

Analysing the Impact of Eurasian Beavers on Water Quality: Evidence from the Upper River Otter

Madeleine Tattersall, University of Exeter

Introduction

- Eurasian beavers (*Castor fiber*) are ecosystem engineers that influence rivers through dam building.
- Beaver dams improve water quality by trapping sediment, slowing flow, and altering biogeochemical processes (Brazier et al., 2020; Puttock et al., 2017).
- This study investigates their impact on water quality in the Upper River Otter, Somerset.



Figure 1 Photograph of the beaver dam

Research Question

Do beaver dams significantly alter water quality?

Prediction

Beaver activity improves downstream water quality by modifying flow and sediment dynamics.

Objectives

Measure key water quality parameters

Compare conditions above and below a beaver dam

Assess whether observed changes are statistically significant

Methods

Water samples were collected monthly between April 2025 and September 2025. Parameters measured were:

- pH
- Total Dissolved Solids (TDS)
- Temperature
- Dissolved Oxygen (DO)
- Total Oxidised Nitrogen (TON)

Study Area

- Otterhead Lakes
- Upper River Otter Catchment → 43km² (gov.uk)
- Consists of two lakes that have been turned into a wetland since beavers arrived in 2017 (Howe et al., 2020)
- Above Beaver Dam → N50.92088 W003.10924
- Below Beaver Dam → N50.92093 W003.10916

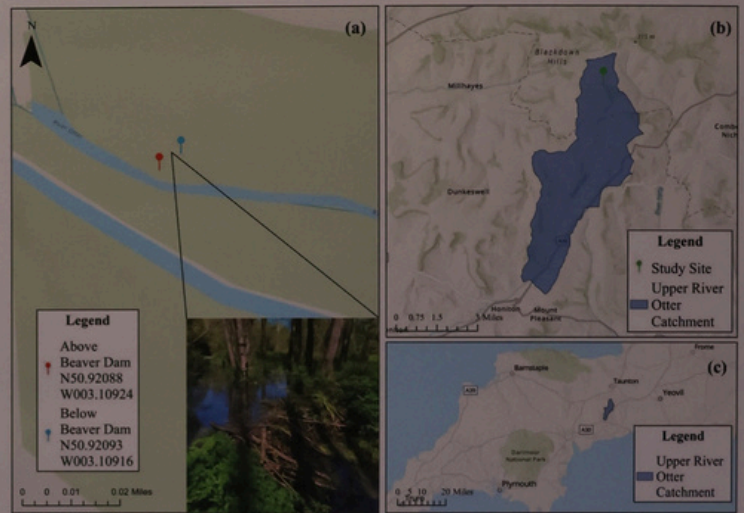


Figure 2 Study site location (a) on the Upper River Otter catchment (b), southwest of England (c). Map created in ArcGIS Pro using the World Topographic Map and World Hillshade basemaps (© Esri). Catchment boundary data from UK Environment Agency Catchment Data Explorer. Photograph taken by the Author.

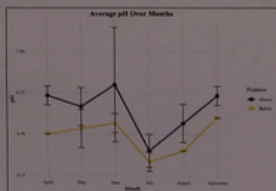


Figure 3 Mean pH values measured monthly between April and September at sampling sites located above and below the beaver dam.

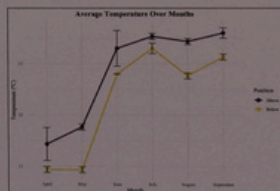


Figure 5 Mean monthly water temperature between April and September at sampling sites located above and below the beaver dam.

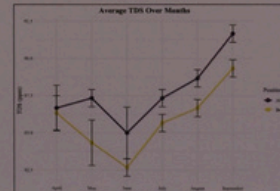


Figure 7 Mean TDS values measured monthly between April and September at sampling sites located above and below the beaver dam.

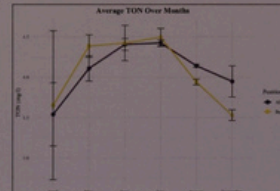


Figure 9 Mean monthly TON between April and September at sampling sites located above and below the beaver dam.

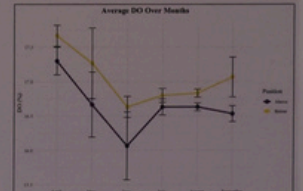


Figure 11 Mean DO values measured monthly between April and September at sampling sites located above and below the beaver dam.

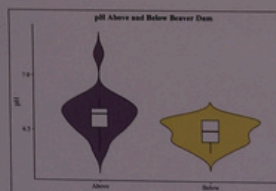


Figure 4 Distribution of pH measurements above and below the beaver dam.

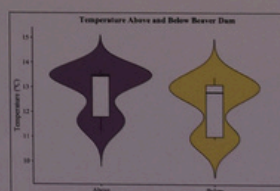


Figure 6 Distribution of water temperature measurements above and below the beaver dam.

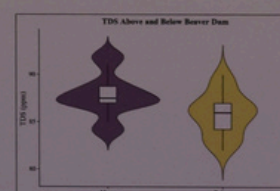


Figure 8 Distribution of TDS measurements above and below the beaver dam.



Figure 10 Distribution of TON measurements above and below the beaver dam.



Figure 12 Distribution of DO measurements above and below the beaver dam.

Discussion and Conclusion

- Beaver damming produced clear, measurable changes in water quality, with significant differences in pH, temperature, TDS, and DO between upstream and downstream sites.
- The dam acts as a natural filter, reducing dissolved solids, while increased turbulence enhances oxygen levels downstream. In contrast, TON showed no significant change, likely reflecting low nutrient levels in the catchment.
- Overall, these findings demonstrate that beavers can modify water chemistry and enhance river function, supporting their role as a Nature-based Solution for river restoration, even in a relatively unpolluted catchment.

Key findings

- pH ↓ below the dam
- Temperature ↓ below the dam
- TDS ↓ below the dam
- TON → no significant change
- DO ↑ below the dam

References:

- Brazier et al., *WIREs Water* 2020, 8, e1494.
 Esri, *World Topographic Map* (2012)
 Gov.uk, *Upper River Otter Water Body* (n.d.)
 Howe & Crutchley, *Nat. England Evid. Rev.* 2020, NEER018
 Puttock et al., *Sci. Total Environ.* 2017, 576, 430–443

Acknowledgements:

Thanks to Diego Panici for supervision, Wessex Water and the Otterhead Estate Trust for site access, and University of Exeter Geography Amory Laboratory staff for sample analysis



Wessex Water
TTL GROUP



University of Exeter

The Ecosystem Engineer: Evaluating Beaver Impacts on Biodiversity

Leoni Rushton

BSc (hons) Animal Conservation Science
University of Cumbria | S2201474@uni.cumbria.ac.uk



Background

Beavers are recognised as keystone ecosystem engineers due to their ability to modify hydrology and create complex wetland habitats that support diverse flora and fauna (Hood and Larson, 2015). A site occupied by beavers for approximately 15 years provides a valuable opportunity to investigate the long-term ecological impacts of sustained ecosystem engineering (Stringer *et al.*, 2015). Prolonged beaver activity can significantly alter habitat structure, vegetation succession, and ecosystem functioning over time (Law *et al.*, 2016).

Aims and Objectives

The aim is to evaluate the Eurasian beaver's ecological role, and the impact their activity has on biodiversity and freshwater ecosystems.

1. Compare biodiversity between a beaver occupied Loch and a Loch with no beaver presence.
2. Assess habitat complexity at both sites by analysing structural features, biodiversity patterns and water dynamics.
3. Conduct biological and physical habitat surveys at each Loch, including vegetation assessments, aquatic invertebrate sampling, field observations and camera trapping.

Research Question

How does long-term Eurasian beaver (*Castor fiber*) activity influence biodiversity, habitat complexity, and freshwater ecosystem functioning in Knapdale, Scotland?

Sampling Site

Figure: Locations of the sampling sites in Knapdale Forest. Dubh Loch (56.0521°N, 5.5602°W) is distinguished by active beaver damming (raising its water level by ~1.1m), whereas Torr Mor (56.0299°N, 5.6208°W) shows no beaver modification. The inset situates Knapdale in western Scotland. These sites were part of the Scottish Beaver Trial (first wild beavers released in Knapdale in 2009).



Figure 2. Map showing the Torr Mor Pond and the Dubh Loch, both located in Mid-Argyll, Scotland. They are 6.2 miles apart.

Rationale

Long-term beaver occupation creates relatively stable wetland systems, allowing sustained ecological responses to ecosystem engineering to be assessed. Comparing a beaver-modified loch with a non-beaver loch enables evaluation of how beaver activity influences biodiversity, habitat complexity, and freshwater ecosystem functioning (Law *et al.*, 2016).

Despite increasing interest in beaver reintroduction across the UK, limited long-term research exists within Scottish freshwater systems. This study aims to provide evidence on the ecological benefits, and potential limitations, associated with prolonged beaver activity and wetland creation (Stringer *et al.*, 2016).

Methodology

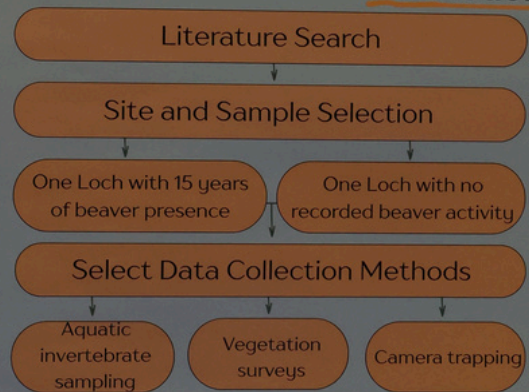


Figure 1. Overview of the study rationale, paired-site comparative design, and ecological survey methods used to assess biodiversity, habitat complexity, and ecosystem functioning in beaver-modified and non-beaver freshwater systems in Knapdale, Scotland.

Results

Preliminary survey results show clear differences in faunal abundance between sites with a three-fold increase at the beaver modified site. The hope is to use a multi-variate analysis to utilise all 3 data sets together

Note: Plant species were surveyed at both sites, but vegetation abundance data is not included in this figure.

This early pattern indicates that beaver activity may enhance habitat complexity and support richer, more abundant animal communities across multiple taxa.

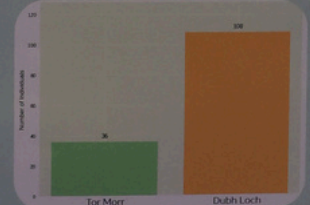


Figure 3. This figure presents early summary data from biodiversity surveys conducted at the two study sites. Abundance refers to the total number of individual organisms recorded across all surveyed faunal taxa, including aquatic invertebrates and camera detected vertebrates.

Species Found

Cased Caddis, Water Mites, Whirling Beetle, Horse Leech, Stickleback, Water Beetle, Tadpole, Lesser Waterboatman, Stonefly Nymph, Dragonfly Nymph, Greater Water Boatman, Damselfly Larvae, Common Stretch Spider, Wandering Snail, Quick Gloss Snail, Mayfly Nymph, Flat-bodied Upwing, Blue-winged Olive, Mosquito, Pond Skater, Caseless Caddis, Olive, Bloodworm, Hairworm, Badger, Beaver, Otter, Fox, Sika Deer, Roe Deer, Heron, Mallard, Chaffinch, Grey Wagtail, Dragonfly, Mute Swan, Wood Mouse, Jay, Bank Vole, Water Shrew, Pine Marten, Wren, Robin, Red Squirrel, Woodcock, Weasel, Bumblebee, Toad, Hooded Crow, Bullfinch.

References

Stringer, A.P., Blake, D. and Gaywood, M.J. (2015) A review of beaver (*Castor spp.*) impacts on biodiversity, and potential impacts following a reintroduction to Scotland. Scottish Natural Heritage Commissioned Report No. 815.

Hood, G.A. and Larson, D.G. (2015) 'Ecological engineering and aquatic connectivity: a new perspective from beaver-modified wetlands', *Freshwater Biology*, 60(1), pp. 198-208.

Law, A., McLean, F. and Willby, N.J. (2016) Habitat engineering by beaver benefits aquatic biodiversity and ecosystem processes in agricultural streams. *Freshwater Biology*, 61(4), pp.486-499.

Stringer, A.P. and Gaywood, M.J. (2016) The impacts of beavers (*Castor spp.*) on biodiversity and the ecological basis for their reintroduction to Scotland, UK. *Manuscript review*, 46(4), pp.270-285.

Gantt Chart

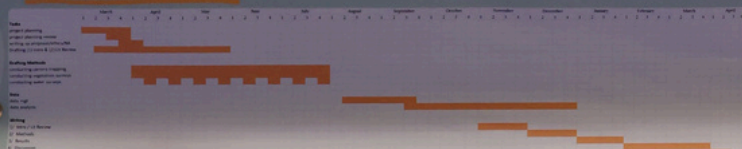


Figure 4. Gantt chart illustrating the full dissertation workflow, including planning, fieldwork, data processing, and writing phases from March 2025 to April 2026



Scan the QR code to find the **Field risk assessment, Dissertation Proposal and the Carbon footprint consideration**
Ethical considerations were reviewed, but no formal ethical approval was required for this study.



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s.webb.23@abdn.ac.uk

British Beaver Landscapes:

how do we culturally value beaver landscapes in Britain?

