidimensional importance for ecosystems as well as for humans themselves, vegetation deserves special care and protection.

The aim of the study was to analyze the condition and transformations of vegetation in the coastal zone of Lake Rgielskie and to identify threats resulting both from human activity and natural processes.

As part of the fieldwork, a vegetation inventory was conducted, during which 72 phytosociological relevés were carried out, identifying a total of 270 species. The collected data were then analyzed by classifying species according to their affiliation with plant communities, invasiveness, and conservation status, including their presence on Red Lists. At the same time, elements of anthropogenic transformation were identified, such as piers, illegal waste dumping sites, and recreational areas.

The results clearly indicate a strong impact of human activity on the structure and diversity of vegetation. The northern and north-western parts of the shoreline, intensively used by humans, were characterized by lower biodiversity and a dominance of invasive species. In contrast, areas that are difficult to access, located in the southern and south-eastern parts of the lake’s coastal zone, are less transformed and have retained a more natural character. Within these areas, a significantly higher

number of native and protected species were recorded, such as great fen-sedge (*Cladium mariscus* (L.) Pohl), early marsh-orchid (*Dactylorhiza incarnata* (L.) Soó), and marsh helleborine (*Epipactis palustris* (L.) Crantz). Additionally, Sites of Community Importance (SCI) were identified, designated by codes 3150, 6410, 6510, 7210, and 7140, which, despite the wild nature of these areas, are particularly vulnerable to degradation due to human activities such as new land parcel divisions and damage caused by cars, quad bikes, and other vehicles.

Increased fishing activity, the presence of buildings and related technical infrastructure, piers, and informal beaches lead to habitat degradation, environmental pollution, and the spread of invasive species.

The study proposes examples of conservation measures aimed at improving the relationship between humans and nature in this area, including ecological education, monitoring of protected species and their habitats, removal of invasive species, and rational spatial planning. It also emphasizes the need for cooperation between administrative bodies, the scientific community, and local residents in order to preserve the natural values of the studied area.

The obtained results confirm that the coastal zone of a lake is an ecosystem particularly sensitive to ongoing changes, and its protection requires conscious actions that take into account both anthropogenic and natural factors.

Analysis of the spatial and vertical migration of pesticide residues into deep sections of soil profiles

Igor Śniady[1]*, Roksana Kruć-Fijałkowska[1], Zuzanna Krawczak[1], Wojciech Pryszcz[1], Krzysztof Dragon[1], Dariusz Dróżdżyński[2], Rafał Motała[2]

[1]Faculty of Geographical and Geological Sciences, Adam Mickiewicz University

[2]Department of Pesticide Residue Research, Institute of Plant Protection-National Research Institute

*Corresponding author: igosni@st.amu.edu.pl

Increasing food demand and agricultural intensification have contributed to the widespread use of pesticides, resulting in their frequent detection in soils, surface waters, and groundwater. However, studies on the migration of pesticide residues into deeper parts of soil profiles remain limited, particularly with respect to a broad spectrum of active substances. Pesticide migration within soil profiles depends on several factors, including lithology and topography, the latter of which may influence surface runoff and water redistribution, as well as the activity of soil microorganisms. This study provides one of the first broad assessments of pesticide migration into deep soil profile sections, down to 120 cm, based on the analysis of nearly 400 substances. Soil samples were collected from two boreholes in each of three selected experimental fields: in March and May 2024 at EF17 and EF49, and in March 2024 only at EF83. Pesticide residues were determined using ultra-performance liquid chromatography coupled to triple quadrupole mass spectrometry (UPLC-MS/MS). Twenty-three substances were identified. Among the detected compounds, fungicides (64%) and herbicides (32%) dominated. The total concentrations of pesticide residues in soils from individual boreholes ranged from 110.63 μg/kg to 980.01 μg/kg. Most substances were detected within the upper 40 cm of the soil profile, whereas below this depth, residues of dimethomorph, chloridazon, fenpropimorph, fluopicolide, flusilazole, fluxapyroxad, metribuzin, and the metabolite 2,6-dichlorobenzamide were found. No substances were detected in the 100–120 cm interval. Deeper pesticide migration was observed in experimental fields with a higher sand fraction content,

indicating the important role of lithology, and may additionally be associated with preferential water flow. Moreover, pesticide residues for which no application was recorded during the analysed period were detected in all examined experimental fields, highlighting the role of topography in the redistribution of pesticide residues between fields. Overall, the results indicate that topography and lithology are key factors controlling the spatial and vertical migration of pesticide residues and suggest that, even in profiles containing tills, the potential risk of pesticide transport towards shallow groundwater may remain significant.

Status and perspectives of protection of elm-ash floodplain forests

Kamil Muszyński

Poznań University of Life Sciences
Corresponding author: kamil.j.muszynski@gmail.com

The study concerns the condition of the typical lowland elm-ash floodplain forests (Ficario-Ulmetum minoris typicum) in the Middle Odra River Valley and the possibilities for their protection. Along a section of the Odra river over 30 kilometers long, 8 research plots on the floodplain forest habitat were examined. Twenty four phytosociological relevés were performed.

An unfavorable state of the examined floodplain forests was demonstrated, which was related to by the cutting off of part of the area from the river's natural floods by embankments, as well as the significant influence of the geographically alien Pennsylvania ash (Fraxinus pennsylvanica).

The lack of a clearly specified species composition of the stands, which could be considered a reference for the Ficario-Ulmetum minoris floodplain forest, was aso indicated. Such a reference would be important for both the assessment of the habitat's condition and its management. It was noted that in attempting to maintain the studied floodplain forests as oak-ash-elm forests, pedunculate oak (Quercus robur) and European ash (Fraxinus excelsior) would require active measures to keep them in the composition of the examined plant community.

