CREW CENTRE OF EXPERTISE FOR WATERS

Evidence needs for river woodlands in Scotland

Policy Brief

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Key Recommendations

1. **Fostering of cross-sectoral policy alignment and development (across water, land sectors, air quality, biodiversity, climate change and communities)** is vital to enable River Woodland restoration and realise the potential multiple benefits.

2. **Targeted funding for interdisciplinary research on River Woodlands** is urgently needed to enhance understanding of their biophysical and socio-economic impacts, improve predictive tools, and guide effective implementation.

3. **Coordination and funding to refine and integrate monitoring and data strategies** is required as part of long-term, large-scale assessments of River Woodland impacts that embrace state-of-the-art analytical techniques to inform policy and practice.

4. **Fostering opportunities for private sector support for River Woodlands** will rely on clear funding models, partnerships, regulatory frameworks, and evidence of business benefits.

5. **National coordination and knowledge sharing** are needed to improve data accessibility, best-practice guidance, and collaboration among key stakeholders.

Background

Healthy River Woodlands (RW) provide wide-ranging environmental and societal benefits. Their expansion, restoration and management are important for enhancing water and air quality, flood and drought resilience, biodiversity, soil health, agriculture, and community well-being. Given these benefits, RW can contribute to achieving the policy objectives of many frameworks in Scotland, including the Scottish Biodiversity Strategy (SBS), Scotland's Forestry Strategy (SFS), National Flood Resilience Strategy, Third Land Use Strategy, Scottish Soils Framework, National Planning Framework 4, Scotland's River Basin Management Plans (RBMP), and Scotland Mental Health and Wellbeing Strategy: outcomes framework. The recent Scottish National Adaptation Plan (SNAP3) also strongly aligns with the potential of RW as a nature-based solution.

Upcoming policy developments (e.g. Natural Environment Bill, Natural Capital Market Framework, the development of the Ecosystem Restoration Code and renewals of both Land Use and Forestry Strategies), and RBMP4 present key opportunities for policies and regulation to preserve and expand RW to maximise benefit delivery. The 2022 Riverwoods Evidence Review[1] assessed the evidence base for RW benefits and identified research needs. Addressing priority evidence needs will support policy development and inform practice (e.g. practitioner guidance, model upscaling and scenario predictions, business engagement, and long-term investment strategies) and implementation (e.g.

via the Agri-Environment Climate Scheme). To achieve this, it is crucial to complement literature reviews with an understanding of sector-specific evidence needs, ensuring that future research and development efforts effectively inform policy and practice.

Research Undertaken

This project "Creating healthy and resilient river systems across Scotland: prioritising research and development gap opportunities for river woodlands" (2024-2025) aimed to:

1. Reviewed a decade of global literature to address 60 specific knowledge gaps, which were redefined to create 47 critical knowledge gaps;

2. Identify what evidence is most needed to enable policy development to support healthy, resilient RW systems;

3. Identify pathways to address these gaps, thereby fostering investment in priority RW R&D required, new RW and improved river environments.

Alongside the evidence review, we engaged with 115 stakeholders from various sectors – including the public sector, third sector, research, and private sector – through an online survey, interviews, focus groups, and consultations. These discussions focused on policy challenges, monitoring needs, and restoration finance. Here, we present our key findings and outline their policy implications.

Key Findings

Our research confirmed that many of the RW knowledge gaps proposed in the 2022 review were still gaps. This included some areas of RW functions, formerly declared strong evidence, that should be recognised as having multiple knowledge gaps requiring future research. Combining the overall results of the 2022 strength of evidence rankings, investigation of specific gaps and

stakeholder input allowed prioritisation within this project (Figure 1).