Stephanie Webb, Dr. Alan Law, Prof. David G. Anderson, Dr. Flurina Wartmann



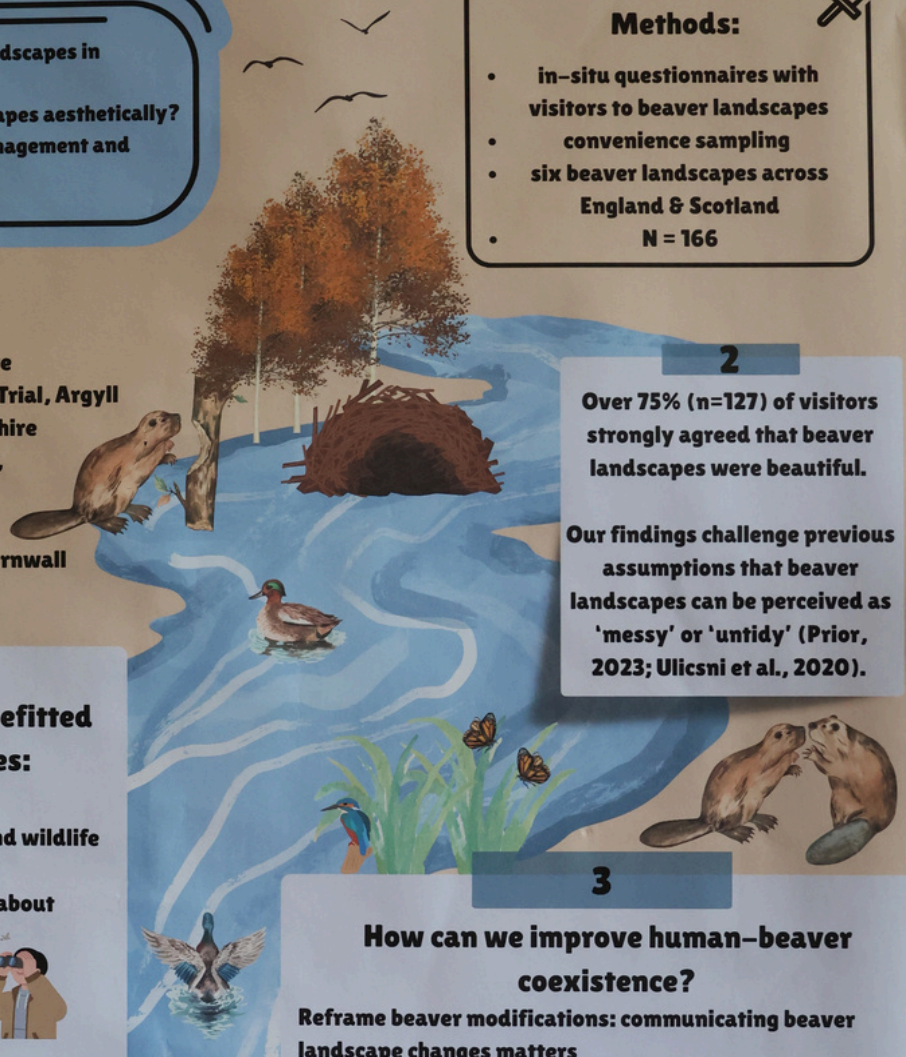
1. How do visitors benefit from beaver landscapes in Britain?
2. How do visitors perceive beaver landscapes aesthetically?
3. Recommendations for future beaver management and visitor engagement.

Methods:

- in-situ questionnaires with visitors to beaver landscapes
- convenience sampling
- six beaver landscapes across England & Scotland
- N = 166

Field Sites:

- Bamff Wildland, Perthshire
- Knapdale Scottish Beaver Trial, Argyll
- Mill Dam, Dunkeld, Perthshire
- National Trust Wallington, Northumberland
- Otterton, Devon
- Woodland Valley Farm, Cornwall



1

Visitors to beaver landscapes benefitted from multiple cultural services:

- recreational opportunities such as hiking and wildlife watching
- educational opportunities such as learning about nature
- feeling connected to nature
- gaining inspiration from the landscape



Visitors recognised biodiversity benefits of beaver modified landscapes, recognised the beaver as a nature based solution and liked seeing beaver activity. However, some visitors disliked the perceived environmental 'damage' beavers caused, and potential obstruction to roads and paths.

2

Over 75% (n=127) of visitors strongly agreed that beaver landscapes were beautiful.

Our findings challenge previous assumptions that beaver landscapes can be perceived as 'messy' or 'untidy' (Prior, 2023; Ulicsni et al., 2020).

3

How can we improve human-beaver coexistence?

Reframe beaver modifications: communicating beaver landscape changes matters

-increase educational material in beaver landscapes to mitigate 'damage' discourse and aid public awareness

Invest in accessible infrastructure and educational opportunities:

-beaver landscapes can be popular recreationally and can act as 'outdoor classrooms', potentially generating nature interest in younger generations (Gandy & Watts, 2021)

Build local benefit mechanisms:

-those impacted by beaver modifications should also access benefits, this could include ecotourism revenue sharing, or ecosystem service payments (Simpson, et al. 2021)

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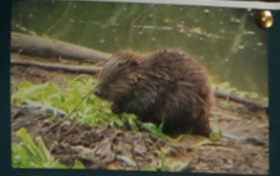
UNIVERSITY OF ABERDEEN
British Beaver Landscapes: how do we culturally value beaver landscapes?

... of a wider PhD project aiming to explore human-beaver ... arway, and Switzerland. Feel free to ask me any questions!

Five years of habitat changes and greenhouse gas emission monitoring at Hatchmere beaver reintroduction, Cheshire: lessons learnt.

Lucia Galvez-Bravo, Richard Young, Christian Woodward, Maria Nolan, Mike Longden, Danielle Hinchcliffe & Stephanie Evers

School of Biological and Environmental Sciences, Liverpool John Moores University, Liverpool, UK



1. Introduction

- In the UK, numerous beaver reintroductions have taken place within fenced enclosures, as habitat and water quality restoration tools.¹
- Habitat modification by beavers in enclosed areas can differ from free-roaming in their extent and intensity.
- In November 2020, a pair of beavers were introduced into a 4.5ha enclosure at Hatchmere Nature Reserve (Cheshire, UK, Fig. 1).

Aims: To monitor habitat changes and greenhouse gas emissions at following beaver reintroduction

2. Habitat changes

- Phase 1 (JNCC, 2010) habitat surveys were carried out in 2019, 2023, 2024 and 2025 (Figure 1).
- Habitat alpha-diversity remained similar throughout the first 5 years after reintroduction. Habitat changes (Beta-diversity) driven by turnover: new habitats replaced previous ones (Fig 2 a and b). New swamp and flooded woodland areas created – increasing habitat heterogeneity at the landscape scale.

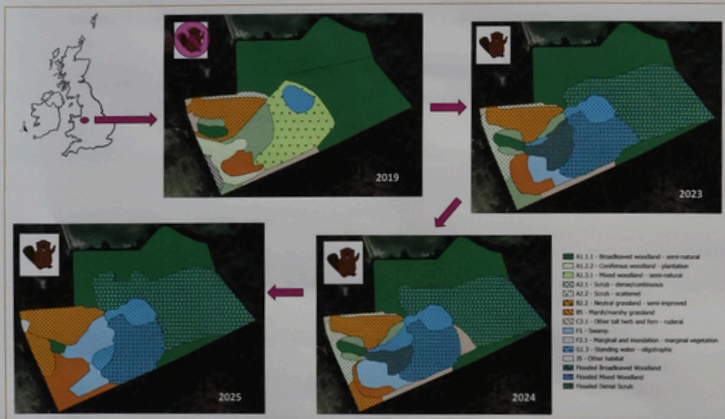


Figure 1. Location of study site in Cheshire, UK and temporal changes in habitat cover after beaver reintroduction in 2020. Habitat classifications follow Phase I survey categories (JNCC, 2010).

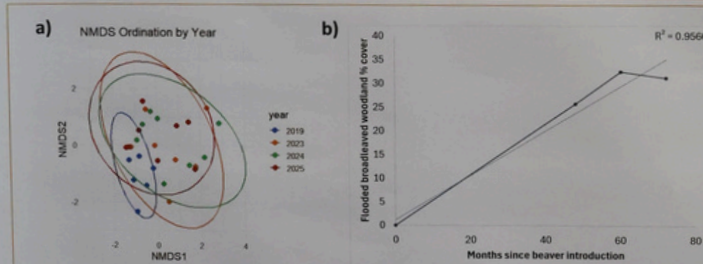


Figure 2. a) Non-metric Multidimensional Scaling plot of habitat composition in the beaver enclosure from 2019 - 2025. Total habitat beta diversity differed significantly, (PERMANOVA: pseudo-F_{1,38} = 6.15, R² = 0.14, p = 0.001). Beaver-induced habitat changes explained 14% of habitat composition in the beaver enclosure, driven by turnover (PERMANOVA: pseudo-F_{1,38} = 8.75, R² = 0.19, p = 0.001). b) Relationship between Habitat % cover of flooded woodland and months since Beaver introduction. Over 30% of the area was transformed into novel wetland habitats.

3. Greenhouse gas emissions

- Greenhouse gas emissions (CO₂ and CH₄) data collected seasonally (2020-2023) in different habitat types and control areas.
- Both aquatic (floating chambers) and soil (collars) emissions showed similar seasonal fluctuations inside and outside the beaver enclosure.

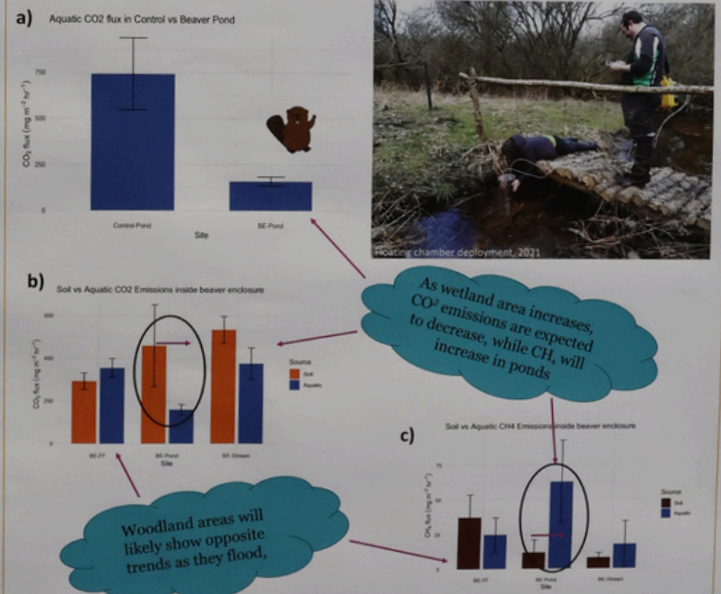


Figure 3. a) Average CO₂ flux (mg CO₂ per m² per hr) measured using floating chambers at beaver pond and control sites. b) Average CO₂ flux (mg CO₂ per m² per hr) and c) CH₄ flux (mg CO₂ per m² per hr) for soil and water at all habitat types inside the beaver enclosure: BE-FF = wet woodland/flooded forest; BE-Pond = Beaver pond; BE-Stream = Stream inside the beaver enclosure.

4. Discussion

- Beavers cause large changes in habitat composition within 2 years after reintroduction.
- Greenhouse gas emissions don't change – other than seasonally – in existing habitats. However, overall cover of each habitat type changes and new habitats (e.g. “flooded forest”), with different emission factors, appear in the area.
- The beaver enclosure transforms into a dynamic mosaic of source-sink areas for greenhouse gases.
- Strengths:** Early, continuous monitoring helps identify trends, adapt methods and increases data reliability.
- Challenges:** Habitat changes forced us to change sampling sites and seasonal fluctuations can confound effects: at least 2 seasons per year are recommended
- Applications:** Monitoring of fenced reintroductions is important. Large changes can be expected soon after reintroduction, settling afterwards.³

Acknowledgements

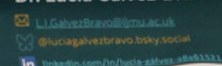
This work was funded by LjMU's staff development fund and was carried out in collaboration with Cheshire Wildlife Trust. With thanks to LjMU student volunteers and collaborators.



References

- Law, A., Gaywood, M.J., Jones, K.C., Ramsay, P. and Wilby, N.J. (2017) Using ecosystem engineers as tools in habitat restoration and rewilding: beaver and wetlands. *Science of the Total Environment*, 605-606, 1021-1030
- Joint Nature Conservation Committee (JNCC). (2010) *Handbook for Phase 1 habitat survey: a technique for environmental audit*. Revised reprint. Peterborough: JNCC
- Hallberg, L., Larsen, A., Ceperley, N. et al. Beavers can convert stream corridors to persistent carbon sinks. *Commun Earth Environ* 7, 737 (2026).

