

Scottish Environment Protection Agency

**River restoration at the catchment scale
in Scotland:
Current status and opportunities**

Final report (draft)

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June 2008

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Executive summary

This report was commissioned to determine the nature and level of catchment scale river restoration activity in Scotland. Catchment scale river restoration was defined as “*any river restoration activity that singly, or in combination, restores natural catchment processes and a naturally functioning ecosystem and brings benefit or environmental services to the whole catchment and not just to the site of restoration*”. The method of data collection was principally by soliciting information and views from key stakeholders and practitioners in the field of river restoration. The following key findings are apparent:

River restoration should be underpinned by a good understanding of catchment processes taking in account longitudinal, lateral and vertical connectivity within the natural systems and also timescales of response. River restoration projects that restore processes and target more than one outcome should be the goal.

From a stakeholders and practitioners perspective SEPA’s river basin planning process was seen as potentially being able to provide a framework for the delivery of river restoration at the catchment scale. However a number of limitations were identified as hindering process including lack of national strategy and coordination, and funding.

Organisation within Scotland with a role to play in river restoration stressed the need for partnerships in delivering restoration, that the role of the Scottish Government is to develop the mechanism and funding streams and for SEPA to coordinate delivery. A current limitation is that few organisations have specific and detailed knowledge on how to plan and undertake river restoration and there is a general feeling that the absence of a centralised river restoration database and river restoration ‘best practice guidelines’ are largely absent.

Traditionally river restoration has focussed on a single driver with fisheries being the most important followed by biodiversity. Sustainable flood management and climate change adaptation are seen as emerging drivers of river restoration. Most individuals appreciate that river restoration can bring about multiple benefits but a lack of scientific

assessment and monitoring makes this difficult to assess. This was demonstrated by the fact that few projects had specific targets and indicators of success.

Catchment scale river restoration initiatives in Scotland are limited in number and of those that do exist few have extended beyond the planning and baseline survey stages. River restoration activity overall, however, is on the increase.

RESS believes that river restoration operating at the catchment scale will over the next 25 years will bring about substantial improvement in the environmental quality of river corridors together with linked environmental services and help the Scottish Government meet many of its obligations associated EU Directives and climate change.

Key recommendations of the report are:

- (i) New river restoration initiatives should be at the catchment scale, focus on restoring hydrological, chemical, geomorphological and ecological processes and be underpinned by a good conceptual and scientific understanding of the environment.
- (ii) There is the need for two or three catchment scale river restoration projects to act as demonstration sites and a model for others to follow. Effective assessment and monitoring of these is also a necessity.
- (iii) There is a real need for an evidence base in performance and success of restoration measures. This would be facilitated by a central river restoration project database reporting on the nature and success of individual projects and standardised protocols for monitoring projects. In this way the effectiveness of investments could be appraised.
- (iv) SEPA via the river basin planning process is well placed to provide the coordination and strategic view of river restoration in Scotland. River basin management planning is likely to be the catalyst if resources are provided for river restoration.

Preface

Recent attention has focussed on restoration of ecosystems with the context of catchment management. Drivers of restoration are varied and often interconnected but can be linked to legislation (e.g. EU Directives such as the Water Framework Directive and the Floods Directive), environmental concerns (e.g. climate change adaptation and mitigation) and socio-economics issues (e.g. a falling rural population).

Opportunities exist to build on individual initiatives focussed on a single driver and look towards achieving multiple benefits such as flood mitigation and biodiversity conservation. New opportunities are now presenting themselves in this regard in relation to sustainable flood management and habitat restoration but the level of activity needs to be heightened to bring about benefit across Scotland. In order to achieve this there is a need to identify and understand what has already been done in terms of river restoration and what potential there is for developing synergies between initiatives.

The background for this commissioning report therefore is to ascertain the state of play of catchment scale river restoration in Scotland and to relay this information to the public. As such the intention of this report is for it to be open to all.

Dr Chris Spray MBE
Director of Environmental Science, SEPA

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Acknowledgements

We would like to acknowledge all the organisations and individuals who volunteered information and views regarding river restoration and without which this report could not have been produced. Funding for the study was provided by SEPA with the intention of the report and information being made available to all those with an interest in river restoration.

