LARGE WOODY DEBRIS BOOSTS ABUNDANCE AND DIVERSITY. A Study of Bats and Aquatic Invertebrates.

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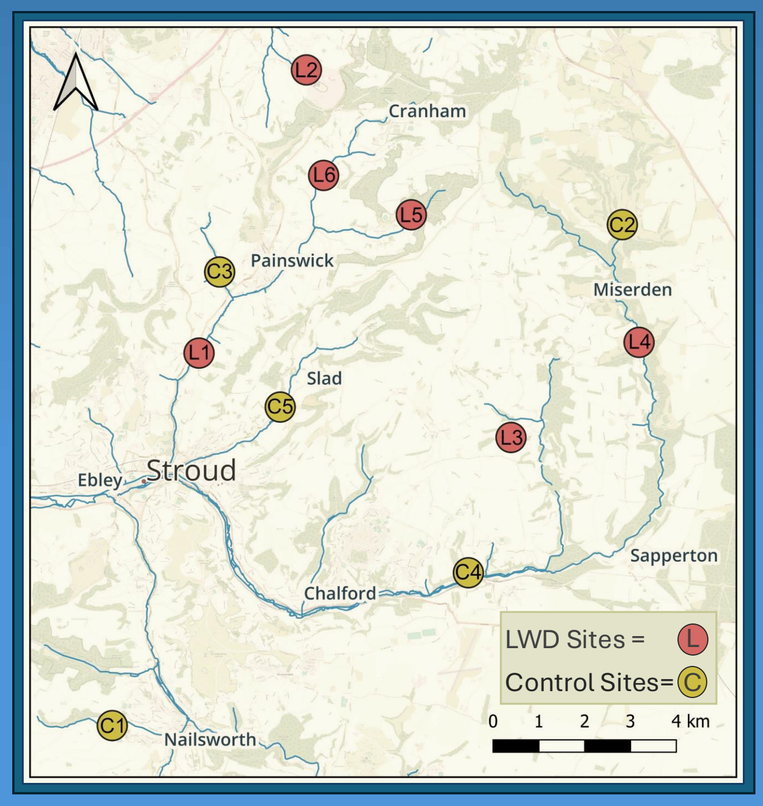
1. INTRODUCTION

- Over thousands of years, humans have modified hydrology[1], impacting upon watercourses and freshwater habitats[2]. Urbanisation and climate change have amplified these issues, reducing biodiversity and increasing flash flooding[3,4].
- Traditional engineered approaches have failed to avert flooding, instigating the employment of catchment-based natural flood management such as such as the installation of in-stream large woody debris (LWD) as 'leaky dams'[5].
- LWD consists of deadwood of over 1 metre in length and 10cm in diameter. In previous studies, its presence has been found to increase diversity and abundance of aquatic macroinvertebrates[6].
- This study explores whether these increases are found within the lowland catchment of the River Frome and whether correlations are found to Chiroptera (bat) diversity and abundance.
- Bats are a protected order within the UK[7] due to historic declines. Emergent aquatic invertebrates form a major part of bat's diets, and they are strongly associated with riparian habitats[8].

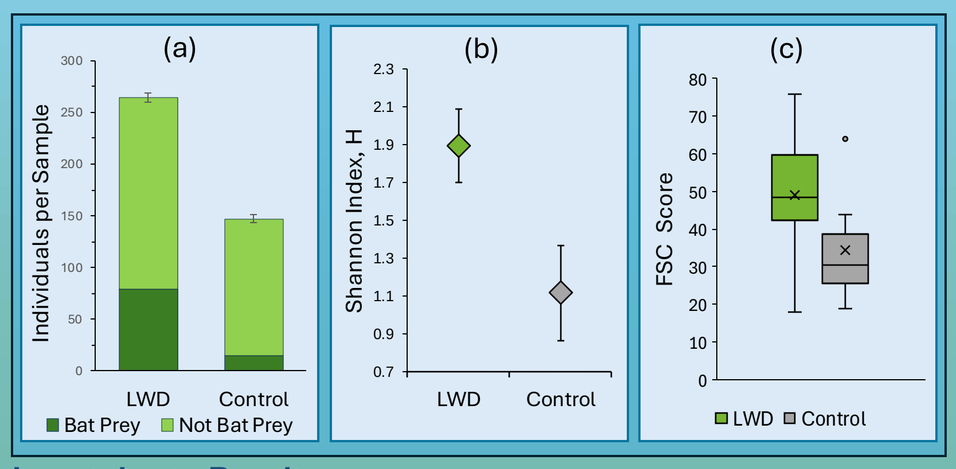
2. METHOD

- In July and August 2024, three minute instream kick-net surveys were conducted at four control sites C1- C4 and six LWD sites L1- L6. Invertebrates were identified and recorded.