Dr. Lucia Galvez-Bravo



Process-based model predicts seasonal variation in eDNA transport - a case study on Eurasian beavers in a small river

James A. Macarthur¹ | Didier Pont² | Meriem Bouhouche³ | Barbara Morrisey¹ | Nathan P. Griffiths¹ | Frank Rosell³ | Jørn Henrik Sønsteby³ | Martin J. Gaywood^{1,4} | Bernd Hänfling¹

¹ Institute for Biodiversity and Freshwater Conservation, University of the Highlands and Islands, Inverness, UK. ² Institute of Hydrobiology and Aquatic Ecosystem Management (IHG), University of Natural Resources and Life Sciences, Vienna, Austria. ³ Faculty of Technology, Natural Sciences, and Maritime Sciences, University of South-Eastern Norway, Bø in Telemark, Norway. ⁴ NatureScot, Great Glen House, Leachkin Road, Inverness, IV3 8NW, UK

Email: EX40JM@uhi.ac.uk
Twitter: @JamesMacarthur_ BlueSky: @JamesMacarthur



Factors influencing eDNA transport

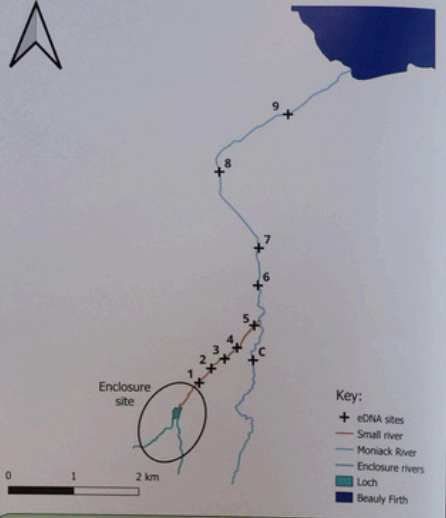
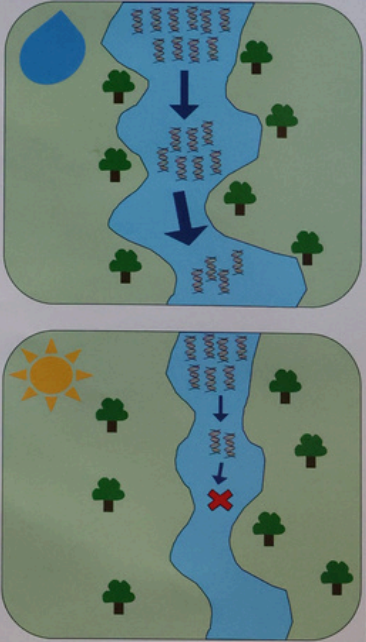
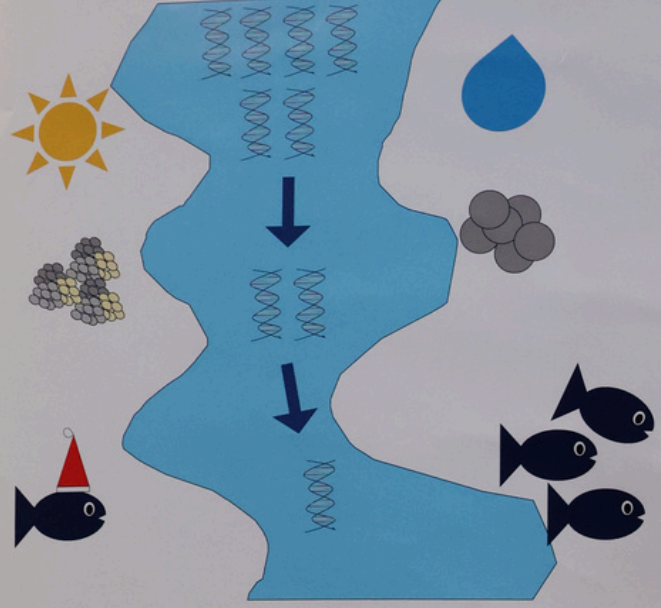


Figure 1: eDNA locations (n = 10, black cross) downstream of an enclosure site ranging from 0 to 5.8 km. Two samples were collected from a control (C) upstream of the confluence to confirm there were no other sources of beaver eDNA.

Results

- Shortest eDNA transport in July and August where beavers were no longer detected 1.4 km downstream.
- Summer eDNA to study localised distribution of beavers in a catchment.
- Longest eDNA transport from December – March where beavers were consistently detected 5.8 km downstream.
- Winter eDNA to detect whether beavers are present in the catchment.
- eDNA transport models are also applicable to small river systems and semi-aquatic mammals.

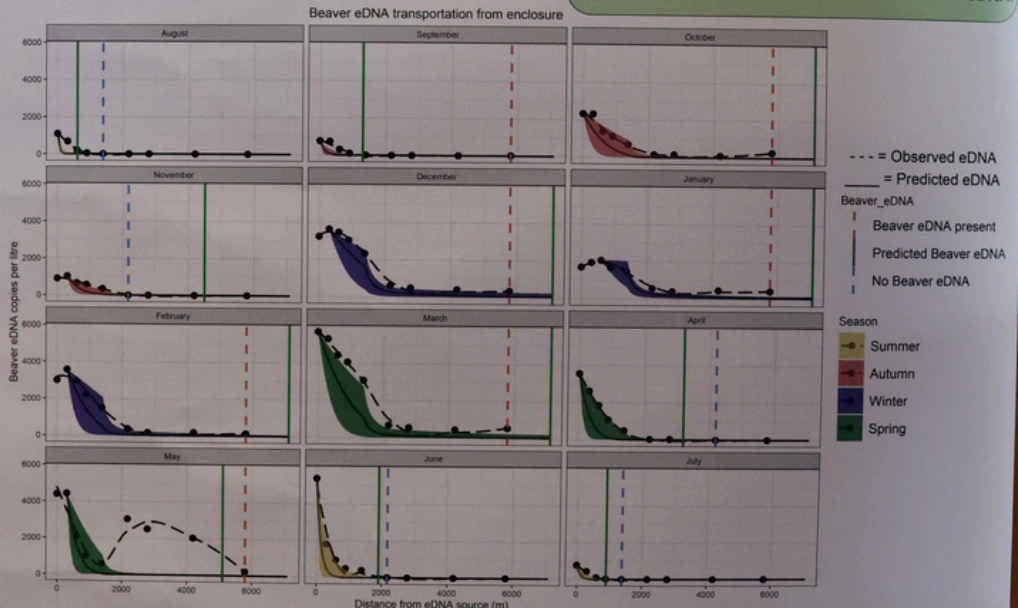


Figure 2: Observed (dashed black line and black dots) and predicted (solid black line) eDNA transport distances each month. The shading represents 95% confidence intervals for the predicted transport distance, and the colour corresponds to the season (yellow: Summer, red: Autumn, purple: Winter, green: Spring). The vertical lines represent the distance beaver eDNA is transported (red: beaver eDNA present, green: maximum predicted beaver eDNA, blue: no beaver eDNA present).

Scan the QR code to find out more



eDNA workflow:

1. Collection
2. Filtration
3. DNA extraction

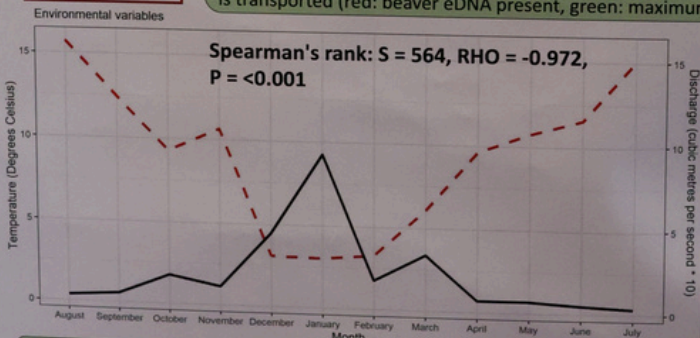


Figure 3: Average discharge (solid black line) and temperature (dashed red line) over the course of the year.

Methods

- Nine sites were visited 12 times over the course of a year, and temperature and discharge were measured each month.

eDNA transport model (Pont, 2024)

$$C_d = C_0 \cdot e^{-\frac{w(r \cdot h + \bar{V}_s)}{Q} \cdot d}$$

- C_d (copies / L) = predicted eDNA concentration at a distance d
- C_0 = eDNA concentration measured at the source point
- w = river width (m)
- r = the rate of eDNA degradation (per hour) which increases exponentially with temperature
- h = river depth (m)
- \bar{V}_s = the average eDNA settling velocity ($mm \cdot s^{-1}$)
- Q = discharge (in $m^3 \cdot s^{-1}$) at a given river section (in m)

Ecological Responses to Beaver Activity



IMPLICATIONS FOR TROPHIC INTERACTIONS AND HABITAT USE

Megan Boffin¹, Dr Bernd Hänfling¹, Dr Michelle Jackson², Dr Martin Gaywood³, Dr Sally Mackenzie⁴, Dr Claire Howe⁵

¹Institute for Biodiversity & Freshwater Conservation, UHI Inverness

²Department of Biology, University of Oxford ³NatureScot

⁴Cairngorms National Park Authority ⁵Natural England

Rationale & Aims

- The Eurasian beaver (*Castor fiber*) is a reintroduced ecosystem engineer that transforms hydrology, vegetation structure and biodiversity through the species' activity.¹
- While physical habitat changes are well documented, indirect/ trophic responses remain more poorly understood.²
- In particular, there is a lack of scientific evidence linking beaver-driven habitat change to predator-prey dynamics and habitat use in wetland systems.³

Primary Aims:

Assess how beaver reintroductions and subsequent wetland engineering influences ecosystem structure/ function
 Improve existing understanding of indirect and trophic effects of beavers on wetland ecosystems



Chapter Plan

UK BEAVERS: SYSTEMATIC MAP & EVIDENCE GAP ANALYSIS

- Systematic synthesis of UK evidence on beaver reintroductions and ecological responses to beaver engineering
- Quantify geographic and methodological spread within the literature
- Identify underrepresented research areas and evidence gaps
- Highlight priority research to inform future restoration, monitoring & management

PREY COMMUNITY IMPACTS AND TROPHIC RESPONSES

- Compare prey community assemblages in wetlands highly modified by beavers vs controls
- Assess otter (*Lutra lutra*) spatial ecology and activity patterns across wetland types
- Test whether prey composition predicts higher otter co-occurrence
- Create assessment index to quantify levels of beaver-driven habitat modification

STRUCTURAL COMPLEXITY & MULTI-TAXA HABITAT USE

- Compare species diversity/ richness metrics of bird and bat communities on a gradient of beaver engineering
- Measure structural complexity and deadwood availability
- Quantify use of 3D structure by pine marten (*Martes martes*)
- Test whether beaver-created habitat heterogeneity predicts species richness and composition

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megan.boffin@uhi.ac.uk

UPCOMING METHODS

Systematic Review
 Exclusion Criteria Refinement/
 IRR Statistics
 Coding in NVivo



Freshwater eDNA sampling + metabarcoding

Other spoint analysis

Camera trap surveys of beaver wetland features
 Acoustic monitoring



References

¹Strayer, R.E., Patten, A., Graham, H.A. et al. 2021. Beaver: Nature's ecosystem engineers. *WIREs Water* 8(1), e1494. DOI:10.1002/wat21494

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³Eden, P., Luchman, C., Jacobine Andrew et al. 2017. Beavers: evidence of ecosystem-level effects of beaver in Scotland's upland forests. *Environmental Research*, 158, 121-131. DOI:10.1016/j.envres.2017.07.011



Quantifying beaver-driven habitat change
 Piloting beaver-engineering habitat index

STAKEHOLDER PERCEPTIONS OF BEAVER MITIGATION IN SCOTLAND

Alice Turner¹, Roger Auster², Karen Ramoo³, Jenny Bryce³, Clare Andrews¹, Sharon Kessler¹, Hannes Stephan¹, Alan Law¹
¹University of Stirling, ²University of Exeter, ³NatureScot

BACKGROUND

Expanding beaver populations in Scotland are increasing **human-beaver interactions**¹. While current mitigation guidance focuses on ecological and practical approaches², **stakeholder experiences post-mitigation remain under-explored**, yet essential to reintroduction success³. This study examines stakeholder perceptions of beaver mitigation to support more effective and collaborative future beaver management.

EXPLORATORY RESEARCH QUESTIONS

- 1 How do stakeholders perceive the effectiveness of beaver management and mitigation in Scotland?
- 2 What challenges do stakeholders associate with beaver mitigation?
- 3 How can stakeholder perspectives inform future beaver management?

METHODS



Online survey with 29 qual/quant questions



22 stakeholders with direct experience of beaver mitigations. Farmers, estate managers, environmentalists, conservationists, transport/infrastructure workers and retired individuals



Purposive and convenience sampling using an existing NatureScot database



Open-ended responses analysed using reflexive thematic analysis, alongside Likert-scale quantitative responses

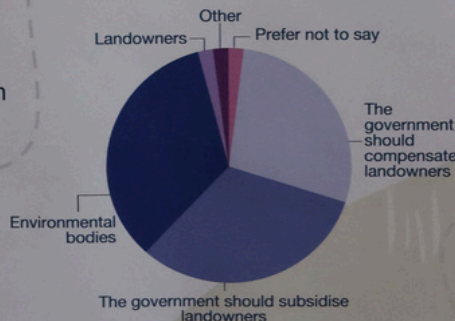
SUBSET OF PRELIMINARY RESULTS...

Expectation	Reality
Damage mitigation	Water management
Habitat protection	Tree protection
Population management	Financial/time cost
Financial/time cost	Aesthetic impact
	Regulatory frustration

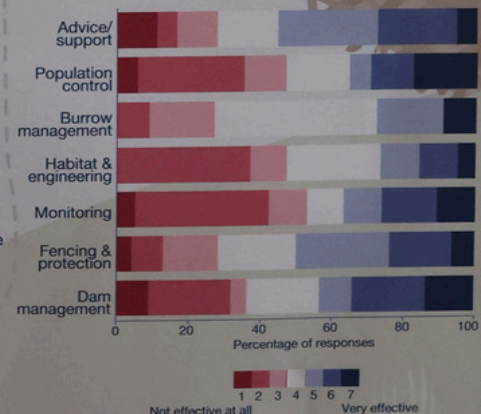
How should beavers be managed?

Lethal **control** and relocation
 Better **education**/public knowledge
 More **consideration** towards beavers
 More **financial support**
 Less **bureaucracy**

Who should pay for beavers?