I. FRAMEWORK

1. Introduction

1.1. Background

This report addresses the “state of play” with regard to catchment scale river restoration in Scotland with a focus on the key organisations and individuals concerned with delivery at the national, regional or catchment level. An interest in catchment scale restoration and its ability to deliver measurable environmental benefits in terms of such issues as biodiversity, water quality and flood defence is emerging but to date it appears as if few organisations and individuals in the UK have developed frameworks and strategies to optimise delivery at the catchment scale (Ormerod, 2004; RRC, 2005). This is despite the concept of integrated catchment management and river basin management now being well established.

Proponents of river restoration suggest that catchment scale restoration can bring about significant improvements in river “health”. However, Matt Kondolf based on his experience on the Sacramento and San Joaquin rivers in California has stressed the need for an integrated and strategic approach and suggested that uncoordinated piece-meal restoration can have questionable ecosystem-wide benefit (Kondolf, 2000). Healthy river corridors can provide important environmental services over degraded ones. River restoration services can include flood attenuation, nutrient uptake, and habitat for species with conservation designations leading to improved and sustainable river management.

There are major river restoration investment programs now underway in a number of countries. For example, a large proportion of flood defence budgets in Denmark and Southern Germany are now being used to create more robust natural solutions to flooding. In Denmark, for example, the government has a strategy of buying up land and relocating farms from land liable to flooding to higher ground allowing river and floodplain restoration, sustainable flood management and land uses compatible with flooding and

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flood attenuation to take place. Tockner and Stanford (2002) argue that floodplains are natural control structures and should be used that way.

In a Scottish context, one of the first projects to champion of a catchment based approach to improving rivers was initiated by WWF in the mid 1990s via its “Wild Rivers” Initiative. Scottish Natural Heritage also commissioned a review and evaluation of integrated catchment management in the mid 1990s (Werritty, 1995). Since then, the promotional work of the River Restoration Centre (RRC) and the focusing of minds by the Water Framework Directive have kept catchment scale restoration in Scotland at the forefront of many peoples thinking. A number of reviews on catchment scale restoration have been undertaken by the RRC, but these were not explicitly focussed on Scotland, or only focussed on a particular area such as catchment management plans and diffuse pollution (Wright and Gairns, 2004 - DPI No23/PW, LG). The RRC (2005) identify eight Scottish catchment projects that incorporated river restoration but no explicitly catchment scale river restoration projects. Those listed were the Ugie wetland project, Ythan project, Spey, Dee-Ken Management Plan, Tweed Management Plan, Forth Wise Use of Floodplains Project, the Cree Valley Catchment Partnership, and Ettrick floodplain Habitat Enhancement Project. However, the situation is changing rapidly with new projects emerging and some faltering, though information on current drivers for activity is lacking. Wright and Gairns (2004) highlighted most catchment management plans were for the rural parts of the east of Scotland and 66% of them had been driven by water quality issues.

Investment in specific river restoration activities may be linked intimately to a range of other environmental policy drivers such as urban regeneration, sustainable flood management, biodiversity action planning and diffuse pollution control. This is important in that river restoration is likely to fulfil a range of legislative obligations and in the long-term will be found to have good cost-benefit ratios. The multiple policy benefits of investing in restoring river morphology is and has been widely recognised within the USA (Palmer and Allan, 2006) and Europe for nearly a decade now. River restoration must not be viewed independently from catchment/land use management, and the importance of the later to alleviating the pressure on Scotland’s water can not be over emphasised in terms of dealing with some of the problems at source.

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Two key issues in catchment scale river restoration can be identified when approaching restoration at the catchment scale. Firstly, what is the extent to which different river restorations activities, often at different locations in the catchment, can bring about multiple benefits (see Table 1) that are complementary in addressing environmental issues of concern? Examples of potential multiple benefits include:

- Removing redundant flood barriers may reduce the risk of flooding downstream and may improve biodiversity.
- Creating/restoring wetlands may improve biodiversity and reduce inputs of diffuse pollution.
- Establishing natural riparian corridors may reduce diffuse pollution and create important wildlife corridors.
- Creating more natural river environments in urban areas improves amenity and provides a focus for urban regeneration.