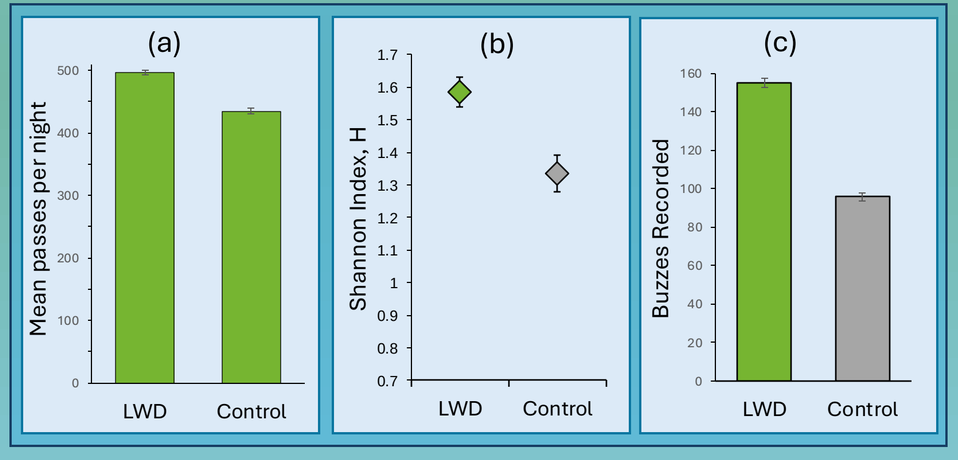
- Anabat Swift static bat detectors were deployed at each site for one week.
- Full spectrum recordings were analysed to identify and count bat passes and feeding buzzes per night.

3. KEY RESULTS



Invertebrate Results: (a) Mean (± SE) total abundance per sample. (b) Mean Shannon diversity indices (95% CI). (c) Site FSC biotic scores.

- Invertebrates n=4,351 across samples n=20. Bat passes n= 31,332 across sites n=11.
- Mean Shannon Weiner diversity index of invertebrates greater at LWD ($t=4.91$, $df=311$, $p<0.001$).
- Mean biotic score higher at LWD ($\chi^2=23.78$, $df=1$, $p<0.001$).
- Shannon Weiner diversity index of bats greater at LWD ($t=6.969$, $df=4261$, $p<0.001$).
- Linear regression between 'bat prey' invertebrates and bat passes showed significant positive relationship ($r=0.372$, $df=49$, $p=0.008$).



Bats Results: (a) Mean (± SE) total passes per night. (b) Shannon diversity indices (95% CI). (c) Mean Buzzes per night (± SE).

4. DISCUSSION

- Greater access to optimal foraging should positively correlate with reproductive fitness and abundance in bats.
- Results suggest potential for utilisation of LWD to mitigate effects of widespread insect losses to insectivorous species[9].
- Confirming ecological benefits of LWD installations, fills existing evidence gaps for the Stroud Natural Flood Management Project.
- Further research is recommended to explore relationships to non-benthic invertebrates using alternative survey methods e.g. suction traps. Relationships of LWD to other species such as fish, dipper *(Cinclus cinclus)* and otter *(Lutra lutra)* also merit further study.
- By highlighting the benefits of LWD to species at higher trophic levels, it is hoped that these results will encourage further research and widen the implementation of LWD.

References:[1]Kirkpatrick, J. (2024). A Big History of Land Clearance and Deforestation. Journal of Big History, 7(3), pp 1-18. [2] Dudgeon, D. *et al*, (2006). Freshwater biodiversity: importance, threats, status and conservation challenges. Biological Reviews, 81(2), pp 163-182. [3]Shaw, E. *et al* (2021). Urban rivers corridors in the Don Catchment, UK: From ignored, ignoble and industrial to green, seen and celebrated. Sustainability, 13(14), pp 7646. [4] Döll, P., & Zhang, J. (2010). Impact of climate change on freshwater ecosystems: a global-scale analysis of ecologically relevant river flow alterations. Hydrology and Earth System Sciences, 14(5), pp 783-799. [5] Environment Agency. (2017). Working with natural processes– evidence directory in Environment Agency for England and Wales. Bristol Retrieved from https://assets.publishing.service.gov.uk/media/6036c5468fa8f5480a5386e9/Working_with_natural_processes_evidence_directory.pdf. [6]Cashman, M. *et al* (2016). Combined stable-isotope and fatty-acid analyses demonstrate that large wood increases the autochthonous trophic base of a macroinvertebrate assemblage. Freshwater Biology, 61(4), pp 549-564. [7] Collins, J. e. (2023). Bat Surveys for Professional Ecologists: Good Practice Guidelines. London. Bats Conservation Trust. [8]Racey, P. (1998). The importance of the riparian environment as a habitat for British bats. Cambridge. Cambridge University Press.[9] Shortall, C. et al (2009). Long-term changes in the abundance of flying insects. Insect Conservation and Diversity, 2(4), pp 251-260. **Bat images**: Barracuda1983, CC BY-SA 3.0 https://creativecommons.org/licenses/by-sa/3.0, NPS-Gov, via Wikimedia Commons. **All other images:** Smith, B (2024).

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