Perceived effectiveness of mitigation techniques



NEXT STEPS

Analyse all results and share summary of current stakeholder perspectives with NatureScot to identify key considerations and recommendations for future beaver management strategies in Scotland.



UNIVERSITY of STIRLING



References
¹Coz, D. M., & Young, J. C. (2020). Conflicts over wildlife conservation: Learning from the reintroduction of beavers in Scotland. *People and Nature*, 2(2), 406–419. <https://doi.org/10.1002/pan3.10076>
²Campbell-Palmer, R., Gow, D., Campbell, R., Dickinson, H., & Girling, S. (2016). *The Eurasian beaver handbook: Ecology and management of castor fiber*. Pelagic Publishing.
³Auster, R. E., Barr, S. W., & Brauser, R. E. (2021). Improving engagement in managing reintroduction conflicts: Learning from beaver reintroduction. *Journal of Environmental Planning and Management*, 64(10), 1713–1734. <https://doi.org/10.1080/09640568.2020.1837069>
 A huge thank you to all participants who took the time to share their views with us and to the University of Stirling for providing funding for this project.



alice-e-turner
 alice.turner@stir.ac.uk



Eager beavers benefit riparian insects in enclosures

Purpose: to monitor the impact of Beavers on terrestrial insects.

Key findings:

- Damming of the watercourse created new off-line channels, wet ground and bare mud margins important features for groundhoppers (Orthoptera).
- The increased riparian habitat led to increased wetland plants supporting increased numbers of pollinators (bumblebees).

Introduction

Beavers are ecosystem engineers, their dam building and foraging behaviour influence river corridor structure, geomorphology, nutrient cycling and water storage. As they modify the land they create new habitats of higher biodiversity value, a key element of natural flood management (NFM).

In the first 1–2 years of Beaver meadow development, wet grassland with puddles can form, with a mosaic of shallow mud shores interspersed with taller vegetation. This has potential to create ideal habitat for insects such as the Slender Groundhopper which benefit from wet bare ground on riparian rewilding sites developing on former arable fields. The increased riparian zone allows growth of wetland plant species, supporting pollinators such as bumblebees.

This study aimed to monitor the impact of Beavers on Orthoptera (grasshoppers, bush-crickets and groundhoppers) and pollinators (bumblebees) at Spains Hall.



Map of the features in Beaver enclosures and control meadows at Spains Hall Estate.

Spains Hall Estate is in Finchingfield, south-east England. The Estate is 800ha total area. Beavers were reintroduced to former arable land reverting naturally to open floodplain grassland and scrub mosaics. The study monitored two fenced Beaver enclosures and two unfenced open meadow control sites.

Study Site

- In 2023 Beavers were released into two 20ha enclosures on the estate.
- The enclosures were formerly arable farmland.

Controls

- Two unfenced open meadow control sites were selected for this study without Beavers.

Set up	<ul style="list-style-type: none"> • Four 1-m wide × 100-m long transects were established in each of the two Beaver enclosure and two control meadows. • Each transect was walked at a slow, strolling pace (2 km/hr) once in June, July, August and September (4 surveys per year).
Orthoptera	<ul style="list-style-type: none"> • Adult and nymphal Orthoptera were counted visually by flushing in 2024. • Simultaneously, a stridulation monitoring technique was used to record adult males of species which stridulated (sung) along the transects.
Pollinators	<ul style="list-style-type: none"> • Bumblebees (<i>Bombus</i> spp.) were identified and counted in 2024 and 2025. • The plant species used for gathering pollen and nectar by each pollinator was identified.
Vegetation	<ul style="list-style-type: none"> • 40 vegetation heights were recorded at random positions along each transect using a 1-m ruler in September 2024 and 2025, when plants were at their maximum height. • The vegetation species the ruler touched at ground level was recorded.

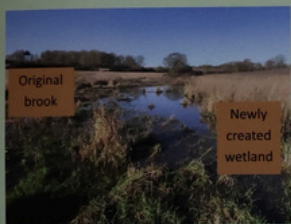


Image 1: Beaver enclosure



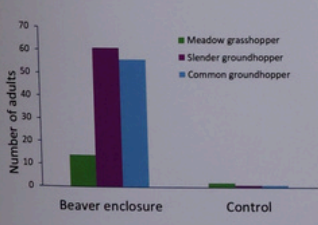
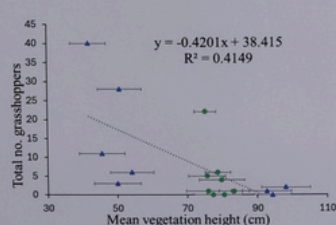
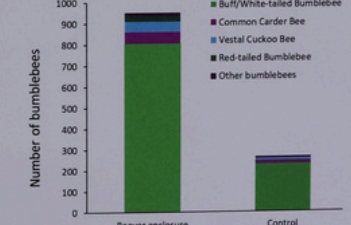

Image 2: New dry channel created by Beaver damming which dried out



Image 3: Beaver dam across Finchingfield Brook

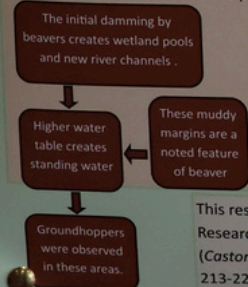


Image 4: Control meadow habitat

Orthoptera	Vegetation	Pollinators	Wetland plant species
<ul style="list-style-type: none"> • Nine species of Orthoptera (33% of British native species) were recorded in both the Beaver enclosures and control meadows. • Abundance of Lesser Marsh Grasshopper, Slender Groundhopper and Common Groundhopper was significantly higher in the Beaver enclosures compared to the control meadows. • Higher species diversity in the Beaver enclosures compared to the controls. 	<ul style="list-style-type: none"> • Vegetation height influenced the abundance and diversity of Orthoptera. • There was a significant negative relationship between vegetation height and numbers for the Field Grasshopper, indicating a preference for short vegetation. • Species diversity had statistical evidence for a significant negative relationship with vegetation height, suggesting more diverse assemblages at low sward heights (<50 cm). 	<ul style="list-style-type: none"> • Nine species of bumblebee were found in the Beaver enclosure meadows compared to 7 in the controls. • The enclosures had a higher number of bumblebees than the control meadows (953 vs. 266, respectively). • The most widely recorded species were the Buff/White-tailed Bumblebees forming 87% of observations combined. 	<ul style="list-style-type: none"> • Bumblebees (workers and drones) were found on four different species of wetland plant. • Across all study sites, 82% of bumblebees visited Common Comfrey. Water Mint was the second most visited species, being used by 12% of bumblebees. • In June 2025, there were over 1000 flowers of Common Comfrey within each Beaver enclosure transect section, whereas within the controls there were less than 100 flowers on average. 

Conclusion

Beavers provide multiple benefits to the ecosystem as they modify the landscape. As shown within this study they create ideal habitat for Orthoptera and increase riparian plant abundance allowing a larger population of bumblebees to be supported. Beavers are a form of Natural Flood Management helping to hold water back and reduce its velocity. The dams naturally filter water, act as carbon sinks and help to reduce eutrophication. Beavers could be a tool to mitigate the impacts of climate change.



The UK government has also recently authorised the wild release of Beavers; therefore, the future focus is likely to move away from captive reintroductions. Enclosures limit Beaver impact on the landscape, confining it to a relatively small area which could prevent successional stages from fully developing. Beavers can abandon areas in the wider landscape which allows Beaver meadows to dry out and develop into tall grassland and scrub, while newly dammed rivers revert to early successional floodplain habitats with pools and bare mud.

This research is published in the Journal of Orthoptera Research (2025). 'Initial response of Orthoptera to beaver (*Castor fiber*) reintroductions in post-arable enclosures'. 34(2): 213-222. doi: 10.3897/jor.34.154843

Tim Gardiner

EA: Biodiversity Technical Specialist
tim.gardiner@environment-agency.gov.uk



Emily Crisp

EA: Biodiversity Graduate
emily.crisp@environment-agency.gov.uk



- Dam building: leads to higher water levels and diversity of flow in river channels
- Lodges: become biodiversity hotspots with a high degree of habitat heterogeneity
- Coppicing: stimulates regrowth and creates structural diversity adding to habitat mosaics



Email me!
s.webb.23@abdn.ac.uk

British Beaver Landscapes: how do we culturally value beaver landscapes in Britain?

Stephanie Webb, Dr. Alan Law, Prof. David G. Anderson, Dr. Flurina Wartmann

?

1. How do visitors benefit from beaver landscapes in Britain?
2. How do visitors perceive beaver landscapes aesthetically?
3. Recommendations for future beaver management and visitor engagement.

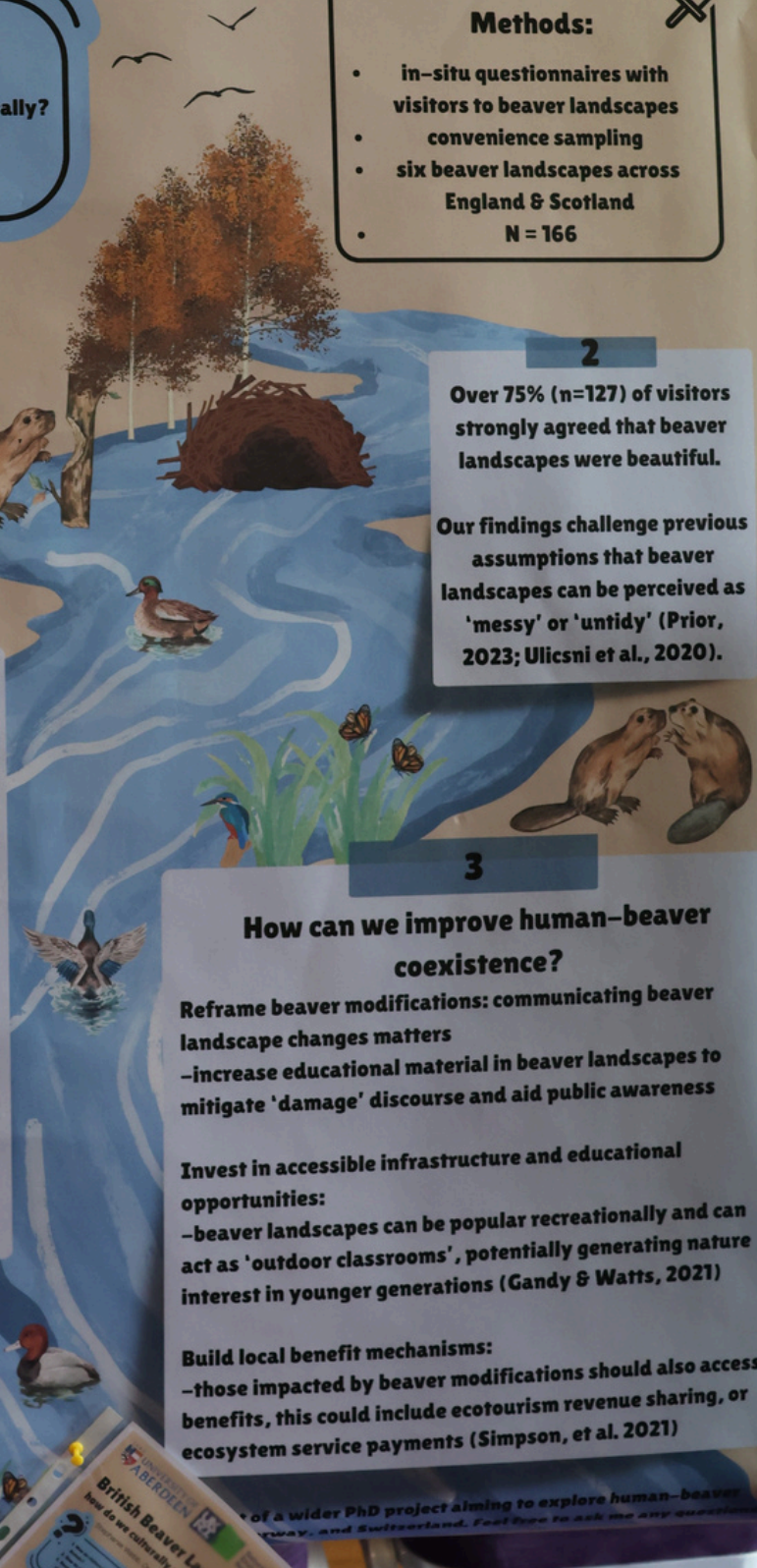
Methods:

- in-situ questionnaires with visitors to beaver landscapes
- convenience sampling
- six beaver landscapes across England & Scotland
- N = 166

Field Sites:



- Bamff Wildland, Perthshire
- Knapdale Scottish Beaver Trial, Argyll
- Mill Dam, Dunkeld, Perthshire
- National Trust Wallington, Northumberland
- Otterton, Devon
- Woodland Valley Farm, Cornwall



2

Over 75% (n=127) of visitors strongly agreed that beaver landscapes were beautiful.

Our findings challenge previous assumptions that beaver landscapes can be perceived as 'messy' or 'untidy' (Prior, 2023; Ulicsni et al., 2020).

1

Visitors to beaver landscapes benefitted from multiple cultural services:

- recreational opportunities such as hiking and wildlife watching
- educational opportunities such as learning about nature
- feeling connected to nature
- gaining inspiration from the landscape

Visitors recognised biodiversity benefits of beaver modified landscapes, recognised the beaver as a nature based solution and liked seeing beaver activity. However, some visitors disliked the perceived environmental 'damage' beavers caused, and potential obstruction to roads and paths.

3

How can we improve human-beaver coexistence?