Secondly, it is not clear over what timescale the activities are likely to show environmental improvement.

1.2. Definitions

The RRC (2005) defined river restoration at the catchment scale as “river and floodplain focussed restoration that considers catchment scale morphological, hydrological, ecological processes and associated land management pressures”.

For the purpose of this report, CRESS will define river restoration at the catchment scale as:

A river restoration activity that singly, or in combination, restores natural catchment processes and a naturally functioning ecosystem and brings benefit or environmental services to the whole catchment and not just to the site of restoration.

It is also important here to document the Scottish Government use of the words restoration and remediation. Restoration is viewed as “manipulation of the physical,

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chemical or biological characteristics of a site with the goal of returning natural conditions/functions that have been degraded or lost". Remediation "is a catchall term for all beneficial environmental improvements and does not necessarily mean returning a site to a previous condition" (Greig and Marsden, 2008; SEPA National Environment Group -Restoration Cover Note).

We do not consider softening of engineering structures placed in a river to fulfil a development function as river restoration (e.g. River Nith diversion at House of Water to allow coal mining). Similarly, such measures as sustainable urban drainage schemes are viewed as a mitigation technique to prevent pollution at source and not a river restoration technique *per se*.

Another key point is that the improvement of an environmental service cannot be at the expense of natural river processes and reinstatement of naturally functioning river ecosystems will bring about a suite of other environmental services. The key environmental services considered in this report are:

- Biodiversity conservation and enhancement
- Bank erosion control
- Flood attenuation
- Diffuse pollution mitigation
- Safeguarding habitat of species with important conservation designations
- Increasing salmonid abundance
- Improved aesthetics
- Adaptation to climate change

1.3. Aims and objectives

The overall aim of this project is to ascertain the national picture with regard to catchment scale river restoration activity in Scotland focussing on the drivers, organisations involved, geographical distribution of projects and nature and timescale of existing and planned projects.

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The key aims of the project are:

- (i) to provide information of the current status of river restoration initiatives in Scotland and their location and characteristics;
- (ii) to determine the relative importance of various drivers as a catalyst for river restoration;
- (iii) to determine to which extent there is synergy or otherwise between different types of river restoration projects, organisations' strategies and which drivers may bring about multiple benefits;
- (iv) to determine the extent to which organisations in Scotland have a commitment to oversee and undertake river restoration at the catchment scale; and
- (v) to analyse the current situation in Scotland with respect to the implementation of a national river restoration strategy.

Finally, within this report, CRESS has also used its scientific knowledge of catchment scale hydrological and ecological processes and expertise on river restoration to provide a critical assessment of the potential way forward for catchment scale restoration in Scotland.

1.4. Structure of the report

This report has 4 main sections. Section I provides the context to the study and introduces a conceptual and theoretical framework to river restoration at the catchment scale. It includes an introduction explaining the background to the study, definitions and the key aims and objectives. It also introduces a conceptual insight in to the manner in which one needs to consider environmental and ecological processes in river restoration at the catchment scale, together with time and geographical location issues. Section II introduces the methods of data collection. Section III provides an analysis of results including views of interested parties on river restoration, organisations approaches to river restoration and the nature and scale of river restoration activity in Scotland. The final section (IV) provides a discussion and conclusion including recommendations for action.

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2. Conceptual and theoretical framework

It is pertinent in the context of this report to provide a conceptual framework for catchment scale river restoration from an environmental science and management perspective. Our basic assumptions are (i) maximum benefit will be gained if river restoration is implemented at the catchment scale, and (ii) measure of effectiveness should be assessed in relation to multiple responses/benefits (Wharton and Gilvear, 2007).

2.1. Approaches to restoration

In undertaking catchment scale river restoration, the key is to understand the manner in which the river system has been degraded, the resultant loss of environmental services that the pristine system provided and how restoring the system can bring about beneficial change across a range of indicators. Our assertion is that catchment scale river restoration must strategically consider the level of benefit an activity can bring to a single driver, the overall level of benefit that can be accumulated across the range of benefits that the activity will bring and the timescale over which restoration will bring about benefit.