Key words: Ficario-Ulmetum, ash-elm forests, protection, management

Biodiversity in the harsh and variable environment of post-coal-mining heaps encompassed by fires: mosses from Upper Silesia, Poland

Łukasz Kruszewski[1]*, Iwona Dembicz[2], Adam Stebel[3]

[1]Institute of Geological Sciences, Polish Academy of Sciences
[2]Faculty of Biology, University of Warsaw
[3]Medical University of Silesia
*Corresponding author: lkruszewski@twarda.pan.pl

We studied mosses in the „Szarlota" heap at Rydułtowy (RDT, including a highly hydrated fumarole with constant T of 50±2 °C – site 1), the "Wrzosy" heap at Pszów (PS), and the "Dębieńsko" mine heap at Czerwionka-Leszczyny (CD).

The dominant moss species identified in all three heaps probed is *Ceratodon purpureus*. *Pohlia nutans* and *Bryum argenteum* follow it at both PS sites and site 1 of SRD. Additional species identified at the former site are *B. caespiticum*, *B. dichotomum*, and *Aulacomnium palustre*. At the site 2 of SRD, *Leptobryum pyriforme* is also abundant, and the third species observed is *Physcomitrium eurystomum*. The species typical for PS is *Brachythecium rutabulum*. *Campylopus introflexus* – the highly invasive species well-known from the heaps – is recorded at CD.

C. purpureus tolerates pollution to a larger extent than many other moss species and is known from coal- and heavy-metal-mining areas (Richardson, 1981). *P. nutans* is a common extremophile, that is psychro-, xero-, acid-, halo-, heavy-metal- and UV-resistant (Munford et al., 2021; Boulc'h et al., 2020; Wang et al., 2019; Li et al., 2019). *B. argenteum*, also common, is a desiccation-resistant (Gao et al., 2017) nitrophile (RBGE, 2026), commonly associated with the post-fire-environment pioneer liverwort, *Marchantia polymorpha* (Fausey, 2003; observed in plenty nearby the SRD site 1). *P. eurystomum* is, in turn, an endangered species in many European countries (Stešević et al., 2010).

Biodiversity in the harsh and variable environment of post-coal-mining heaps: higher plants and fungi of fumarolic sites, Upper Silesia, Poland

Łukasz Kruszewski[1]*, Iwona Dembicz[2], Julia Pawłowska[3], Adam Stebel[4]

[1]Institute of Geological Sciences, Polish Academy of Sciences
[2]Faculty of Biology, University of Warsaw
[3]Faculty of Biology, University of Warsaw
[4]Medical University of Silesia
*Corresponding author: lkruszewski@twarda.pan.pl

Phytosociological relevés (PR) and additional, preliminary observations in 3 Upper Silesian heaps, at Rydułtowy (RDT), Pszów (PS), and Czerwionka-Leszczyny (CD; see details in Kruszewski *et al.*, this proceedings) allowed to pinpoint numerous environmentally important species of higher plants. Plant gigantism was also noted.

The RDT species include *Amaranthus retroflexus* and *Digitaria sanguinalis*; *Lepidium* spp., *Polygonum aviculare*, and *Vulpia myuros* (within PR - hydrated fumaroles); *Centaurium pulchellum*, *Chaenorrhinum minus*, *Conyza canadensis*, *Epilobium tetragonum*, *Rubus* spp., *Rumex acetosella*, *Pilosella officinarum* associated with *Pilosella piloselloides*, *Solanum nigrum*, *Veronica arvensis* (between the PR and N-rich fumaroles); *Epilobium dodonaei*, *Inula conyza*, *Vulpia myuros*, and *Arrenatherum elatius* (plateau); *Carlina vulgaris*, *Centaurea stoebe*, *Diplotaxis muralis*, *E. dodonaei*; *Festuca pallens* and *Petrorhagia prolifera* (both, as *C. pulchellum*, partially protected/endangered/rare species), *Petrosedum rupestre*, *Erigeron annuus* (N-slope terraces); and *Alyssum* spp. (foothills).

The PS species are *Apera interrupta*, *Agrostis stolonifera*, *Spergularia rubra* (fumaroles at a plateau edge); *Amaranthus retroflexus*, *Atriplex tatarica*, and *Lipandra polysperma* (N slope of the plateau).

The CD species include *Spergula morisonii* (PR site), *Bidens tripartita* and *Digitaria sanguinalis* (burning cone); *Holcus lanatus* (N slope of the cone); halophyte *Puccinelia distans* (a halophyte), *Chaenorrhinum minus*, *Cirsium vulgare*, *E. dodonaei*, *Eragrostis minor*, *E. albensis*, *Lotus uliginosus*, *Spergula arvensis*, and

Spergularia rubra (periodically wet foothills). The *Scleroderma citrinum* fungus is found in plenty in vicinity of local sulfate crust.

In two low-temperature fumaroles of RDT >150 microfungi species were identified, including the dominant *Verruconis gallopava* and *Cladophialophora humicola* (both sites); with *Fodinomyces uranophilus*, *Rhizopus microsporus*, *Penicillium simplicissimum*, *Acidomelania panicicola*, *Acidomyces*, *Acrophialophora fusispora*, *Aureobasidium*, *Candida parapsilosis*, *Cladosporium*, *Collophora*, *Coniothyrium*, *Cryptococcus*, *Cyberlindnera jadinii*, *Exophiala xenobiotica* (and *E. oligosperma*), *Fusarium*, *Goffeauzyma metallitolerans*, *Mortierella wolfii* and few other *M.*, *Ochroconis*, *Rasamsonia argillacea*, *Rhizophlyctis rosea*, *Rhodotorula mucilaginosa* and *R. toruloides*, *Rigidoporus vinctus*, *Purpureocillium lilacinum*, *Pyrenopeziza revincta*, *Saccharomyces cerevisiae*, *Scytalidium*, *Sporobolomyces roseus*, *Sterigmatomyces halophilus*, *Talaromyces*, *Tremella*, *Trichosporon*; *A. oregonensis*, *Cutaneotrichosporon cyanovorans*, *Microsporomyces bloemfonteinensis*, *Mucor ardhlaengiktus*, *Mycena leptocephala*, *Pseudobensingtonia ingoldii*, and *Spencerozyma crocea*, as other examples. Some of them are (poly)extremophiles.