Reframe beaver modifications: communicating beaver landscape changes matters

- increase educational material in beaver landscapes to mitigate 'damage' discourse and aid public awareness

Invest in accessible infrastructure and educational opportunities:

- beaver landscapes can be popular recreationally and can act as 'outdoor classrooms', potentially generating nature interest in younger generations (Gandy & Watts, 2021)

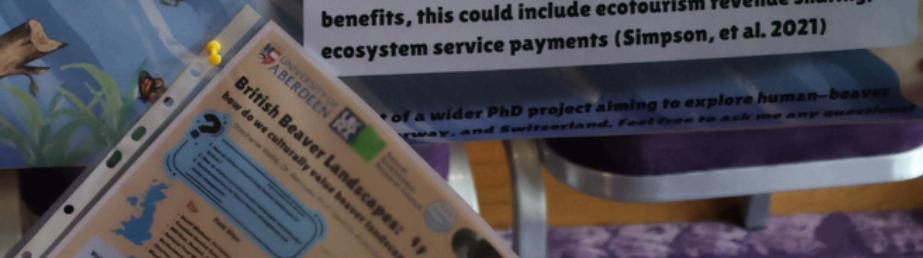
Build local benefit mechanisms:

- those impacted by beaver modifications should also access benefits, this could include ecotourism revenue sharing, or ecosystem service payments (Simpson, et al. 2021)

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Beaver Dam Assessment Methodology for Salmonids

Needham, R., Leonard, S., Edgeworth, E., Smith, M., Holden, M., Osmond, D., & McCandless, E. (2025). *Beaver Dam Assessment Methodology for Salmonids*.

Introduction

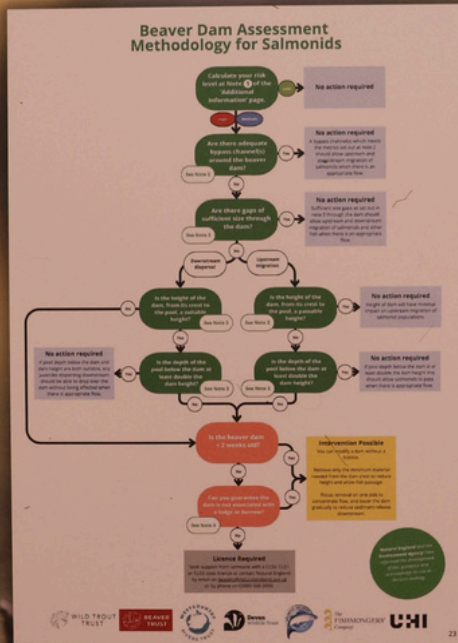
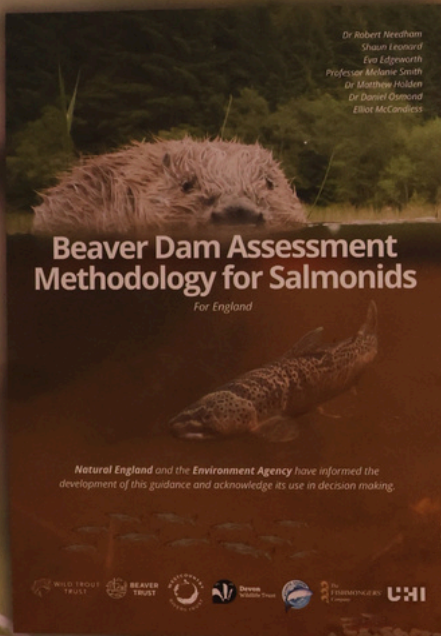
- Beaver dams represent both a challenge and an opportunity for migratory salmonids in stressed freshwater ecosystems, where species such as Atlantic salmon are now endangered.
- The potential effects of beaver dams on fish communities are highly site specific and temporal, influenced by factors such as local topography and hydrology.
- The *Beaver-Salmonid Working Group's* priority recommendation in 2015 following the completion of the Scottish Beaver Trial was for the development of a management strategy which highlights when intervention may be required.
- This issue is compounded by the fact that the majority of existing knowledge on fish passage originates from man-made structures, which remain fixed in size, shape, and structure over time.

Aims & Objectives

- The Beaver Dam Assessment Methodology for Salmonids is adapted from the SNIFFER methodology and IFM's fish pass manual used to assess human infrastructure.
- BDAMS seeks to simplify this complex issue by providing a structured approach to evaluating whether a beaver dam impedes fish passage and identifies appropriate actions, including possible modifications and highlights key legal considerations.
- While it may never be a 'perfect' solution, in the absence of alternatives, BDAMS is a practical and pragmatic tool, balancing technical content and accessibility for non-specialists.

Methodology

- The methodology consists of just two A4 pages—an easy-to-use flowchart accompanied by essential definitions and explanatory figures—enabling users to assess the passability of dams for migratory salmonids.
- This concise tool is embedded within a 36-page pack that provides essential background on salmonid and beaver ecology, their distribution, and salmonid migration, whilst discussing the potential positive and negative impacts of beaver activity on migratory salmonids.
- The two-page methodology will be produced as a laminated pull-out for use in the field, as well as being included in the printed pack. It will also be made widely available online through all partner websites.



Additional Information

1. Risk Matrix

	High	Medium	Low
Are Atlantic Salmon or any other 'at-risk' salmonid populations present in the catchment?	Yes	Don't know	No
Is this considered a spawning / nursery stream?	Yes	Don't know	No
Is this a crucial time of year at your location for either the upstream spawning migration or the downstream sea migration of salmonids?	Yes	Don't know	No
Are there other obstructions (beaver or man-made) nearby which may further impede salmonid migration?	Yes	Don't know	No
Does the quantity of water flowing in the stream increase following rainfall events?	No	Don't know	Yes
Is there a short-range weather forecast for rain that might increase the quantity of flow to over top the dam or create a bypass channel?	No	Don't know	Yes
Is the reach heavily wooded, limiting the stream's ability to cut bypass channels around the dam?	Yes	Don't know	No

The most frequent risk level indicated by your answers to the questions in the risk matrix above is the risk level you should carry into the flowchart on the previous page to evaluate if intervention is required.

2. Adequate Bypass Channel
A bypass channel around a beaver dam for migratory fish is a waterway that enables fish to pass safely around the dam. An adequate bypass channel has:

- A minimum width of 0.6m.
- A minimum depth of 0.2m.
- A gentle slope of less than 15% gradient.
- A steady flow rate less than 1 metre per second.
- Entry and exit points at the same level as the stream upstream and downstream of the dam.

3. Criteria for assessing the passability of beaver dam for fish

Criteria	Atlantic salmon (upstream migration)	Large trout (upstream migration)	Small trout (upstream migration)	Downstream migration
Size of gaps in beaver dam (m)	≥0.3m x 0.3m	≥0.3m x 0.3m	≥0.3m x 0.3m	≥0.3m x 0.3m
Dam height (m) (from the crest of the dam to the pool below)	≤0.45m	≤0.45m	≤0.3m	≤0.45m
Depth of pool below dam (m)	≥ 2x Dam height	≥ 2x Dam height	≥ 2x Dam height	≥ 2x Dam height

4. Guaranteeing a beaver dam is not associated with a lodge or burrow
Beavers typically build their lodges in the increased water level zone created behind their dams. Look for a large mound of branches, logs, and mud above the waterline, which could indicate a lodge.
Burrows are harder to spot, as they are usually underground and on the banks. However, clear signs like slight mud or worm paths where beavers enter and leave the water can indicate their presence.
After a visual inspection of the area behind the dam if you are uncertain of the presence of a lodge or burrow then please contact 'us' in the flowchart and contact Natural England for support as you could get a 6-month prison sentence or an unlimited fine if you are convicted of modifying a beaver dam associated with a lodge or burrow.

Worked Example 1

Access the pack here

SCAN ME

Worked Example 2

Beavers, fish and us in the English landscape

Irene Breda, Prof Paul Kemp and Dr Andrew Vowles
International Centre for Ecohydraulics Research
University of Southampton

Background

European beaver were **hunted to extinction** in the UK, but have been **reintroduced** since the early 2000s.

Known as **ecosystem engineers**, beavers build dams to increase water level to meet their needs: flood foraging areas and keep entrances of lodges underwater for predator protection.

Beaver activity increases channel complexity, enhances habitat heterogeneity and leads to wetland creation.



Does beaver activity impact fish communities?

Dam building impacts the river habitat significantly, for example by transforming free-flowing stretches into ponds, accumulating sediment and organic matter, and changing water temperature and depth. These variables determine the fish community composition of a particular area.

Habitat requirements of fish vary according to species and life stage. Beaver activity results in an aquatic environment that is biologically, hydraulically, thermally and structurally diverse. These significant **habitat modifications can shift habitat suitability from one fish species or life stage to another.**

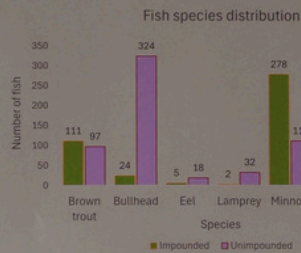


Figure 1. Distribution of fish species in impounded and unimpounded reaches surveyed via electric fishing in the rivers Love, Tale and Frome, in September 2025.

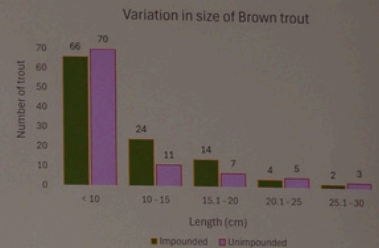


Figure 2. Length of brown trout (n, 98) across impounded and unimpounded reaches, from electric fishing surveys carried out in the rivers Love, Tale and Frome, in September 2025.

Variability of beaver activity across the South of England

We are designing a loop model to understand why beaver activity differs across landscapes and between land uses.

Using the systems thinking approach, we investigate beaver modified landscapes as complex, interconnected wholes.

We shift our focus from isolated events (e.g. dam building) to underlying structures and dynamic patterns.

E.g. seasonal flow dynamics → dams burst
→ riverscape is reshaped → flooding
→ human/wildlife conflict → management shifts.

This wider perspective enables better anticipation of ecological change and management of complex environmental issues.

Does beaver activity impact fish movement?

What's there to fear? **Migratory fish might not be able to swim past dams.** We know that beaver and fish have co-evolved and salmonids in particular have developed behavioural and physical **adaptations** to allow them to **cross beaver dams** at important life stages.

Where rivers can respond naturally to beaver impoundment, **bypass channels** develop on the side of dams, providing a passage for fish. During periods of low flow, beaver dams might become **temporally** impassable, but these events are generally short lived and very localised.

Where? River Love, trib. of the r. Otter (Devon).

When? Sep-Dec 2026 and 2027 for upstream migration, Spring 2027 for downstream migration.

How? PIT (Passive integrated transponder) tags and copper loops around dams.



Brown trout, *Salmo trutta*

Does public attitude towards beaver reintroductions shift over time?

What's the main fear? Flooding of productive land, roads, homes.



Theory: three stages of acceptance

- Novelty** and curiosity, **no conflict** as beavers occupy best habitat that doesn't need modifications.
- Increased conflict** as beavers move and alter habitats.
- Methods** are in place to **manage conflict**, beavers are accepted as **natural**, the positive effects of their presence are appreciated.

Are we following this trajectory?

Help me find out by completing the questionnaire!



Why does it matter?

- Beavers live across England, but we don't know how they affect fish here!
- Our **knowledge** of how beavers affect the environment is **based mostly on studies from the US** and concerning *Castor canadensis*, a different species of beaver.
- We want to **help stakeholders** understand what the real implications of beaver presence are, and debunk the myths.
- We aim to provide information to those tasked with managing land where beavers are present, so they can make **evidence-based decisions**.

References

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- Rosell, F., & Campbell-Palmer, R. (2022). Beavers: ecology, behaviour, conservation, and management. Oxford University Press.

Funders

UNIVERSITY OF
Southampton



Would you like to keep in touch? Email me at i.breda@soton.ac.uk

Woodland creation in the presence of beaver (*Castor fiber*)

Kelsey Wilson, Jenny Bryce and Roisin Campbell-Palmer. How to create woodlands that are resilient in the presence of beaver (*Castor fiber*): a review of current evidence. NatureScot Research Report 1368..

Background & Objectives

- **Woodland expansion:** Scotland aims to increase woodland cover.
- **Beaver overlap:** Riparian engineers increasingly share target areas.
- **Study aim:** Provide practical guidance for woodland creation with beavers.

Methods

- **Literature Review:** Compiled studies on woodland management with beavers.
- **Questionnaire:** Surveyed 8 land managers across 6 countries.
- **Scottish Field Survey:** Measured beaver and deer impacts at 14 Scottish sites.

Key Findings

- **Literature Review:** No formal guidance currently exists; Impacts are similar across beaver species; 36 studies many with relevance to woodland creation.
- **Questionnaire:** Woodland creation goals vary (biodiversity, timber, flood mitigation, carbon) but 88% of managers seek more guidance. Deer browsing viewed as a greater challenge than beaver activity.
- **Scottish Field Survey:** Beaver impacts at 3/14 sites. An average 38% of trees browsed in riparian zone or 4.4% of overall scheme, flooding only at 1 site, deer impacts were difficult to assess due to the common use of deer fencing.

Conclusions

- Beavers provide significant ecosystem benefits but also present management challenges.
- Their presence should not deter woodland creation, even in upland or fragmented areas where opportunities for new planting exist.
- As central-place foragers, beaver browsing tends to be clustered and highly localised rather than evenly spread across sites.
- Effective deer management remains a critical factor in ensuring the success of woodland creation
- The goal should be to promote woodlands that are resilient, rather than resistant, to natural processes and wildlife impacts.
- Further trials are required to generate the evidence needed for robust, practical design guidance.
- Finally, integrating beavers into woodland policy and planning is essential for long-term success.