In this context different river restoration activities can be assigned into different groupings:

- Single and short-term benefits
- Single and long-term benefits
- Multiple and short-term benefits
- Multiple and long-term benefits.

Each type can also be assigned as to whether the activity principally brings about reach-scale or catchment-scale benefits. In general restoring process will bring catchment benefits whereas restoring morphology will be more reach scale in terms of the primary

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benefit. The key is not only the benefit but the sustainability of the benefit and in this respect restoring process is the answer. Of course in many cases the level of confidence in the restoration meeting an objective needs to be factored in to this framework. High confidence low cost projects are the ultimate objective. In many cases river restoration can be an inexpensive method of bringing about improvement at low cost.

2.2. Multiple drivers

River Restoration in the UK has largely been centred on biodiversity and fisheries, although some appreciation of benefit in terms of mitigating diffuse pollution, and flood attenuation potential does exist (RRC, 2005; Wharton and Gilvear, 2007). When appraising restoration projects however, post project appraisal has almost always been targeted at one benefit without the scheme being appraised more holistically. Table 1 provides a theoretical assessment as to the extent to which a range of river restoration activities may bring about multiple benefits across 5 principle drivers of restoration in Scotland. On average any single restoration activity is likely to assist with improvement to three key areas of environmental concern relating to river management. The level of potential improvement has essentially been graded on a 5 fold classification. Adding the scores provides an indication of the extent of multiple benefits that might be achieved by that restoration activity. In reality the benefits that arise will be dependent upon the scale of the activity, location in the catchment, pressures on the river system, where on the river system the beneficial impact is measured, and the range and relative dominance of an array of environmental processes operating in the catchment. Overall our assertion is that where possible river restoration should be targeted at delivering multiple benefits.

2.3. Catchment context and scales

Catchments represent an area of land whereby runoff (usually) drains to a single point on the stream network. Management of land and water at the catchment scale has been widely accepted as the only way forward in protecting water resources and freshwater environments and, with the Water Framework Directive is incorporated in the river basin planning process. In this context the characteristics of a river system should be viewed

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as the cumulative products of the processes of catchment runoff, sediment mobilisation and transport, nutrient sources and fluxes, and catchment, riparian and in-channel ecological processes – a number of scientists have described this as the fluvial hydrosystem.

The fluvial hydrosystem should be viewed in 3 dimensions with the importance of longitudinal (i.e. source to mouth), lateral (from the centre of the river, via the river margin to the valley sides) and vertical (via the bed through the hyporheic zone to the groundwater system) connectivity being appreciated. Holmes (1998) suggests that hydrological and geomorphological connectivity is critical to maintaining biodiversity, productivity, attenuating flood waves, reducing nutrient loadings, trapping sediment and promoting groundwater recharge. River habitat has also been conceptualised as being hierarchical in nature with network, segment, reach, meso-habitat and microhabitat nested within each other (Poole, 2002). Without this spatial and hierarchical approach to catchment scale river restoration, it will not be optimised and will result in incidents of restoration failures.

In relation to a hierarchical scale, river restoration cannot be seen as a simple panacea in terms of the remedying the impacts of poor land use management; river restoration and land management need to work in tandem. Improving instream physical habitat for example would be a poor investment of resources if water quality was a limiting factor induced by diffuse pollution. Similarly weir removal to provide sediment transport continuity will have a lesser impact where sediment sources are few upstream, compared to a highly erodible upstream catchment. In other words there needs to be appreciation of the role of catchment runoff processes, flow hydraulics, sediment transport, organic and nutrient fluxes and biological responses in formulating river restoration strategies. Restoring natural processes should always be the primary goal of restoration (see Appendix 1 for a summary of selected restoration activities and impacts on environmental and ecological processes).