Stakeholders generally support RW restoration but want better access to existing knowledge (scientific evidence and case studies), funding, and practical tools. Rather than focusing on single issues, stakeholders prefer an integrated approach that combines evidence across multiple benefits. They want tools that address RW's overall impact, rather than isolated studies on specific benefits.
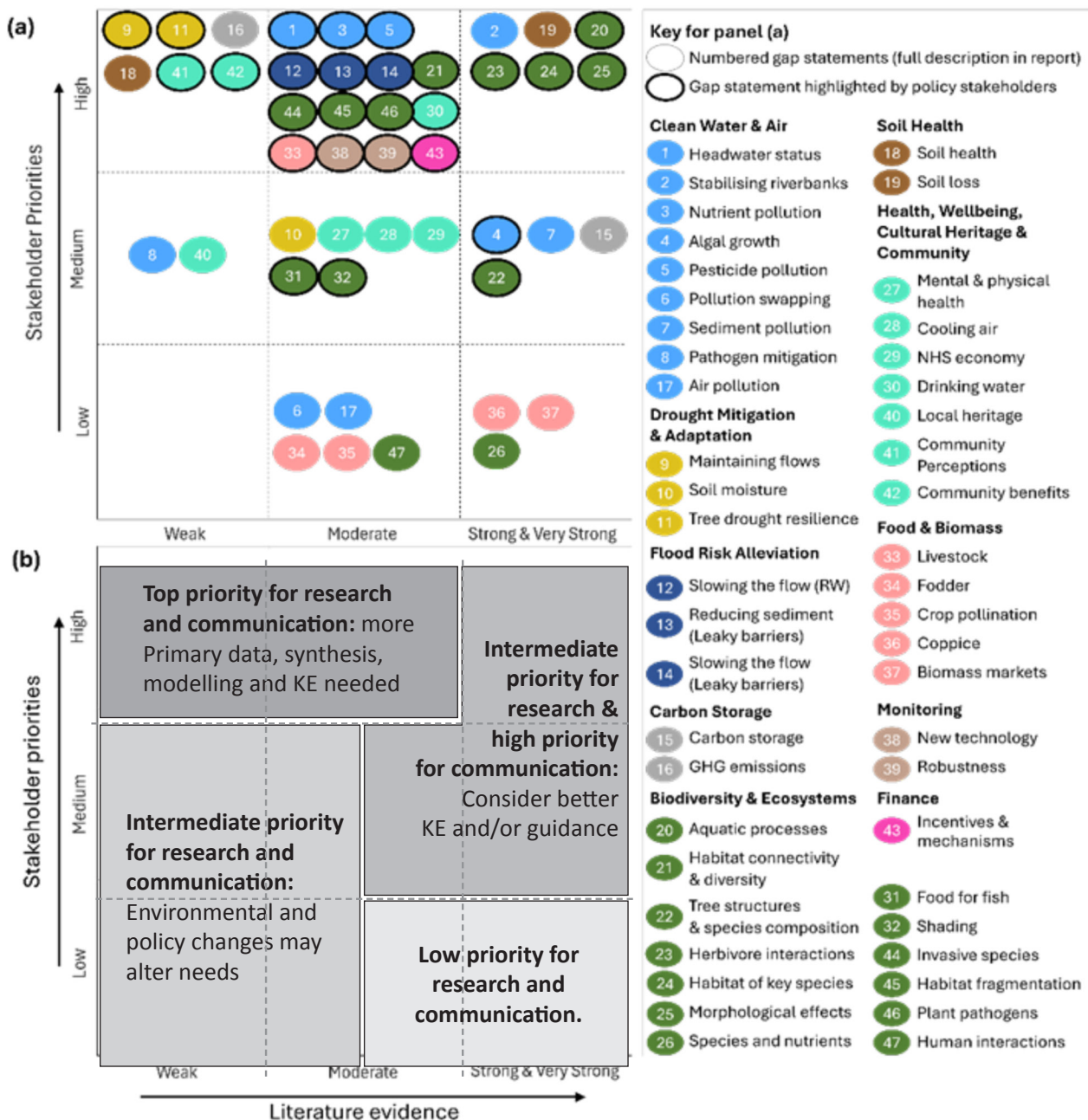
Figure 1: Overview of Stakeholder Priorities and Supporting Evidence. (a) The 47 identified gaps, categorised by benefit themes, as discussed with stakeholders. (b) Recommended priority areas for action based on overall stakeholder input. Note: KE = KnowledgeExchange. The matrix positions are based on a review of the specific gaps (x-axis) and the full stakeholder engagement process (y axis). The bold circular numbered gap statements were highlighted by policy stakeholders and correspond to evidence needs that may help address challenges raised by policy stakeholders in Figure 2. For identification of the specific number gaps (1-47) above, see the summary text in Table 3 and details in Tables 5-12 of the main report.

Research is particularly weak in key areas like RW placement for water management, drought-resistant tree species, carbon storage, and public attitudes toward RW restoration. Figure 1 a) shows stakeholders priorities according to levels of evidence of reviewed gaps. 1 b) shows some overall pathways for resolving evidence needs. The bold circular numbered gap statements were highlighted by policy stakeholders in Figure 1a) and correspond to evidence needs that may help address challenges raised by policy stakeholders in Figure 2.