One of 6 entry points (all similar) into Site A from the adjacent watercourse (Photo: K Wilson).

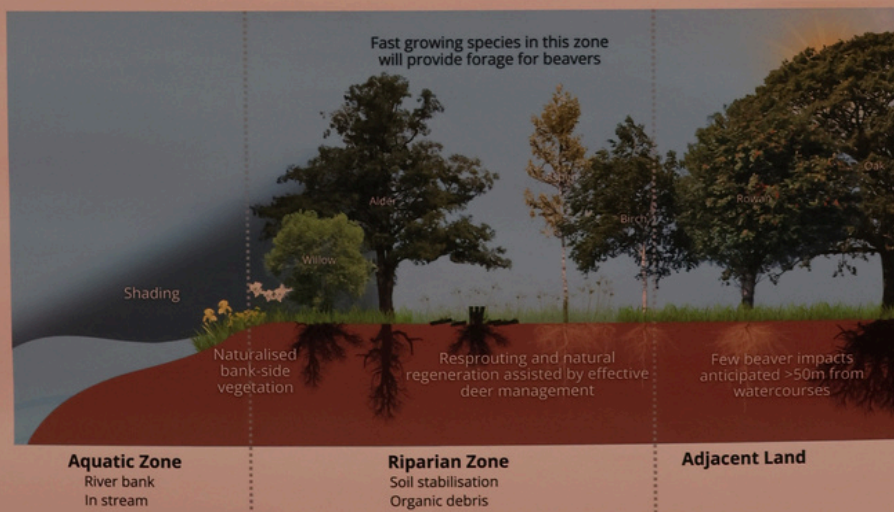


Protection of young trees with wire mesh guards where traditional plastic tubes have been ineffective in deterring beaver (Photo: R Campbell).



Beaver browsing impacts (above vole guards) of varying ages on planted trees at Site C (Photos: K Wilson).

Recommendations for Beaver Resilient Woodland



Riparian focus:
Set clear riverside habitat objectives.

Beaver inclusion: Plan tolerance vs. protection from the outset.

Design choices: Adapt species, density, and layout for resilience.

Monitoring: Track deer and beaver impacts to guide management.



Scan here to read the full report

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BEAVER
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Beaver burrowing on the River Isla, Scotland

Roo Campbell, Kieren Jones, Ann-Marie MacMaster and Jenny Bryce.
NatureScot. *Scotland's Nature Agency.*

Introduction



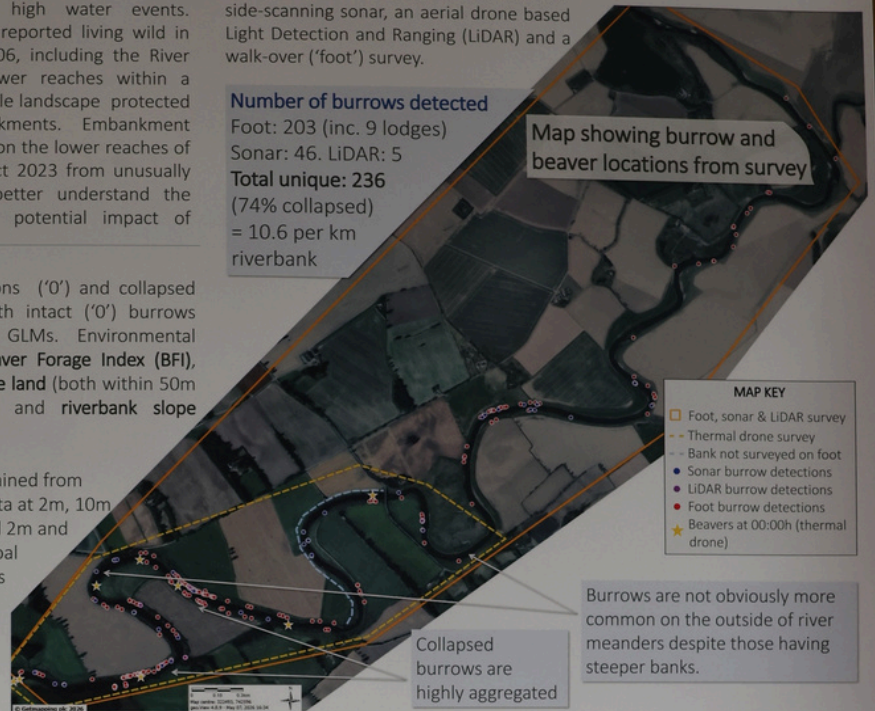
Flood embankment breach on River Isla in 2023.

Beaver burrowing may increase the risk of bankside erosion and flood-bank breaching during high water events. Beavers were first reported living wild in Tayside around 2006, including the River Isla which has lower reaches within a predominantly arable landscape protected by flood embankments. Embankment breaches occurred on the lower reaches of the River Isla in Oct 2023 from unusually high rainfall. To better understand the scale, nature and potential impact of

beaver burrowing activity we undertook a survey of this area using a combination of side-scanning sonar, an aerial drone based Light Detection and Ranging (LiDAR) and a walk-over ('foot') survey.

Number of burrows detected
Foot: 203 (inc. 9 lodges)
Sonar: 46. LiDAR: 5
Total unique: 236
(74% collapsed)
= 10.6 per km riverbank

Map showing burrow and beaver locations from survey



- MAP KEY**
- Foot, sonar & LiDAR survey
 - Thermal drone survey
 - Bank not surveyed on foot
 - Sonar burrow detections
 - LiDAR burrow detections
 - Foot burrow detections
 - Beavers at 00:00h (thermal drone)

Burrows are not obviously more common on the outside of river meanders despite those having steeper banks.

Collapsed burrows are highly aggregated

Methods

Survey

Sonar, LiDAR and foot surveys were conducted in Feb-Mar 2024 and extended along the River Isla from the confluence with the Lunan burn upstream to the River Ericht, covering 22km of riverbank (see map). The foot survey excluded a section of the north bank SW of the bridge. The foot survey recorded burrow status (collapsed or not) and the distance from water of any visible collapsed chambers. A thermal drone survey was conducted overnight in Mar 2026 on the lower 5.5km river section to census beavers (see map).

Analysis

Burrow locations ('1') were compared with

burrow-free locations ('0') and collapsed ('1') compared with intact ('0') burrows using binomial GLMs. Environmental variables were **Beaver Forage Index (BFI)**, proportion of **arable land** (both within 50m of each location) and **riverbank slope characteristics**.

Slope data was obtained from sonar and LiDAR data at 2m, 10m and 20m inland and 2m and 5m offshore. Principal Component Analysis was used to extract characteristics of slope from these five points.

Results & Discussion

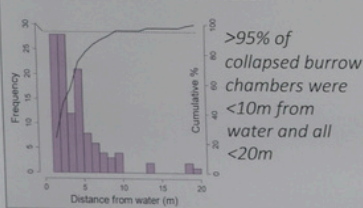
Comparison of detection methods

- 13 of 40 sonar detections were also detected on foot and 6 not surveyed (so ~2/3rds were not detected on foot).
- All 5 LiDAR detections were also detected on foot (and therefore not use in further analyses).
- 185 of 203 foot detections (9/10ths) were not detected by other methods.

Why more burrows detected by foot?

- Collapsed burrow entrances are not always detectable?
- Some burrows had entrances above waterline.
- Some burrow entrances near waterline or in marginal aquatic vegetation may be masked by sonar backscatter?

Chamber distance from water

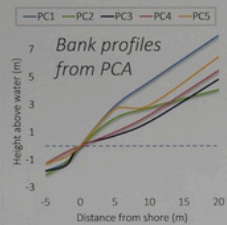


Beaver population size

The thermal drone survey detected max 8 beavers in the lower section of the survey, equivalent to 1-2 territories.



Bank slope characteristics



Three of the five Principal Components (PCs) from slope data proved informative in later analyses (see box to right):

- PC1 = general bank steepness
- PC2 = offshore steepness
- PC4 = shallow margins

Burrowing status

The probability that a burrow had collapsed was lower in areas with the most trees (areas with more BFI grade 5 land) and higher at locations with steeper banks (PC1, see table).

Results table of binomial model of intact (0) vs collapsed (1) burrows (* = a significant effect).

Predictor	Estimate	SE	z	P
Intercept	0.374	0.768	0.488	0.626
BFI = 5 (m ²)	-0.001	0.000	-2.572	0.010*
P. arable	0.344	0.688	0.501	0.617
PC1	0.033	0.014	2.393	0.017*
PC2-5	~	~	~	All > 0.050

Main conclusions

- The high number of burrows are not due to a high density of beavers, but to the long history of beavers on this river and frequent fluctuation in water levels combined with sandy soil: when a burrow is inundated at high water, collapse occurs and a new burrow needs to be dug. This frequency of burrowing on the River Isla is unlikely to be representative of burrowing rates in other rivers.
- Side scanning sonar was a useful additional tool for burrow detection but needs to be used alongside other methods.
- Planting trees on riverbanks might increase the chance a beaver will burrow but will also reducing the risk of collapse. In contrast, removing trees may not reduce burrowing risk, especially in steep banks where other food is available.
- Moving flood banks back would negate many burrowing issues and leave more space for the river when in flood, thereby also reducing embankment spill-over risk.

Burrowing and environmental variables

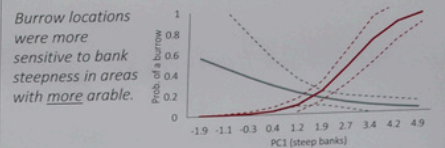
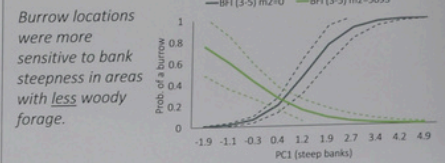
Sonar and foot burrows detections showed similar environmental patterns and so were combined. Burrows were more likely where there was (see Table):

- More woody forage (BFI grades 3-5)
- More arable land
- Steeper banks (PC1) and steeper offshore (PC2)
- Less shallow margins (PC4)

Predictor	Estimate	SE	z	P
Intercept	-1.537	0.091	-16.906	< 0.001
BFI grade 3-5 (m ²)	0.314	0.103	3.038	0.002
Proportion arable	0.388	0.096	4.036	< 0.001
PC1	0.683	0.105	6.538	< 0.001
PC2	0.334	0.095	3.511	< 0.001
PC4	-0.275	0.095	-2.879	0.004
BFI grade 3-5 × PC1	-0.569	0.121	-4.695	< 0.001
Proportion arable × PC1	-0.465	0.119	-3.893	< 0.001

Table of sig. effects (PC3, PC5 and their interactions with BFI & arable were not sig.)

- BFI and arable interacted significantly with bank steepness (PC1):



Key points:

Beavers burrow near food resources and prefer steeper banks (not associated with river meanders, see map). They may be less choosy about burrow locations in woody habitat because this is a patchy resource, whereas arable is less patchy but seasonally and annually variable.

Acknowledgements

Initial work on the sonar survey method was funded by the Scottish Government CivTech® scheme. Sonar and LiDAR surveys were conducted by Storm Geomatics and JBA Consulting. The thermal drone survey was conducted by Boddy Environmental Ltd. Thanks to the landowners for survey access. Thanks also to Ben Rusk, Karen Frake, Kirsten Brewster and Susi Hodgson.

Characterising mosquito ecology in beaver mediated wetlands: a preliminary study

✉ Harrison.Hardy@UKHSA.gov.uk

Harrison Hardy, Sarah Biddlecombe, Alexander Vaux, Amy Edwards, Anthony Abbott, Jolyon Medlock – UKHSA – Porton Down

Introduction

- February 2025: Natural England and DEFRA released the policy paper - "Wild release and management of beavers in England."



- Introduced licensing for new wild release projects and allowed existing beaver populations to naturally expand their range.
- Wetland and riverine habitats, which beavers colonise, are also important environments for British mosquito (Diptera, Culicidae) populations.

- Some British mosquito species can transmit medically or veterinary important pathogens, while many are primarily nuisance biters or comparatively benign.

- Beaver-driven habitat modifications may be associated with changes in mosquito ecology, though the extent and public health relevance of these interactions in the UK remains unclear.

- We undertook a preliminary assessment of mosquito presence, abundance, seasonality, and species composition in UK beaver wetlands.



Methods

Study locations and duration

- Four beaver-colonised wetlands in the River Otter (Devon) Beaver trial catchment.
- Mixture of habitat types and colony ages.
- Sampling from April to September 2025.



Sampling methods

- Adult mosquito trapping using Mosquito Magnets (MM) & Biogens BG Sentinels (BG).
 - 2x Mosquito Magnets per site, and 1x BG Sentinel; operated for 10-11 trap nights per month.
 - 452 cumulative trap nights (MM: 240, BG: 212).

- Standardised larval dip sampling at both fixed sites and opportunistic areas.
 - 4x fixed sites per study location.
 - 165 sampling events (fixed: 96, opp: 69) consisting of 15 dips per event (2475 cumulative dips).

Results – a work in progress

Mosquito species represented

- 5546 total larvae captured, comprising four species, in order of abundance: *Culex pipiens s.l.* (2605); *Culiseta annulata* (838); *Anopheles claviger* (667); *An. maculipennis s.l.* (28).
- And two subfamilies of first instar larvae that could not be ID'd further: 1) Culicinae (1283); Anophelinae (125).