Breaking the barrier: impact of calibrated compressive force on the germination and viability of *Robinia pseudoacacia L.*

Marin Lukačević[1]*, Krzysztof Słowiński[1], Beata Grygierzec[2], Edita Štefanić[3], Agnieszka Synowiec[2], Tomasz Grzywacz[1], Monika Barbara Gach[1]

[1]Department of Forest Utilization and Forest Techniques, Faculty of Forestry, University of Agriculture in Krakow

[2]Department of Agroecology and Plant Production, Faculty of Agriculture and Economics, University of Agriculture in Krakow

[3]Department of Phytomedicine, Faculty of Agrobiotechnical Sciences Osijek, Josip Juraj Strossmayer University of Osijek

*Corresponding author: marin.lukacevic@urk.edu.pl

Among the most successful arboreal invaders of temperate regions worldwide is the black locust (*Robinia pseudoacacia L.*). While the species' persistence is driven by a water-impermeable seed coat that ensures decadal seed bank viability, its structural vulnerability to mechanical loading remains unexplored. This study evaluated the impact of calibrated compressive forces (CCFs) to identify the precise thresholds at which force either triggers germination or induces seed mortality. Mature seeds were obtained from a commercial supplier and disinfected afterwards. To overcome physical dormancy, seeds were subjected to thermal scarification at 80 °C for 30 minutes. Subsequently, they were divided into two experimental groups, i.e., a natural air-dry group and a 24-hour-soaked group. Both seed groups were compressed using the Shimadzu AGX-V universal testing machine. Air-dry seeds were exposed to a broad force range (e.g., 0–300 N), whereas the soaked seeds were tested within a narrower range (e.g., 0–30 N). Following CCF treatments, seeds were incubated in Petri dishes on moistened filter paper for 14 days at 30 °C in the dark. Germination was recorded once the radicle reached 2 mm. The CCFs elicited a clear, non-linear germination pattern. For air-dry seeds, forces of 30–100 N markedly enhanced germination (57–62%) compared with the untreated control (30%), indicating a strong stimulatory effect. Germination sharply declined at 150 N (31%)

and was completely inhibited at ≥ 200 N (0%). In contrast, the soaked seeds exhibited significantly accelerated germination even at the lowest CCFs. Specifically, treatments of 5–30 N acted as germination stimulants, reaching their maximum cumulative germination (58%) within the first four days, compared with the control (26%). These results demonstrate that the seed's hydration state fundamentally dictates its response to CCFs. While air-dry seeds exhibit high structural resilience, with a lethal threshold of 200 N, the soaked seeds were far more sensitive, undergoing stimulation with no lethal thresholds observed. Consequently, lower forces for air-dry (e.g., 30–100 N) and soaked (e.g., 5–30 N) seeds are insufficient to destroy them; instead, they act as germination stimulants. In turn, this highlights a critical management risk: unless mechanical treatments reach the lethal threshold, they may inadvertently promote invasion by breaking dormancy rather than depleting the soil seed bank.

Keywords: physical pressure; seed hydration state; germination; lethal threshold

How selected factors affect nanoplastic flocculation efficiency

Katarzyna Gołębiowska*, Elżbieta Grządka

Department of Physical Chemistry, Faculty of Chemistry, Maria Curie-Skłodowska University in Lublin

*Corresponding author: katarzyna.golebiowska.kg@gmail.com

The objective of this study was to evaluate how various environmental factors influence the process of coagulation, flocculation and sedimentation of nanoplastics (NPs) in aqueous dispersions with the use of a natural coagulant (CG) and a bioflocculant (BF). NPs removal was quantified using UV-VIS spectrophotometry, which enabled the determination of the removal degree, and next, the floc structure was examined using optical microscopy and scanning electron microscopy (SEM).

The experimental materials used in this study consisted of a NPs suspension (75 mg/50 ml), with CaCl2 (0.033 mol/dm3, corresponding to an ionic strength of 0.1 mol/dm3) as CG. All systems contained 40 ppm of sodium alginate (NaAA) as BF. Three independent experimental series were conducted – the first one being temperature variation (15, 25 and 35°C), second being pH adjustment (5,7 and 9), and the last being the presence of additional pollutants (nanometal particles, namely nanosilver, nanogold and nanocopper), each introduced at 25 ppm.

The removal degree was measured using a Cary 100 Bio UV-VIS spectrophotometer (Varian Instruments) at 500 nm after 1h. However, in the case of the third evaluation pertaining nanometal presence, the measurement time extended to 24h. Floc morphology was characterized with an AZ100M optical microscope (Nikon, Japan) and a Quanta 3D FEG SEM (FEI, USA).

The obtained results indicate that temperature affected the NPs removal process, with the highest efficiency being recorded at 35°C. Next, increasing pH above neutral conditions led to a marked decline in removal performance. Furthermore, even at low concentrations, the presence of studied nanometals significantly altered the process kinetics, resulting in an extension of the time required for effective removal from 1 hour to 24 hours. Each tested parameter demonstrated a measurable impact on NP removal, providing insight and opportunities for further optimization and development of water treatment conditions for future research.