Strong scientific evidence supports RW benefits for clean water, soil health, biodiversity, and wildlife protection, but there is a need for better knowledge-sharing and guidance.

More studies should explore RW management, tree placement, and long-term monitoring to measure their effectiveness.

Practical challenges—such as limited funding, lack of collaboration, and inconsistent data—may be bigger barriers to RW implementation than gaps in scientific knowledge.

Policy areas and main policies

Challenges identified by policy stakeholders which would require further evidence

Cross policy challenges
SNAP3,
NPF4 and Local Env. Planning,
Taskforce on Nature-related
Financial Disclosures (TNFD),
Natural Capital Market Framework

- **Effective siting & assess cumulative effects at scale**
- **Understanding incentives & participation barriers**
- **Optimal RW extent, structure, and function**
- **Climate change resilience in RW management**
- **Nature finance regulation, supporting market standardisation.**

Biodiversity
SBS, SFS, Beaver Strategy

- **Invasive species management**
- **Herbivore management (regeneration after grazing, attitudes toward control, trade-offs between beaver protection and ecosystem benefits, effective tree protection and design)**
- **RW and biosecurity**
- **Compensatory tree planting**
- **Habitat connectivity**
- **Tree planting in designated areas**

Agriculture and forestry
Forestry Grant Scheme, Woodland
Carbon Code, SFS, Scottish Rural
Development
Programme (SRDP)

- **Integrating afforestation grants and agricultural payments to incentivise farmers**
- **Balancing productivity with RW establishment**
- **Managing tree planting between agricultural land and watercourses**

Water quality and quantity
Flood Resilience Strategy, Flood
Risk Management
Planning, RBMP, Woodland Water
Code

- **Managing tree planting & water scarcity**
- **Incorporating RW into flood management strategies**
- **Managing trade-off RW effect on different water quality parameters (water cycle, pH, temperature, DOC levels, nutrient budgets, phytoremediation, pesticide use risks)**
- **RW and headwaters management to benefit downstream flow and water quality**

Figure 2: Policy challenges raised by policy stakeholders which would benefit from further evidence on topics presented in Figure 1 and some relevant policies.

Implications for policy

Recommendation 1: Foster cross-sectoral policy alignment and development

1.1. As identified elsewhere across Europe[2], there is a critical need for further policy integration of river woodland targets and associated reporting both within and across topics and strategies (e.g. Biodiversity, Soils, Flooding, Water, Environment, Climate Change, Forestry, Agriculture, SNAP3 and associated policy links). This would enable grant funding and timescales for delivery to be streamlined across government departments and better manage conflicting agendas. SNAP3 provides a potential framework for this, and in doing so provides an opportunity to resolve evidence needs.

1.2. Additional evidence is needed to support policy implementation and ensure the realisation of multiple RW benefits across landscapes. For example, evidence-based solutions for herbivore management issues related to beavers and deer will require work at the intersection of forestry, agriculture, and biodiversity policy. The upcoming Natural Environment (Scotland) Bill will set legally binding restoration targets to promote delivery across the board.

1.3. Stakeholders involved in policy design, implementation, regulation, and guidance provision must collaborate across sectors to address challenges relating to key evidence needs (research and monitoring), funding (nature finance), and policy goals (restoration targets, climate change, integrated land-use). A key overarching challenge is establishing clear policy targets for RW: e.g. location, species, area and continuity, management regimes, knowledge sharing, and land-manager engagement.

Recommendation 2: Develop targeted funding for interdisciplinary research on River Woodlands

2.1. Commission biophysical research on multiple RW effects and interactions, especially between shading, flood reduction, water stress and drought resilience, biodiversity conflicts, diffuse pollution, soil health, and carbon quantification and dynamics across soil, biomass and deadwood elements of RW. This aligns with multiple relevant Scottish policy strategies, which are also interlinked (e.g. for SNAP3, Biodiversity, Land use, Flood Resilience, etc.). Implementation of trials to inform practical guidelines for RW siting, design, and management for both urban and rural locations would also benefit regional and place-based collaborations (such as the Rural Diffuse Pollution Plan for Scotland, NPF4, and the UK Woodland Water Code) and underpin development of grant schemes (e.g. targeting RW for Forestry Grant Scheme enhanced payment rates).