- 6 species identified from adult sampling, in order of abundance: *An. claviger* (535 ♀, 9 ♂); *Cx. pipiens s.l.* (165 ♀, 5 ♂); *Cs. annulata* (147 ♀, 4 ♂); *Coquillettia richiardii* (9 ♀); *An. maculipennis s.l.* (3 ♀, 1 ♂); *An. plumbeus* (1 ♀).

Non-culicids present

- Culicoides* Sp. were found consistently in Mosquito Magnet catches.
- ~28 taxa of non-mosquitoes were caught incidentally in addition, including:
 - 9 well-known predators.
 - 6 moderate or opportunistic predators.

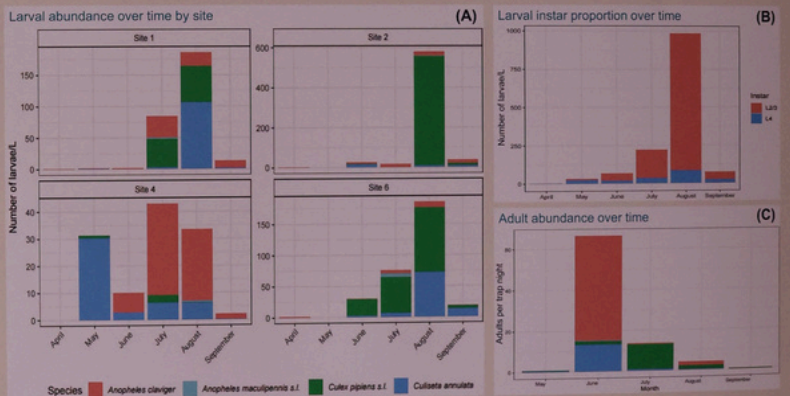


- Highly predatory organisms included Odonata nymphs (i), Nepidae (ii), Dytiscidae larvae (iii) and adults (iv), Notonectoidea (v), Newt larvae, and tadpoles.



Mosquito abundance and phenology

- Inclusive of all sites, larvae were present throughout the entire study duration, though their abundance and species composition varied by sample site (A).



- Proportionally, *Cx. pipiens s.l.* dominated, followed by *Cs. annulata*, then *An. claviger*.
- Compositional differences likely reflect underlying differences in niche availability at each site.
- Generally low ratio of L4 to L2/3 larvae suggests low survivorship (B), as reflected in comparatively low adult catch rates (C).
- Discordance between overall larval and adult abundance peaks suggests increasing predation pressure throughout summer.
- Site 4, the most recently colonised, presented unclear seasonal trends, different larval species composition, and much lower abundances, suggesting successional influences between sites.

Current insights

Mosquito ecology in beaver wetlands

- Beaver wetlands are highly dynamic mosaics of flowing and standing waters, creating many aquatic mosquito habitats.
- Several mosquito species are found in association with beaver-mediated wetlands in England.
- Evidence from North America suggests that beaver wetlands may modulate and even substantially reduce mosquito populations.
- Mosquito species in our study are generally of little public health and nuisance concern.

Vector concern

- Cx. pipiens s.l.* are potential enzootic vectors of West Nile and Usutu virus.
- Floodwater species were notably absent, such as *Ae. vexans* or *Ae. caspius*, both of which present a significant biting nuisance and vector concern.
- Culicoides* require further identification to species.

Moving forwards

Lessons learnt

- Methodology must consider the dynamic nature of beaver-mediated wetlands.
 - Changes in the landscape affect accessibility and safety, and the suitability of different sampling methods.
- Beaver wetlands are incredibly complex and provide a large number of niches, which many organisms, not just mosquitoes, may exploit.

Future work

- A before-and-after study of mosquito ecology in areas with planned beaver releases, paired with nearby wetlands/riparian environments which remain uncolonised by beavers.
 - Requires close partnership with land managers and pre-planning around the already substantial undertaking of beaver release.

• If interested, please email me!

Acknowledgements

We would like to thank Clinton Devon Estates, Sam Bridgewater, and Sam Bryant-Evans for allowing and facilitating this study within the beaver-colonised areas under their management.

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"Beaver fever" chill out

Low prevalence of *Giardia* spp. in wild Scottish beavers (*Castor fiber*)

Romain Pizzi, Fiona Howie, Daniel Arah, Sheelagh MacAllister, Rob Needham, Veselina Alva, Gary Curran, Roo Campbell, Roisin Campbell-Palmer.

Background

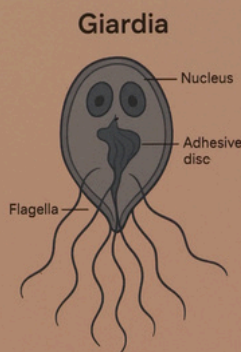
- *Giardia* species are protozoal parasites and a common cause of waterborne gastroenteritis in humans.
- In North America, giardiasis is often referred to as "Beaver Fever," raising concerns about beavers and their translocation as a potential zoonotic risk in Britain.

Methods

- 273 wild free-living Eurasian beavers (*Castor fiber*) trapped for conflict-mitigation translocation (2019–2025).
- 26 wild beavers found dead, examined post-mortem.
- *Giardia* detection: rapid enzyme immunoassay for soluble *Giardia* antigen in rectal faeces.



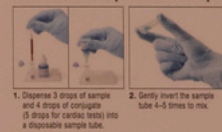
Beaver faecal sample being collected from a wild free-living beaver as part of the conservation translocation process at Five Sisters Zoo (©Beaver Trust)



Giardia: A microscopic parasite that attaches to the small intestine using its adhesive disc, causing the intestinal infection giardiasis.

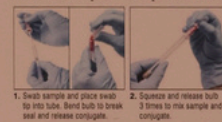
Using SNAP Test Kits

Pet-side screening you don't have to second-guess
Blood/serum/plasma sample test procedure



1. Dispense 3 drops of sample and 4 drops of conjugate (5 drops for cardiac tests) into a disposable sample tube.
2. Gently invert the sample tube 4-5 times to mix.
3. Pour the entire contents of the sample tube into the sample well of a SNAP device.

Faecal sample test procedure



1. Swab sample and place swab to into tube. Bend bulb to break seal and release conjugate.
2. Squeeze and release bulb 3 times to mix sample and conjugate.
3. Squeeze bulb to dispense 5 drops into the sample well of a SNAP device.



4. When color first appears in the activation circle, press firmly to activate. You will hear a distinct "snap".
5. When the appropriate development time has passed, read the result.

Blue dot = positive
Any color development in the sample spot indicates a positive result.
The SNAP[®] cPL[™] Test, SNAP[®] pL[™] Test and SNAP[®] Faecal proBp[™] Test are the exceptions because they provide comparative results.

SNAP[®] *Giardia* Test: A rapid enzyme-linked immunoassay designed to detect *Giardia* antigen in fecal samples. The assay employs antigen-antibody binding and a colorimetric substrate reaction, providing point-of-care results within minutes to aid in the diagnosis of giardiasis in animals.

Results

Live Beavers:

- Prevalence: 1.83% (95% CI: 0.6–4.22%).
- No infected animals showed clinical illness.
- All positive animals treated → retested negative.
- No difference in post-translocation survival.
- Age differences:
 - Kits: 3.53%
 - Adults: 0.68%
 - Not statistically significant.

Dead Beavers

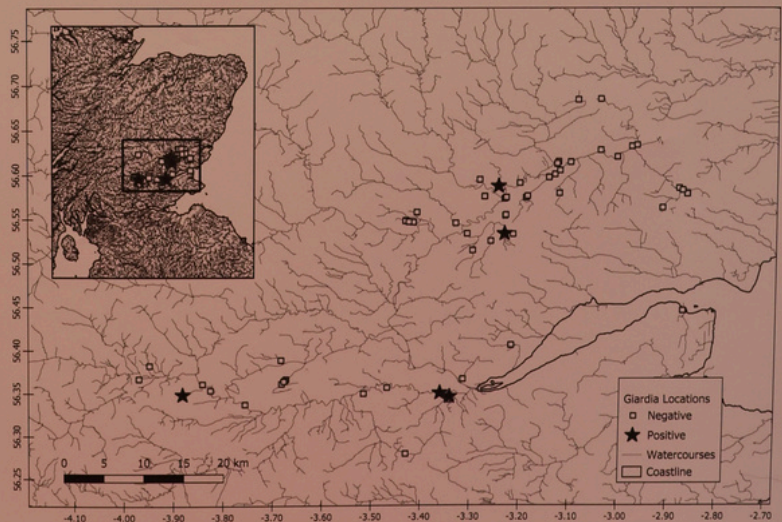
- Prevalence: 3.85% (95% CI: 0.097–19.64%).
- One positive adult female.
- Cause of death: *Staphylococcus aureus* sepsis from bite wounds, not related to *Giardia*.

Conclusion

While beavers appear to be an occasional spill-over *Giardia* host in Scotland, they currently appear to pose only a low risk as a source of infection for humans or other animals.

This may be subject to change as beaver populations increase and therefore ongoing monitoring is recommended.

Spatial Distribution of *Giardia* in Wild Beavers



Map showing the results of *Giardia* testing in 299 wild-living beavers (273 live-captured and 26 dead). Positive detections (stars) are concentrated at several sites, while negative results (squares) are dispersed across the catchment.

For access to the full paper, or if you have any further questions, please contact Roisin@beavertrust.org



BEAVER TRUST



Mapping *Leptospira* exposure in Eurasian Beavers (*Castor fiber*) across the Tayside catchment, Scotland

Daniel Arah, Romain Pizzi, David M. Bailey, Harry Bannister, Veselina Alvas, Roisin Campbell-Palmer

Study Aims

This study aimed to:

- Assess *Leptospira* exposure prevalence in wild Eurasian beavers in the Tayside catchment in Scotland
- Identify circulating serovars and likely maintenance hosts
- Investigate spatial patterns of exposure
- Assess evidence of clinical disease associated with infection
- Explore demographic predictors of seropositivity

Background

Leptospira spp. are zoonotic bacteria transmitted primarily through urine-contaminated water and soil. Semi-aquatic mammals such as Eurasian beavers (*Castor fiber*) may experience elevated exposure risk due to their close association with freshwater systems.

Leptospirosis can cause a spectrum of disease severity ranging from subclinical infection to organ failure and death. Although beavers are not recognised maintenance hosts for *Leptospira*, previous studies have documented exposure in both wild and translocated populations.

Understanding pathogen exposure in expanding beaver populations is increasingly important given:

- Rapid beaver recolonisation across Britain
- Increasing wildlife-livestock interactions
- Potential implications for translocation and reintroduction programmes
- The potential role of beavers as sentinel species for environmental contamination

Methodology

Study Population

- 288 wild beavers trapped between 2019–2025
- 280 blood samples analysed
- All animals trapped under licence within the Tayside catchment, Scotland
- Animals were undergoing health screening prior to licensed translocation

Veterinary Examination

All beavers underwent:

- Full clinical examination
- Haematology and serum biochemistry
- Behavioural and welfare monitoring
- Anaesthesia using isoflurane in oxygen

Serology

Serum samples were tested at APHA Weybridge using Microscopic Agglutination Testing (MAT).

- 19 *Leptospira* serovars tested
- Positive titres identified exposure
- Titres $\geq 1:1600$ considered indicative of active/recent infection

Statistical Analysis

A binomial Generalised Linear Mixed Model (GLMM) assessed relationships between sex, age class and seropositivity.

Random effects included location, month and year.

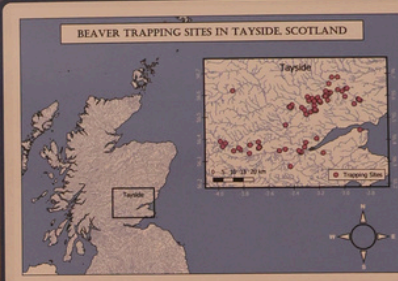


Fig. 1 Map of Scotland with an enhanced view of the Tayside catchment. Beaver trapping sites for testing for *Leptospira* serology are marked

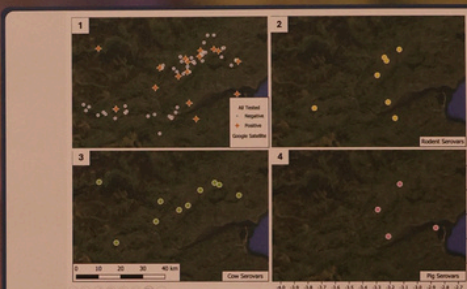


Fig. 2 *Leptospira* distribution in beavers, Tayside catchment.

- 1) locations of all tested beavers (positives marked as stars);
- 2) rodent-associated serovars (n=10) recorded across seven sites;
- 3) bovine-associated serovars (n=28) recorded across ten sites;
- 4) porcine-associated serovars (n=8) recorded across four sites.

Background: Satellite imagery ©2025 Google. Map data: Google Satellite via QGIS

Findings



No significant effects detected for sex or adult versus kit age classes. Sub-adults showed substantially lower odds of seropositivity, although this trend was marginally non-significant.



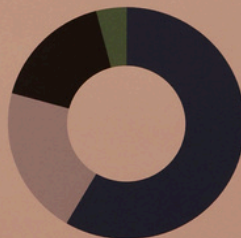
The strongest predictor was spatial clustering by location. This suggests infection risk varies substantially between territories and family groups.



Exposure sites appeared spatially widespread across the Tayside catchment. There was strong clustering within individual sites, and serovars within sites were frequently associated with the same maintenance host group. Bovine-associated serovars dominated many agricultural landscapes.