Microbial Community Composition Across Multiple Tissues of *Pinna nobilis* Following Mass Mortality Events in the Mediterranean

Zhouling Chen*, Kangwei Hou, Paulina Cholewińska, Konrad Wojnarowski, Dušan Palić

Ludwig-Maximilians-Universität, Chair for Fish Diseases and Fisheries Biology, Faculty of Veterinary Medicine
*Corresponding author: chzl59737@163.com

Noble Pen shell (*Pinna nobilis*, L. 1758) is the largest endemic Mediterranean bivalve that suffered repeated mass mortality events (MMEs) along the Mediterranean coast since 2016, pushing the species to the brink of extinction. This study analyzed the microbial community composition of different *P. nobilis* tissues after MMEs, including muscle, mantle, gill, and hemolymph. The heatmap of the top 50 variable taxa showed that microbial community composition varied among tissue samples. Yersinia sp. And *Pseudomonas sp.* showed relatively high abundance in multiple samples and were the dominant genera in infected samples. These results suggest that the microbial community structure in infected tissues may be dominated by a few potential opportunistic pathogens or dominant bacterial groups. Alpha diversity analysis showed no significant differences in terms of microbial richness, diversity, or evenness among different tissue types. Beta diversity analysis based on Bray-Curtis distances also showed no clear separation among tissue groups, although some individual samples deviated from the main cluster. The Venn diagram indicates that the tissues share a common core microbiota, while the muscle contains the highest number of tissue-specific taxa, the muscle and hemolymph share the largest number of taxa, suggesting that their microbial community compositions may be more similar. In conclusion, the results indicate that infected P. nobilis tissue samples showed some variation in microbial community composition, particularly associated with the high relative abundance of *Yersinia sp.* and *Pseudomonas sp.* However, there is currently insufficient evidence to demonstrate that different tissues harbor significantly distinct microbial community structures. Further studies with larger sample sizes, pathogen-load data, and histopathological evidence are needed for validation.

Transcriptomic Responses and Antimicrobial Resistance Gene Profiles of Outbreak-Associated *Aeromonas salmonicida* subsp. salmonicida Isolates from Salmonid Fish

Dongqing Zhao[1]*, Konrad Wojnarowski[1], Paulina Cholewińska[1], Tomasz Strzała[2], Peter Steinbauer[3], Dušan Palić[1]

[1]Chair for Fish Diseases and Fisheries Biology, Ludwig-Maximilian-University Munich

[2]Department of Genetics, Faculty of Biology and Animal Science, Wrocław University of Environmental and Life Sciences

[3]Tiergesundheitsdienst Bayern e.V., Poing

*Corresponding author: d.zhao@campus.lmu.de

Aeromonas salmonicida subsp. *salmonicida* (A.s.s.s) is a major bacterial pathogen associated with furunculosis and disease outbreaks in salmonid aquaculture. This study investigated eight outbreak-associated A.s.s.s from clinically diseased salmonid fish in Bavaria, Germany, by integrating transcriptomic profiling with antimicrobial resistance gene screening. For transcriptomic analysis, isolates were cultured under four conditions: Tryptic Soy Broth, Mueller–Hinton Broth, and both media supplemented with 1% fetal bovine serum. Oxford Nanopore sequencing was performed on cDNA and DNA samples to assess culture-dependent transcriptional responses and resistance-associated genetic features. Transcript-level analysis focused on virulence-associated genes involved in motility, secretion systems, and toxin-related functions,

including fliP, aerA, rtxA, exeC, flpH, exeN, tssB, exeL, exeG, flpI, exeB, and exeH. Culture medium composition clearly influenced transcriptional activity, with TSB-based conditions generally showing higher expression of several virulence-associated loci than Mueller–Hinton-based conditions. In particular, TSB supplemented with 1% fetal bovine serum showed a more stable expression pattern, with fewer broadly down regulated genes, suggesting that nutrient availability and host-like supplementation

may affect bacterial physiological activity and virulence-related transcription. Antimicrobial resistance gene screening further showed that the same isolates carried multiple resistance-associated genes. In total, 16 genes related to beta-lactam, aminoglycoside, phenicol, sulfonamide, trimethoprim, tetracycline, and colistin resistance were detected, with blaOXA-956, cphA-5, and mcr-3 present in all isolates. Together, these results indicate that outbreak-associated A.s.s.s isolates combine environment-responsive virulence-associated transcriptional patterns with a broad antimicrobial resistance gene repertoire, highlighting the importance of evaluating both functional gene expression and resistance potential in aquaculture pathogens.

Keywords: Aeromonas salmonicida subsp. salmonicida; salmonid aquaculture; transcriptomics; antimicrobial resistance genes; Oxford Nanopore sequencing

Chemical Composition and Phytotoxic Effects of nanoemulsions of Caraway Essential Oil fractions on Early Growth of selected plants seedlings in a Sand-Based System

Grace Azeez[1], Milica Škorić[2]

[1]Department of Agroecology and Plant Production, University of Agriculture in Kraków

[2]Institute of Field and Vegetable Crops, National Institute of the Republic of Serbia

*Corresponding author: grace.azeez@student.urk.edu.pl

Caraway (*Carum carvi*) is a good source of essential oils, which are considered biological control agents. In this study, we analysed the chemical composition of the EO using GC/MS. We found that the Caraway EO contains mainly monoterpenes: Carvone (53.7%) and Limonene (46.3%). We also evaluated the phytotoxic activity of the essential oil, formulated as eco-friendly nanoemulsions (Polysorbate 80) at concentrations of 0%, 0.01% and 0.05%, assessing their impact on the early growth dynamics of Raphanus sativus, Echinochloa crus-galli and Chenopodium album seedlings. We discovered that the nanoemulsions containing pennyroyal essential oil (EO) exhibit good physicochemical stability. Treatment containing KMEO and KM5 at 0.5% essential oil inhibited the growth of seedlings' shoots and roots. Summing up, the nanoemulsions with pennyroyal EO posed a biochemical stress to the seedlings' initial growth, pointing to possible allelopathic interactions, which should be further studied in natural conditions.

