Project Title	**Thriving Cities, Green Revival: Investigating the Multifaceted Effects of Miyawaki Forests on Urban Ecology**
University (where student will register)	University of Warwick
Which institution will the student be based at?	As above
Theme (Max. 2 selections)	Climate & Environmental Sustainability ☒ Organisms & Ecosystems ☒ Dynamic Earth ☐
Key words	Tiny Forest, Afforestation, Public Engagement, Soil Carbon, Soil Microbes, Greenhouse Gases
Please explain how the project fits within the NERC remit	This studentship aligns with the NERC remit due to its strong focus on interdisciplinary research aimed at understanding and addressing critical environmental challenges, including biodiversity loss and carbon sequestration. By investigating the multifaceted impacts of Miyawaki Forests on urban systems, the studentship contributes to NERC's goal of promoting sustainable urbanisation and enhancing our understanding of interactions between the environment, society, and economy. The project's emphasis on urban ecology, soil science, biogeochemistry, and the benefits of community engagement in environmental science aligns with NERC's commitment to advancing environmental science for the benefit of society. Further, the research's potential to provide actionable recommendations for urban planning and green space management directly addresses NERC's focus on delivering knowledge and solutions to address environmental issues and ensure the resilience of our cities in a changing world.
Supervisory team (including institution & email address	**PI:** Ryan Mushinski, University of Warwick, ryan.mushinski@warwick.ac.uk **Co-I:** Earthwatch-Europe (Claire Narraway, cnarraway@earthwatch.org.uk; & Sophie Cowling, scowling@earthwatch.org.uk) **Co-I:** Daniel Evans, Cranfield University, Daniel.L.Evans@cranfield.ac.uk

Project Highlights:

Innovative Urban Solutions: Addressing urbanisation's challenges, the project explores the potential of Miyawaki Forests to counter pollution, heat, and green space loss, offering a pioneering approach to urban planning.

Holistic Urban Impact Assessment: Uncovering the broader effects of Miyawaki Forests, the study combines social perceptions, soil analysis, biogeochemistry, and microclimate monitoring to provide a comprehensive understanding of their influence on urban ecosystems.

Transdisciplinary Training: The studentship offers multidisciplinary training, equipping the researcher with skills in urban ecology, social science, soil analysis, biogeochemistry, and stakeholder engagement, empowering them to contribute to sustainable urban planning and decision-making.

Overview (including 1 high quality image or figure):

The rapid pace of urbanisation is reshaping the global landscape, leading to profound environmental and social challenges. As cities expand, they often experience increased pollution, heat island effects, reduced green spaces, and altered microclimates. These changes adversely affect both human well-being and ecosystem health. In response, innovative approaches to urban planning and green space design are being sought to mitigate the negative impacts of urbanisation.

Miyawaki Forests, named after Japanese botanist Akira Miyawaki, offer a promising solution. These densely planted urban forests aim to mimic natural ecosystems by incorporating a diverse mix of native plant species in a compact area. Unlike traditional urban forestry practices, which focus on monoculture tree planting, Miyawaki Forests promote biodiversity and ecosystem complexity.

It is widely assumed that these forests offer a multitude of benefits, encompassing carbon sequestration, improved air and water quality, enhanced microclimates, and the establishment of natural habitats in densely populated urban areas. Nonetheless, additional research is required to precisely determine the extent of these advantages. The establishment of these forests can potentially have far-reaching effects on both the social fabric of communities and the intricate biogeochemical cycles that underpin urban ecosystems. As urban planners and policymakers consider the adoption of Miyawaki Forests as a tool for urban greening, there is a critical need to understand the broader implications and trade-offs associated with their implementation.

This PhD studentship will fill this knowledge gap by undertaking a comprehensive investigation into the social, pedological, and biogeochemical impacts of establishing Miyawaki Forests in urban areas. By uncovering the multiple dimensions of these impacts, this research will contribute to informed decision-making in urban planning and green space management. It will also aid in understanding the potential role of Miyawaki Forests in fostering more sustainable, resilient, and liveable urban environments in the face of global environmental changes.

Methodology:

Social Impact: Collaborate with Earthwatch-Europe to assess urban perceptions of Miyawaki Forests, analysing well-being, community engagement, and aesthetic preferences.

Soil Science: Extract soil samples from Miyawaki Forests and analyse physical (e.g., structure, texture, bulk density, water holding capacity), chemical (e.g., pH, nutrients) and biological (e.g., organic matter, microbial biomass) indicators of soil quality.

Biogeochemical Cycling: Analyse plant and soil samples for carbon, nitrogen, and nutrients, deploying soil gas and water sampling for carbon sequestration, nitrogen cycling, revealing microbial biogeochemistry and trace gas fluxes.

Microclimate Analysis: Use sensors and loggers for continuous microclimate monitoring, analysing differences in temperature, humidity, and air quality.

Integration and Synthesis: Merge social, soil, and biogeochemical data, aligning perceptions with ecological impacts. Interpret holistically with multidisciplinary experts. Suggest urban planners, policymakers, and stakeholders utilise findings to address benefits, challenges, and trade-offs of urban Miyawaki Forests.