Only by understanding processes operating in the fluvial systems can sensible decision-making be undertaken in relation to the successful implementation of river restoration activities. For example floodplain wetlands are often cited as providing a function in terms of flood attenuation. However, a floodplain wetland with habitats dominated by

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reeds and sedges, under flood conditions, may provide no more flood storage or when the vegetation stems are flattened under flood conditions no more hydraulic resistance than an equivalent area of unembanked farmland! The critical component of floodplain wetlands that will slow the flow is high hydraulic roughness induced by habitats such as willow carr. The scale of restoration action in relation to environmental processes is also important to consider, in the sense that the scale of action should match the scale of the issue or problem. Any significant flood attenuation potential of a floodplain “forest” is only going to be realised if the area is large in relation to the size of river (ie. perhaps $> 2 \text{ km}^2$ on a floodplain of 200 metres width and not a small “stand”).








The space dimension essentially relates to issues of connectivity and fragmentation. In relation to space it should be appreciated that the same activity will have different impacts in different parts of the catchment and this may also be process specific. For example, removal of a weir for fish passage is likely to have optimum benefit if it is located near to the tidal limit. In contrast weir removal to restore connectivity in terms of downstream sediment flux is likely to have optimum benefit if it is located in the upper reaches, especially if it is isolating major sediment sources. Also there is the issue as to over what distance might the benefits of reach-scale restoration benefit the upstream or downstream river system and this may impact on the number of individual restoration projects required to bring about catchment wide benefit.

There will also be a time dimension in that there will be a greater lag, in many cases between restoration and the benefit being seen the further from the activity being undertaken (Figure 1). In such situation the key decisions relate to the time period in which one is wishing to bring about improvement. Multiple river restoration activities strategically placed are therefore likely to accelerate a return of the river system to good ecological condition overall. We believe restoring processes should be the principle goal of river restoration and one which provides a sustainable way forward.

Table 1. Theoretical assessment as to the extent to which a number of single restoration activities can fulfil multiple benefits

		DRIVERS / BENEFITS				
		Biodiversity	Sustainable Flood Management	Physical Habitat	Fisheries	Diffuse pollution
ACTIVITY	Re-meandering	High	Moderate	High	Moderate-high	
	Buffer strip creation and revegetation	High	Uncertain/variable	Moderate-high	Moderate	Moderate
	Flood embankment removal	Moderate-high	High	Moderate-high		
	Culvert removal	Moderate	Moderate	Moderate	Moderate	
	Weir removal		Uncertain/variable	Moderate-high	High	
	Reconnecting old channels	High	Moderate	High	High	
	Riparian conifer removal	High		High	Moderate-high	Moderate
	Riverine wetland creation	High	Moderate	Moderate		Moderate
	Substrate replenishment	High	Uncertain/variable	High	Moderate-high	
	Bank protection removal	Moderate-high		High	Moderate	
	Beaver reintroduction	Moderate-high	Uncertain/variable	High	Uncertain/variable	
	Woody debris reintroduction	Moderate-high		High	Moderate-high	
	Fish passes				High	
	Alien species removal	High			Uncertain/variable	
	Ecologically acceptable flows	Moderate-high		High	High	
	Less intensive land management	Moderate	Moderate	Moderate	Moderate	Moderate
	Restoring floodplain forests	High	High	High	Moderate	Moderate

Level of benefit colouring indicative of potential benefit to driver

-  Uncertain/variable
-  None
-  Highly damaging
-  Damaging
-  Moderate
-  Moderate-high
-  High