From processing to interpretation: applications supporting spectroscopic data analysis

Agnieszka Wesolowska

Adam Mickiewicz University - Doctoral School of Natural Sciences
*Corresponding author: agnieszka.wesolowska@amu.edu.pl

The increasing complexity and volume of scientific data require efficient, flexible, and user-oriented tools to support data analysis, visualization, and interpretation. This contribution presents an approach based on the development of dedicated applications designed to assist researchers in processing and exploring spectroscopic data. The study demonstrates how custom-built software tools can enhance analytical workflows, improve reproducibility, and facilitate the integration of multiple data sources.

Two applications are introduced as case studies. The first focuses on the analysis of spectroscopic data related to microplastic samples, providing functionality for data preprocessing, visualization, dimensionality reduction, and classification. The application supports multiple data formats and enables systematic comparison of user data with reference libraries, allowing improved identification and characterization of materials.

The second application is dedicated to the analysis of spectral data from laboratory measurements and planetary science datasets, including meteorites and asteroid analogues. It incorporates tools for data normalization, spectral comparison, feature extraction, and the evaluation of relationships between laboratory spectra and remote sensing observations. The integration of heterogeneous datasets enables consistent and comparative analysis across different domains.

Both applications emphasize a modular structure, user interaction, and adaptability to specific research needs. They illustrate how modern programming environments can be used to create efficient tools tailored to particular scientific problems, bridging the gap between raw data and meaningful interpretation.

The presented approach highlights the importance of developing application-level solutions in scientific research, demonstrating their potential to support complex data analysis tasks across different disciplines, particularly in spectroscopic studies.

Environmental diversity of the Kraków-Częstochowa Upland in the light of malacological analysis

Paulina Laskowska-Piekoszewska*, Witold Paweł Alexandrowicz

[1]Department of General Geology and Geotourism, Faculty of Geology, Geophysics and Environmental Protection, AGH University of Krakow
*Corresponding author: laskowska@agh.edu.pl

Mollusks are a group of animals frequently used for the reconstruction of palaeoenvironments and their changes under the influence of natural and/or anthropogenic factors. Snails, by producing a hard calcareous shell, are well preserved in Quaternary deposits, particularly those rich in calcium carbonate, which reduces chemical dissolution. Mollusks are found in various genetically distinct types of deposits, including karstic infillings, both large (caves) and small (niches, widened karstic fissures). Snails with shells are the only type of mollusk considered in presented research. Each taxon produces shells with specific conchological characteristics (e.g., size, shape, details of shell elements), which allows identification to species level. The aim of the present study was to reconstruct environmental changes based on mollusk assemblages preserved in the infillings of small karst forms within limestone outcrops in the Jerzmanowice and Alwernia areas of the Kraków-Częstochowa Upland. The main subject of the research was the analysis of infillings and their malacological content collected from several isolated limestone outcrops: Witkowe Skały, Wilisowe, Chochołowe, Sokołowe Skały, and Ostatnia Skała (in Jerzmanowice) and Gaudynowskie Skały (in Alwernia).

Malacological studies carried out on ten profiles of small karst infillings in the southern Kraków-Częstochowa Upland lead to several conclusions:

- The individual profiles contain distinctly different mollusk assemblages, indicating that the sediments were deposited during various Holocene periods characterized by different climatic conditions and plant formations.
- The oldest sediments are those in the basal sections of the Witkowe Skały profiles, where cold-adapted species typical of the Late Glacial (*Semilimax kotulae*,

Vertigo geyeri, *Columella columella*, *Vertigo ronnebyensis*) were found. Except for the first, these taxa are no longer present in the study area. Younger sediments, probably of Early Holocene age, were found in the upper intervals of the other sites and are characterized by abundant *Discus ruderatus*. Mid-Holocene deposits, dominated by forest taxa including thermophilous species (*Discus perspectivus*), were found in some profiles. Late Holocene and historical deposits exhibit significant faunal variability: shade-loving species dominate north-facing slopes, while xerophilous open-country snails dominate south-facing slopes.

- The ecological and chronological variability of malacocoenoses allows reconstruction of environmental changes in the area from the end of the Late Glacial through the Holocene. Initially, open and moist habitats with a high share of cold-adapted taxa prevailed. In the Early Holocene, forest expansion began, initially with coniferous stands typical of a cool continental climate, accompanied by assemblages rich in *Discus ruderatus*. As the climate warmed and became more oceanic, mixed and deciduous forests developed, and shade-loving and thermophilous taxa (*Discus perspectivus*) became more common, representing the Mid-Holocene climatic optimum. In the Late Holocene, drier conditions led to habitat diversification depending on slope exposure: shaded northern and western slopes retained forests and their associated malacocoenoses, while southern and eastern slopes experienced forest decline and the spread of open grasslands and exposed rock faces. Human activity, particularly deforestation in the Middle Ages, may also have played a role.