2.2. Integrate socio-economic and biophysical research to assess community preferences, cost-effectiveness, and funding possibilities for different RW measures. This would be particularly relevant for consideration under the Scottish National Flood Resilience Strategy.

2.3. Advance tools for RW siting and ecosystem contributions using LiDAR and modelling effects at scale, ensuring transparency in methodologies, and increasing applicability for practitioners (e.g. for informing or evaluating grant applications and Environmental Impact Assessments, aiding delivery of RBMPs and FRMPs).

2.4. The data generated from recommendations 2.1 to 2.4. should be utilised to develop new practical tools, or enhance existing ones, for planning RW coverage and tree placement to maximise multiple benefits. When built on vegetation and ecological site classification (ESC), such research could then inform national coverage targets and appropriate locations for RW and well as updated conditions for funding attribution such as the Forestry Grant Scheme.

Recommendation 3: Support the refinement and integration of monitoring and data strategies

3.1. Adaptive policy implementation and new funding frameworks (such as green financing) need evidence for multiple benefits and long-term resilience of RW. Robust, large-scale, monitoring (e.g. using Catchment Observatories) is needed to supply this.

3.2. Stronger evidence is needed for expected RW outcomes on shading and cooling, flood peaks, and biodiversity. Policies benefitting include RBMP4, Flood Resilience, SBS, Scotland's Beaver Strategy, A Routemap to Resilience for Scotland's Forests and Woodlands. Better quantifying of these outcomes will strengthen delivery and inform payments or credits.

3.3. Develop monitoring indicators for assessing changes in river function and classification to inform varying outcome expectations for RW. These indicators could feed into restoration focused river basin management plans (e.g. RBMP4) and Woodland Water Code (WWC) related monitoring efforts and the Facility for Investment Ready Nature in Scotland (FIRNS) Source to Sea blended finance model.

3.4. Opportunities should be created to explore and adopt technical and methodological advancements, such as monitoring dead wood transport, environmental DNA, and remote sensing (satellite, aerial imagery, and LiDAR data).

3.5. National guidelines for river restoration projects are needed to establish best practices for monitoring, enabling the evaluation of successful outcomes, identification of shortcomings, and recommendations for necessary improvements in implementation.

3.6. High quality data are being generated through well-trained and coordinated citizen science programs (e.g. Riverfly Partnership, SmartRivers). These need long term support, development and promotion.

Recommendation 4: Foster opportunities for improved investment and financing for River Woodlands

4.1. Provide evidence towards standards, ecosystem quality indicators and metrics aligned with existing and developing funding mechanisms such as WWC to explore investment in RW restoration.

4.2. Promote collaboration between public, private, and research sectors to develop funding and implementation strategies for RW. Align with the Scottish National Flood Resilience Strategy, which aims to engage new partners across public, private, and third sectors in flood resilience efforts.

4.3. Strengthen regulatory frameworks and seek to leverage voluntary market mechanisms for natural capital markets and develop valuation metrics beyond carbon e.g. WWC. This will be supported by recommendations 4.1 and 4.2.

4.4. Provide evidence on how RW can generate benefits for specific private sector stakeholders and how evidence can be integrated in private sector mechanisms (reporting, validation). Ensure alignment with the Natural Capital Market Framework to support the development of high-integrity natural capital markets.

Recommendation 5: Enable national coordination & knowledge sharing

5.1. Support initiatives such as Scotland's Environment Web and Riverwoods Digital Centre for Excellence to improve data accessibility and integration for stakeholders.

5.2. Update and communicate relevant national guidance for RW to the farming sector, including Forestry Standard Practices (e.g. UK Creating and Managing Riparian Woodlands guidance; Designing and managing forests and woodlands to reduce flood risk) and other guidance such as the Tweed Forum's Riparian Woodland Management Guidance.

5.3. Support initiatives such as Riverwoods to promote RW at a national level and enhance collaboration between policymakers, researchers, landowners, and communities. Sustain and expand peer-to-peer networks such as the Integrating Trees Network to facilitate knowledge sharing while ensuring a stronger RW focus.

References

[1] Ogilvy, T., Nicola M., Martinez, R., Stutter, M., Sime, I., Wilkinson, M., Morison, J., Broadmeadow, S., & O'brien, L. 2022. Riverwoods for Scotland Report on Scientific Evidence.

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