These findings suggest local environmental exposure linked to surrounding livestock systems.

Maintenance Hosts



- Bovine (28)
- Porcine (8)
- Rodent (10)
- Unknown (2)

Fig. 3 Number of exposures to serovars by maintenance host.

48 exposure events were recorded:
Bovine-associated: *hardjo prajitna* (9 exposures), *hardjo bovis* (7 exposures), *sejroe* (8 exposures), *hebdomadis* (4 exposures).
Rodent-associated: *javanica* (6 exposures), *copenhageni* (2 exposures), *grippotyphosa* (2 exposures).
Porcine-associated: *australis* (4 exposures), *bratislava* (4 exposures).

There was one serovar with an unknown maintenance host: *mini* (2 exposures).

Prevalence Over Time



Key Takeaways



Beavers are incidental spill-over hosts rather than maintenance hosts.



Beavers could be sentinels for waterway contamination by livestock-associated pathogens.



Leptospirosis currently does not appear to represent a major health threat to the Tayside population.



No clinical disease was observed in any beaver despite evidence of exposure and recent infection.

Discussion

This study provides the first comprehensive assessment of *Leptospira* exposure in wild Eurasian beavers in Scotland.

The overall exposure prevalence (8.9%) in beavers from the Tayside catchment is relatively low.

The low prevalence of likely active or recent infection (1.8%) and absence of clinical disease suggest that leptospirosis does not currently pose a significant threat to wild beavers.

The diversity of serovars, associated with livestock, rodents and unknown sources, indicates that beavers are most likely acting as spill-over hosts.

Beavers do not pose any notable risk to humans or wildlife at present.

Continued monitoring is recommended as beaver populations expand.

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Acknowledgements

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Special thanks to: Sheelagh McAllister, Rob Needham, Sam Wickens, Ben Morris and Gary Curran.

Beaver Dam Structural Dynamism and Its Role in Facilitating Mammal Movement

Daniel Arah, MSci Zoology Investigative Project, University of Glasgow

Background

Beavers (*Castor* spp.) are widely recognised as ecosystem engineers due to their ability to modify freshwater ecosystems through dam construction. Beaver dams alter hydrology, sediment dynamics, and habitat structure, creating extensive ecological benefits for aquatic and terrestrial biodiversity.

Although the ecological impacts of beaver ponds are well documented, the ecological role of the physical dam structure itself remains comparatively understudied. Beaver dams may function as natural crossing structures, facilitating terrestrial mammal movement across water barriers and increasing habitat connectivity within riparian landscapes.

Importantly, beaver dams are not static structures. They are semi-permeable and dynamic, changing morphology and flow state in response to hydrological conditions.

Whether dams continue functioning as crossing structures during periods of seasonal high water has not previously been investigated.

Study Aims

This study aimed to:

- Assess whether beaver dams function as crossing points for terrestrial mammals during seasonal high-water conditions
- Investigate how beavers modify dam morphology between summer and winter
- Determine whether dams maintain structural continuity sufficient to facilitate mammal movement during periods of elevated flow

Methodology

Study Area and Site Selection

Multiple watercourses within the Tayside catchment, Scotland. Watercourses ranged from 2–4 m wide when flowing and up to 13 m wide at beaver ponds.

Dam Measurements

- 20 active beaver dams were surveyed
- Measurements collected in:
 - Summer (June–July 2025)
 - Winter (November 2025–January 2026)

Three structural measurements were recorded: Dam length, Total dam height and Water depth immediately downstream

Camera Trapping

- Camera traps monitored 6 beaver dams and 3 control crossing points
 - Total effort: 308 camera trap nights
- Independent mammal crossings were recorded and standardised to crossings per 100 camera nights.

Key Takeaways

Results based on limited dataset from the ongoing study, further year of data required.



Beavers significantly increase dam length and height during seasonal high-water.



Despite higher water transmission, dams remain preferred crossing points for mammals.



Beaver dams are dynamic structures that maintain functional connectivity in changing conditions.



Beaver dams provide both hydrological and ecological benefits beyond aquatic habitat creation.

Seasonal Dam Modification Results

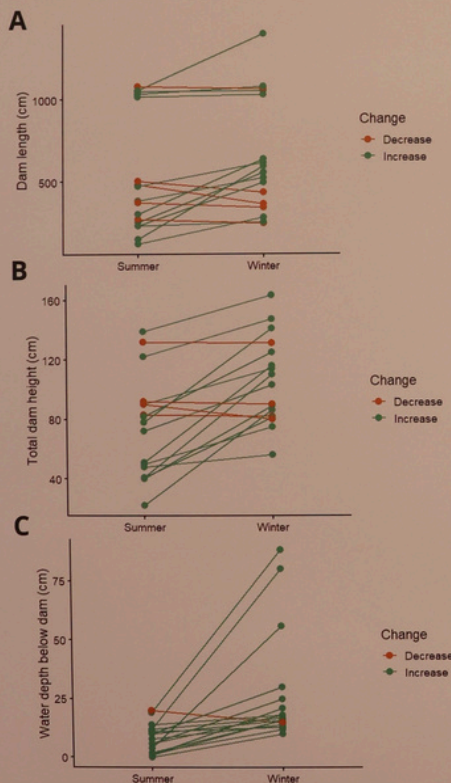


Figure 1. Seasonal Dam Modification Paired dot plot showing seasonal changes in measurements between summer and winter. Individual measurements are marked by points, with lines connecting paired measurements from the same dam. Pairs marked in green indicate an increase at that dam from summer to winter and pairs marked in orange indicate a decrease.

Beavers significantly increased dam dimensions during winter. Dam length (**A**) had a mean winter increase of +113cm ($p = 0.013$), total dam height (**B**) had a mean winter increase of +30cm ($p < 0.001$), water depth below dam (**C**) had a mean water increase of +19cm ($p = 0.003$)

With Thanks

Thank you to the landowners for access and the Beaver Trust team for field support. Special thanks to my supervisor, Dr Victoria Paterson, for her guidance and support throughout this project.

Dam Crossing Results

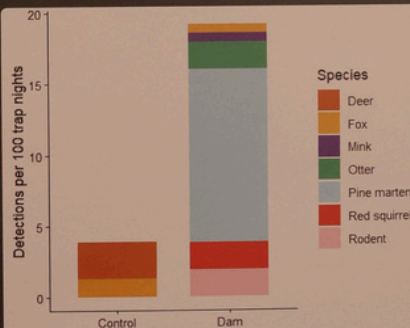


Figure 2. Dam Crossings. 33 independent crossings were recorded. Mammals crossed dams 4.9 times more frequently than control structures.

Beaver dams retained crossing functionality despite:

- Increased winter water transmission
 - Seasonal high-water conditions
 - Increased hydraulic stress
- Pine martens dominated crossings, accounting for 63.3% of all dam crossings.

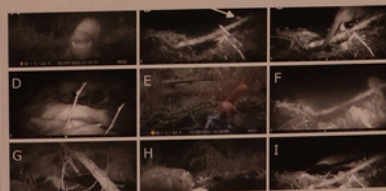
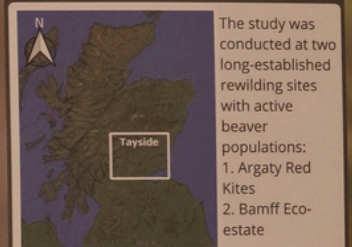


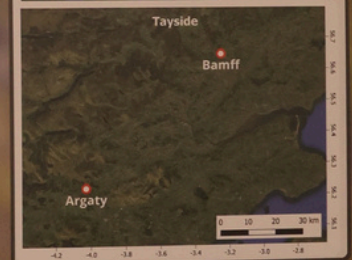
Figure 3. Camera trap images **A**) Pine marten (*Martes martes*); **B**) Small rodent that could not be identified to species; **C**) Otter (*Lutra lutra*); **D**) Red fox (*Vulpes vulpes*); **E**) Red squirrel (*Sciurus vulgaris*); **F**) American mink (*Neogale vison*); **G**) Roe deer (*Capreolus capreolus*); **H**) Eurasian beaver (*Castor fiber*); **I**) Two otters captured by camera traps that were not counted as crossing the dam structure.

Study Sites



The study was conducted at two long-established rewilding sites with active beaver populations:

- Argaty Red Kites
- Bamff Eco-estate



Discussion and Conclusion

This study demonstrates that beaver dams are dynamic and actively maintained structures rather than static landscape features.

Although winter conditions increased water transmission through dams, structural continuity between watercourse banks was retained sufficiently for mammals to continue preferentially using dams as crossing structures.

These findings support the hypothesis that beaver dams act as natural movement corridors that improve functional connectivity across riparian landscapes.

- Beaver dams are seasonally dynamic structures
- Beavers actively extend and maintain dams during high-water periods
- Dams continue functioning as mammal crossing structures during winter
- Beaver dams may improve landscape-scale connectivity for terrestrial mammals
- Beaver ecosystem engineering influences both aquatic and terrestrial ecological processes

The Impacts of Eurasian Beaver Introductions to Agricultural Landscapes

Anthony Lowney, Matt Bell and Wing Ng, Lucy Garrett
 Agriculture, Environmental and Animal Sciences, Hartpury University,
 Gloucestershire, UK.
 Corresponding author: anthony.lowney@hartpury.ac.uk



Abstract

Beavers are currently being reintroduced to the UK, with many studies showing the vital role they have on restoring rivers and wetlands, contributing to the delivery of national biodiversity targets, including the creation of wildlife-rich habitats and halting the decline in species abundance. Few studies have looked at the impacts that beavers would have on agricultural land. It is often thought that agricultural land will be lost to newly created wetland and that tree plantations will be damaged due to the beaver chewing and dam building activities. Therefore, this project aims to investigate the impact of reintroducing beavers to this landscape. Here we will assess the environmental and economic consequences that reintroducing beavers may have on local biomass and species richness. Particularly on those elements that come under the government Biodiversity Net Gain, and higher steward policies. This study hopes to provide valuable insights into the ecological and economic trade-off of beaver reintroduction. This is particularly important as reintroducing beavers on to agricultural land is a controversial topic. Therefore, understanding the complete costs and benefits will help policymakers and land managers make informed decisions about future rewilding initiatives.



Research aims

1. Monitor the changes in land biomass using remote-sensing techniques (aerial imaging) by comparing changes between before and after release, and between areas where beavers settle and do not settle. Use aerial imaging to predict estimate vegetation cover and carbon storage capacity, before and after release.
2. Use of passive acoustic monitoring devices to record bird diversity, before and after the beaver release and across the various farmland habitat to monitor species composition change due to habitat modification by beavers.

Study Site



Figure 1: Elmore Court Estate, next to the river Severn in Gloucestershire. This is our initial study site, but we hope to add to this as more beavers are reintroduced and expand their range.

1. Changes in land biomass

To estimate changes in habitat and carbon storage capacity, measurements will be repeatedly taken before and after beaver release.

- Aerial imagery data is collected using automatic UAV equipped with GPS, low power RGB and multi-spectrum sensors, and a mobile real-time kinematic auto-positioning correction station. The imaging data will be used for mapping different environmental states for landowners (e.g. crop condition and protection, vegetation performance, biomass greenness and densities, etc.).
- The height of plant material will also be measured using a rising plate meter (F400; Farmworks Precision Farming Systems Ltd., Feilding, New Zealand). Thirty points will be taken across each field following a W pattern. The height of plant material was estimated from the average across the thirty points.



Figure 2: Unmanned aerial vehicle set-up with mobile wireless station, flight route plan, drone calibration and adjustment, establishment of ground control points and take-off screenshot from drone control monitor.

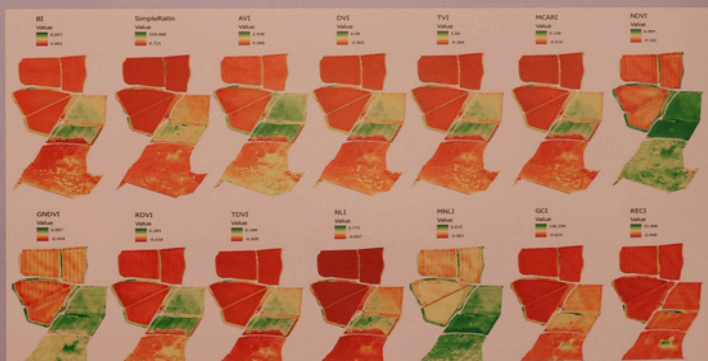


Figure 3: Example of different vegetation performance indices processed by ArcGIS Pro among different agricultural land uses for Hartpury University Home Farm, 2023. Red colour = less vegetation cover, yellow = moderate vegetation cover, and green = higher vegetation cover overall.

2. Passive acoustic bird monitoring

Bioacoustics recordings among the chosen habitats will also be used to estimate changes in bird species and abundance at Elmore court.

- These surveys will consist of two week period recording 1 minute in every 5 minutes with 15 using six recorders. Pre- and Post-beaver release surveys will be conducted twice a year for up to ten years after release, enabling for long-term changes in biodiversity to be identified.
- The Wilder Sensing platform will be used to identify bird species and activity patterns. Wilder Sensing employs the BirdNet library and filters which can be adjusted to using the detection and the location probability confidence. Validation will be undertaken using Audacity software and comparing calls to those confirmed on Xeno canto (Figure 4).



Figure 4: Spectrogram of the identified species labels identified using the Wilder Sensing platform imported to Audacity with the sound file. Labels identify Eurasian curlew which can then be listened to and validated.

Acknowledgments

We thank all staff at Elmore Court, particularly John Cutter and Hazel Alabaster for all their support.