A Comparative Study on the Application of a Light Dynamic Probe and a Light Weight Deflectometer for Assessing Beach Sand Compaction

Maciej Dysierowicz[1]*, Igor Śniady[2], Jerzy Borowicz[2], Weronika Orzechowska[2], Emilia Smardz[2]

[1]Faculty of Drilling, Oil and Gas, AGH University of Krakow,
[2]Faculty of Geographical and Geological Sciences, Adam Mickiewicz University in Poznań
*Corresponding author: macdys@student.agh.edu.pl

Beach sand compaction is one of the key properties controlling its behavior in both geological and geoengineering contexts. From a geological perspective, compaction influences beach resistance to erosion caused by wave action and aeolian processes. From a geoengineering perspective, it is an important factor in planning investments in the coastal zone and may also support the selection of methods for protecting beaches against excessive erosion. This study evaluates and compares the applicability of two geoengineering (geotechnical) methods commonly used to assess soil compaction: the light weight deflectometer (LWD) and the light dynamic probe (DPL). Two measurement campaigns were conducted. During each campaign, measurements with both devices were performed at the same points, and soil samples were collected for laboratory analyses, including grain-size distribution and natural moisture content. The results obtained with both devices were expressed as the density index, which quantitatively describes the compaction state of the tested sands. The agreement between the methods was assessed using Spearman's correlation, Passing-Bablok regression, and Bland-Altman analysis, performed both for the full dataset and after excluding outliers. Principal component analysis (PCA) was additionally applied to evaluate the influence of moisture content and individual grain-size fractions on the obtained results. The LWD results showed markedly lower variability, with an average value of 32 ± 12 MPa, whereas the DPL results averaged 116 ± 152 MPa. The agreement analyses indicated substantial discrepancies between the devices, a lack of correlation, and a strong influence of outliers, reflecting their sensitivity to variable field conditions. According to the Bland-Altman analysis, after

excluding outliers, the mean difference between DPL and LWD was 37.4 MPa, indicating systematically higher values obtained from DPL. The PCA indicated a strong negative relationship between moisture content and the results obtained from both methods. The results highlight the limited agreement between the two devices and suggest that, under the analyzed beach sand conditions, LWD may provide more stable and more representative estimates of near-surface compaction, whereas DPL may better capture point-specific variations in compaction with depth.

Ecotoxicological Effects and Biodegradation Potential of Plant-Based Food-Contact Materials

Klaudia Ławniczak

Faculty of Civil and Environmental Engineering, Warsaw University of Life Sciences (SGGW), Poland
Corresponding author: klaudialawniczak508@gmail.com

Plant-based single-use materials are increasingly considered an alternative to conventional plastics due to their ability to biodegrade. However, biodegradation alone does not provide sufficient information about their overall environmental impact, especially regarding soil organisms and plants. This study assessed the environmental safety of selected biodegradable plant-based materials by combining biodegradation analysis with ecotoxicological evaluation. Three commercially available materials were examined: wood–plastic composite (WPC), polylactic acid (PLA), and palm leaf fibres (PLF). The assessment included physicochemical characterisation, analysis of potentially harmful substance leaching, phytotoxicity tests using *Lepidium sativum* L., and measurements of soil dehydrogenase activity (DHA). Biodegradability was determined based on mass loss after 12 weeks of soil incubation. Palm leaf fibres (PLF) showed high degradation rates, but also caused greater chemical release and negative effects on root growth. In contrast, polymer-based materials (PLA and WPC) exhibited minimal biodegradation, although their leachates reduced soil microbial activity. The results indicate that environmental safety assessment of such materials should consider not only biodegradability, but also their biological and chemical effects on the soil environment.

Occurrence of microplastic items in organs of freshwater and marine fish – an impact of habitat zones and feeding features

Paulina Piskuła*, Aleksander Astel

Department of Environmental Chemistry and Toxicology, Institute of Geography, Pomeranian University in Słupsk
*Corresponding author: paulina.piskula@upsl.edu.pl

In recent years, there has been growing interest in the presence of microplastics (MPs) in marine organisms, particularly in the organs of commercially important fish [1]. Fish can intake MPs items from water through various pathways, including ingestion of contaminated food or water filtration through gills [2]. Due to their small size and resemblance to the natural prey of fish, MPs are easily ingested by ichthyofauna. Additionally, MPs have been found to be present in food such as plankton, detritus, and other organisms that constitute the natural diet of fish. It is possible that ingestion of MPs could potentially lead to physical effects, such as mechanical damage and gastrointestinal blockage. In addition, it could serve as a potential route for introducing chemical substances (e.g. plastic additives, xenobiotics) and pathogenic microorganisms from the surrounding environment into the trophic chain [3]

Despite the increasing number of studies on MPs in aquatic environments, comparative research on freshwater and marine fish remains scarce. The Baltic Sea region is particularly underrepresented in such studies. Due to its limited water exchange with the North Sea, the semi-enclosed Baltic Sea is highly exposed to the accumulation of pollutants, including MPs. Furthermore, in Poland, research on the presence of MPs in freshwater fish organs is limited, hindering a comprehensive assessment of the phenomenon. Previous studies have primarily focused on a limited group of species, which may have hindered a comprehensive understanding of MPs' distribution in both inland and marine ecosystems. Therefore, there is a need for research encompassing a broader range of freshwater and marine species representing different trophic levels, both in Polish inland waters and in the Baltic Sea region. Furthermore, the majority of current studies have focused on investigating MPs in

digestive tracts, while other organs, such as the liver or gills, have not been thoroughly explored. These organs may play a significant role in the accumulation and effects of these pollutants on aquatic organisms.

This is why the purposes of the current study were to assess the presence of MPs in the digestive tract, the liver, and the gills of 6 fish species from the Baltic Sea and 5 freshwater species of northern Poland. A total of 500 individuals were analyzed, including 362 marine fish collected from seven fishing sites in the southern and central Baltic Sea, and 138 freshwater fish from two rivers and coastal lakes in northern Poland. In 291 out of 500 specimens (58%), MPs were found in the gills (47%), digestive tract (39%), or liver (14%). The abundance of MPs items varied from 1 to 12 per fish, with an average of 1.4. The average MPs abundance was 1.1 MPs/individual for freshwater species and 1.6 MPs/individual for marine species. The lowest average number of items was found in sprat (0.2 MPs/individual), while the highest was found in lumpfish (3.3 MPs/individual). Fish exposure to MPs varied significantly depending on habitat type and feeding strategy. The highest exposure levels, and consequently the greatest abundance of items, were observed in benthic marine species and pelagic freshwater fish. Predatory fish from both marine and freshwater ecosystems were characterized by higher MPs abundance in comparison to planktivorous and omnivorous species. In digestive tracts, the dominant size range was 0.11-0.5 mm, 1.01–5 mm; in gills, 0.11–0.5 mm, and in livers, the smallest particles (<0.1 mm) were dominant. Across all organs, MPs were primarily blue and fiber-shaped. Chemical characterization confirmed the presence of cellophane, polyethylene, polypropylene, polyacrylate, and polyamide.