Training and skills:

Students will be awarded CENTA2 Training Credits (CTCs) for participation in CENTA2-provided and ‘free choice’ external training. One CTC equates to ½ day session and students must accrue 100 CTCs across the three years of their PhD.

This interdisciplinary PhD project offers comprehensive training in urban ecology, social science, soil analysis, biogeochemistry, sensor deployment, and stakeholder engagement. The PhD student will gain expertise in urban ecology principles, social perception surveys, soil analysis, biogeochemical techniques, and microclimate monitoring. The student will collaborate with social scientists and multidisciplinary experts and develop skills in data integration, holistic interpretation, and effective communication. The student will also acquire project management skills for efficient research execution. By the end of the PhD, the student will be well positioned to tackle complex urban challenges, provide actionable recommendations, and contribute to sustainable urban planning.

Partners and collaboration (including CASE):

Name of L1/L2 Partner (where applicable)	Earthwatch-Europe
Name of CASE partner (where applicable – project proposal **must** be accompanied by a letter of support from the CASE partner)	None

Further information on partners and collaboration (including CASE):

Earthwatch-Europe is a non-profit environmental organization dedicated to engaging people in scientific research and conservation efforts to address pressing environmental challenges. Founded in 1971, Earthwatch-Europe operates as part of the broader Earthwatch Institute network and focuses specifically on initiatives and projects within Europe. The organisation's primary mission is to promote citizen science by involving volunteers from various backgrounds in hands-on research projects that aim to better understand and protect the natural world. Earthwatch Europe collaborates with scientists, researchers, and experts to design and conduct field research programs that span a wide range of environmental topics, including biodiversity conservation, climate change, wildlife conservation, and sustainable resource management.

Possible timeline:

Year 1:
Months 1-4: Literature review and project planning, refining research objectives and methodologies.
Months 5-8: Collaborate with Earthwatch-Europe to design engagement and nature-connectedness experiments.
Months 9-12: Launch urban perception surveys, engage urban communities, and collect data.

Outcome: Data collection from urban surveys; preliminary engagement with stakeholders.

Year 2:
Months 13-16: Analyse social perception data to understand well-being, engagement, and aesthetic preferences.
Months 13-24: Conduct soil sampling campaigns at Miyawaki Forest and control sites.
Months 13-24: Analyse soil properties and uncover differences in structure, fertility, and carbon movement.

Outcome: Social perception trends; comprehensive soil analysis results.

Year 3:
Months 25-28: Collect plant and soil samples for biogeochemical and pedological analyses.
Months 29-36: Field sampling to integrate microbial biogeochem, and trace gas fluxes. Bioinformatic analysis
Months 29-36: Monitor microclimates using sensors, analysing temperature, humidity, and air quality differences.

Outcome: Soil and biogeochemical insights; microclimate data interpretation.

Concluding Activities:
Months 37-39: Integrate social, soil, and biogeochemical data, identifying correlations and trends.
Months 40-42: Collaborate with multidisciplinary experts to holistically interpret integrated results.
Months 40-42: Develop recommendations, addressing benefits, challenges, and trade-offs.

Outcome: Integrated findings; actionable recommendations.

Months 36-42: Thesis writing, manuscript preparation, and dissemination of research findings through scientific publications and presentations.

This timeline ensures a structured and phased approach to conducting comprehensive research, data collection, analysis, interpretation, and synthesis, leading to informed recommendations for urban planning and green space management.

Further reading:

Miyawaki, A. (1998). Restoration of urban green environments based on the theories of vegetation ecology. Ecological Engineering, 11(1-4): 157-165.

Nowak, D. J., Hirabayashi, S., Bodine, A., & Greenfield, E. (2014). Tree and forest effects on air quality and human health in the United States. Environmental Pollution, 193, 119-129.

Ouyang, Z., Zheng, H., Xiao, Y., Polasky, S., Liu, J., Xu, W., ... & Daily, G. C. (2016). Improvements in ecosystem services from investments in natural capital. Science, 352(6292): 1455-1459.

Li, D., & Sullivan, W. C. (2016). Impact of views to school landscapes on recovery from stress and mental fatigue. Landscape and Urban Planning, 148: 149-158.

Lyytimäki, J., & Sipilä, M. (2009). Hopping on one leg – The challenge of ecosystem disservices for urban green management. Urban Forestry & Urban Greening, 8(4): 309-315

Escobedo, F. J., Kroeger, T., & Wagner, J. E. (2011). Urban forests and pollution mitigation: Analyzing ecosystem services and disservices. Environmental Pollution, 159(8-9): 2078-2087.

Further details:

Mushinski Group (Environmental Processes Laboratory) Website: www.ryanmushinski.com

Earthwatch Europe Website: https://earthwatch.org.uk/

Daniel Evans Research Profile: https://www.cranfield.ac.uk/people/dr-daniel-evans-28309587