Screen-printed sensors in trace analysis of selected biologically active compounds in environmental samples

Katarzyna Tyszczuk-Rotko

Faculty of Chemistry, Institute of Chemical Sciences, Maria Curie-Skłodowska University in Lublin
Corresponding author: katarzyna.tyszczuk-rotko@mail.umcs.pl

Among the electrochemical methods used in trace analysis, stripping voltammetry is worth mentioning. The detection limits of most procedures developed using this method are in the order of 10-10 or 10-9 mol/L, and under favorable conditions, they can even reach below 10-13 mol/L. Among the entire range of electrodes used in voltammetry, screen-printed electrodes (SPEs) deserve special attention. The undoubted advantages of SPEs include their suitability for use in portable analyzers and their ability to handle small sample and reagent volumes, resulting in minimal wastewater production. The interesting properties of SPEs, combined with appropriately selected ink and/or electrode surface modifications, enable the determination of both metal ions and a wide range of organic compounds at low concentration levels. This presentation summarizes information on the types, properties, and practical applications of SPEs, including the determination of trace concentrations of biologically active compounds in environmental samples.

Hydrochemical Functioning of Streams under Strong Anthropogenic Pressure on the example of the Jeziorka River Catchment

Aleksandra Bartoszek, Jagna Letmańska*, Maksym Łaszewski, Jarosław Suchożebrski

Faculty of Geography and Regional Studies, University of Warsaw
*Corresponding author: j.letmanska@student.uw.edu.pl

The intensive urban development of the suburban areas of Warsaw has increased pressure on aquatic ecosystems and led to negative changes in the quality of flowing waters. At the same time, rivers in urbanized areas perform a number of important ecological, social, and economic functions, making the understanding of their hydrochemical functioning essential for sustainable water resource management and environmental protection. The aim of the study was to assess the factors shaping water quality in streams within the Jeziorka River catchment, located within the Warsaw metropolitan region and subjected to strong pressure from urban development and agriculture. Four times in each season (summer, autumn, winter, and spring) measurements of water temperature, specific electrical conductivity, and pH were conducted at a total of 30 sampling sites located along the Jeziorka River and its tributaries. Laboratory analyses included the determination of concentrations of NH4+, NO3-, PO43-, K+, SO42-, and Fe ions. Additionally, concentrations of macro- and microelements were determined at selected sites using ion chromatography and ICP-MS. The results indicate considerable spatial variability in the physico-chemical characteristics of stream water, resulting from different forms of human activity. The water quality of the Jeziorka River is shaped primarily by its tributaries, flow-through reservoirs, wastewater discharges from wastewater treatment plants, and pollutant inflow from urbanized areas. In the middle course of the Jeziorka River, a decrease in biogenic compounds concentrations was documented, indicating intensive self-purification processes occurring within the natural river section. A significant problem is also the discharge of untreated wastewater from municipal treatment plants into the tributaries of the Jeziorka River

Key words: water quality, hydrochemistry, water pollution, urbanization, Jeziorka River

The influence of leaf structure on the retention and leaching of particulate matter during simulated rainfall

Zuzanna Zając[1]*, Hanna Moniuszko[1], Mariia Pismanik[1], Arkadiusz Przybysz[1], Mariola Wrochna[2], Andrzej Zwoliński[1], Robert Popek[1]

[1]Centre for Climate Research Warsaw University of Life Sciences
[2]Department of Plant Protection Warsaw University of Life Sciences
*Corresponding author: d003338@sggw.edu.pl

Air pollution caused by particulate matter (PM) is one of the main threats to the environment and public health in urban areas. Although it is widely known that trees effectively reduce PM concentrations by capturing particles on their leaves, the life cycle of these pollutants (including the process of their removal by rain) is not yet fully understood. This study aims to determine how different leaf morphologies determine the initial ability to retain dust and the dynamics of its removal under simulated rainfall.

Under controlled conditions, rain-washed particulate matter (RWPM), surface-bound particulate matter (SPM), and wax-bound particulate matter (WPM) were analyzed. The results showed significant interspecies variation. The highest total PM accumulation was observed in Taxodium distichum, Paulownia tomentosa, and Araucaria araucana. In contrast, the lowest dust retention capacity was observed in Platanus × acerifolia and Idesia polycarpa. It was also shown that the highest fraction of non-washable dust (permanently retained on the leaves) occurred in A. araucana, T. plicata, and P. tomentosa.

The analysis confirmed that the total amount of retained dust correlates positively with the type of foliage, and a high content of epicuticular waxes significantly improves the retention of fine PM fractions. In contrast, species with smooth leaves and less surface roughness retained significantly less pollution. The data obtained prove that both the structural and biochemical characteristics of leaves (presence of hairs, wax structure) play a key role in the interaction of plants with dust during precipitation. Understanding the dynamics of pollutant accumulation and wash-off provides valuable guidance for spatial planners when selecting tree species for urban planting, allowing for the optimization of greenery in terms of improving air quality.

The Flash Flood in Ćmielów on 11 July 2024 in the Kielce Upland as an Example of an Extreme Weather Event

Wojciech Nadziałek

Jan Kochanowski University in Kielce, Institute of Geography and Environmental Sciences, Department of Geomorphology and Geoarchaeology, Doctoral School of the Jan Kochanowski University in Kielce
Corresponding author: wojtek.nadzialek@poczta.onet.pl

This study presents an analysis of the flash flood that occurred on 11 July 2024 in Ćmielów, located in the Kielce Upland, Poland. The aim of the research was to characterize the meteorological and synoptic conditions conducive to the development of severe thunderstorms and to assess the course and impacts of the event. The analysis was based on data from the Institute of Meteorology and Water Management (IMGW), ERA5 reanalysis, meteorological station records, photographic documentation, and reports on hazardous weather phenomena from the European Severe Weather Database (ESWD). It was found that the development of a nearly stationary thunderstorm line was associated with high tropospheric humidity, moderate values of convective available potential energy (CAPE), and the presence of a wind convergence zone. Intense and prolonged precipitation associated with a nearly stationary thunderstorm cluster led to the occurrence of a flash flood. A nearby private weather station recorded a total precipitation amount of 86.61 mm. The rapid surface runoff resulted in damage to infrastructure and buildings. The conducted analysis demonstrated the significant role of specific meteorological conditions in fostering the development of thunderstorms producing intense rainfall. This event constitutes an example of extreme weather phenomena occurring in the Kielce Upland.

Results of geomorphological research near the megalithic site on Łyżka (Island Beskids, Poland)

Tomasz Kalicki[1], Paweł Przepióra[1*], Monika Żelezik[1], Piotr Biesaga[2]

[1]Jan Kochanowski University in Kielce
[2] independent scientist
*Corresponding author: pawelprzepiora1988@gmail.com

The Stożek on Łyżka Peak archaeological site in the Beskid Wyspowy is one of the new megalithic sites in southern Poland, where interdisciplinary research using geological, geomorphological, geophysical, and archaeological methods has been undertaken, along with dating using OSL and ^{14}C dating. The site is located on the Stożek top (728.4 m a.s.l.) in the northernmost part of the landslide slope of the secondary, eastern peak (785 m a.s.l.) of Łyżka Peak (803.7 m a.s.l.). Megaliths have been identified in two locations on the landslide slope. On the isolated, mound-like Stożek top, rising several meters above the bottom of the surrounding, likely anthropogenic, "moat," there is a stone circle with stone structures on its summit. All megaliths are composed of thick-bedded Magura sandstone. The aim of detailed geomorphological studies was to determine, among other things, the age of the extensive landslide (over 165 ha) on the eastern slopes of Łyżka Peak, where megalithic structures occur. The landslide is bound by a distinct rim from above, and mesoforms, i.e. secondary scarps, marshy depressions, sometimes with small, periodic landslide lakes. This complex morphology may indicate multi-stage and different-time formation of the landslide. Drilling was performed within the Zamek landslide depression at an altitude of approximately 650 m a.s.l., near which a stone wall was built. Sediment samples from the cores were analyzed for grain size and organic matter content (LOI). The marshy depression is filled with mineral-organic sediments at the bottom, of which, in the Łyżka Zamek core at a depth of 220-225 cm, a subfossil tree was found and dated by radiocarbon to 6980±80 BP (MKL-7259) cal. 6012-5723 BC. This allows the

landslide movements to date (primary or secondary at this landslide site) and the tree falls to the Atlantic period during one of the Mesoholocene landslide phases in the Carpathians. This humid climatic phase triggered not only landslides in the Carpathians but also an increase of fluvial activity in the rivers of the upper Vistula River catchment. The depression became peated at the end of the Atlantic - 5560±100 BP (MKL-7260) cal. 4678-4171 BC, which may have been additionally favored by climate humidification. However, at the turn of the Atlantic and Subboreal, after 5360±120 BP (MKL-7261) cal. 4331-3959 BC, debris flow delivered an increased amount of material to the depression, thus clayey peats accumulated here, in which redeposited older wood is found 6060±80 BP (MKL-7262) cal. 5200-4788 BC. After 3130±120 BP (MKL-7263) cal. 1514-1050 BC, the accumulation of peaty silts began in the depression, as the amount of organic matter decreased significantly. The material delivered by debris flow became much thicker. The change in erosion-accumulation processes at the turn of the Subboreal and Subatlantic and the intensification of erosion on the Łyżka Peak slopes could have been caused by deforestation related to the activities of the Lusatian culture community, which can be confirmed by the results of archaeological research from this site.

Climate changes on Mount Śnieżka against the background of Poland's climate in the multiannual period 1990–2010

Iga Telega, Karolina Walczak*

Adam Mickiewicz University
*Corresponding author: kw90328@st.amu.edu.pl

Contemporary climate change, driven by anthropogenic greenhouse gas emissions, is global in nature, and the mountain ecosystems of the Sudetes are particularly sensitive to it. High-altitude stations, such as the Śnieżka observatory (1603 m a.s.l.), play a crucial role in monitoring trends in the free atmosphere, free from the influence of factors like the urban heat island effect. The objective of this study was to analyze changes in thermal conditions on Śnieżka over the 1990–2020 multi-year period and compare them with the entire area of Poland. Daily data from the IMGW-PIB were utilized and subjected to statistical analysis and linear regression.

The results confirm a synchronous warming trend across both studied areas. The analysis revealed a systematic increase in mean annual air temperature; the trend slope for Poland was 0.048, while for Śnieżka it was 0.042. The warmest year in Poland was 2019, with an average of 9.8°C, whereas on Śnieżka it was 2014, with a value of 2.7°C. The coldest year in both cases was 1996 (6.3°C and -0.1°C, respectively). A slight upward trend in total precipitation on Śnieżka was also recorded (coefficient of 0.147), along with a clear decrease in the mean annual wind speed (coefficient of -0.084). These results demonstrate that the unique environment of the Karkonosze Mountains is undergoing significant thermal transformations that correlate with the rest of the country, making Śnieżka a sensitive indicator of global climate fluctuations.

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