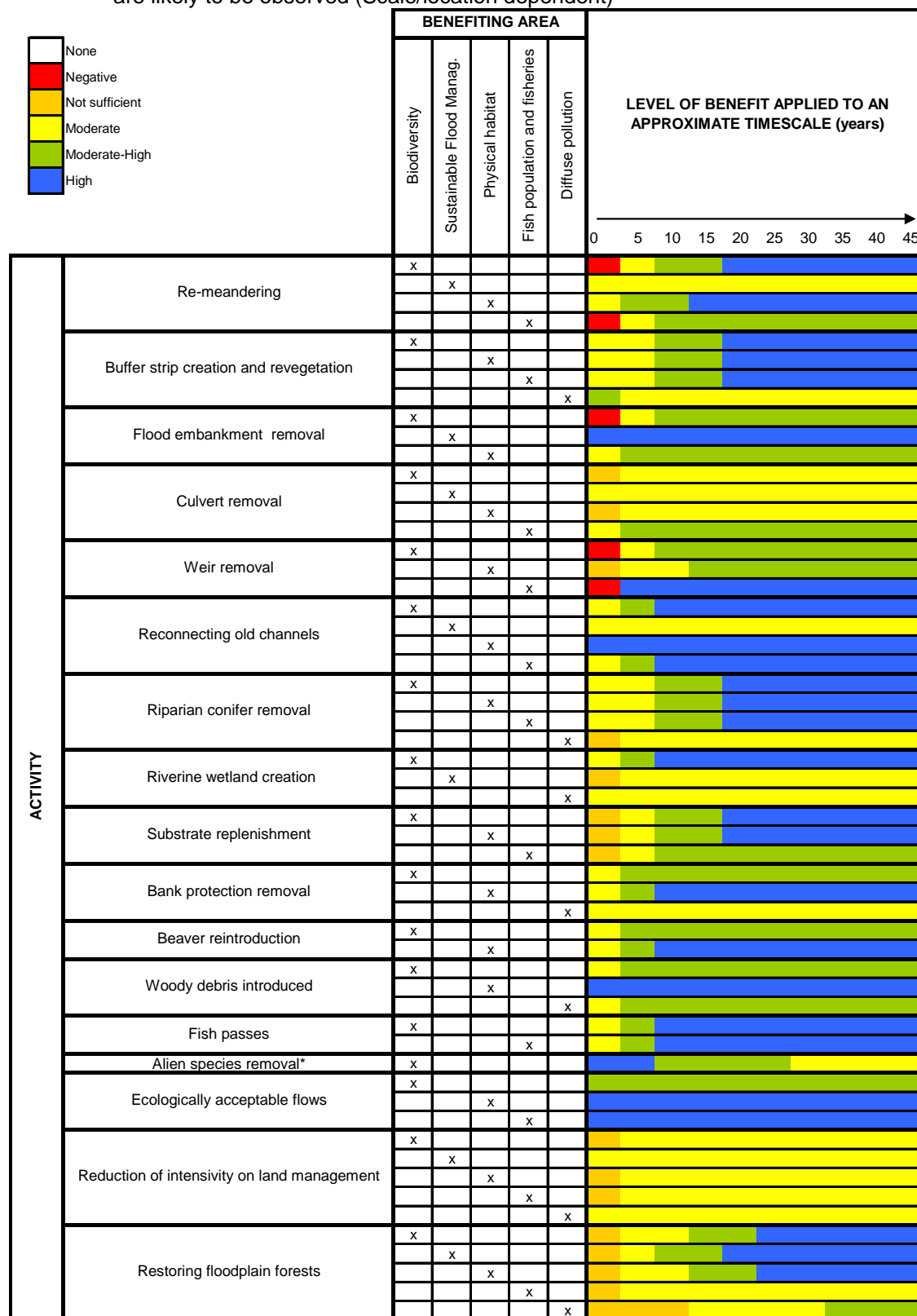
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The importance of an ecosystem basis for river restoration has been stressed in a paper by Palmer *et al.* (2005). Good river restoration should be based on the following 5 criteria:

- articulating a “guiding image”
- improving ecosystems
- increasing resilience
- doing no lasting harm
- completing an ecological assessment

The first step should be articulating a “guiding image”, describing the ecologically healthy river that could exist at a given site. The second step should be to demonstrate that there have been measurable changes towards the guiding image, such as larger fish populations and clearer water. Palmer *et al.* (2005) stress that restoration success should not be viewed as an all-or-nothing, single endpoint, but as an adaptive process where small improvements build up and lessons are learned from any failures. The third criterion for successful river restoration is to create hydrological, geomorphological and ecological conditions that allow the river to be a resilient, self-sustaining system. The fourth criterion is to do no lasting harm – for example not to result in the spread of invasive species. The final criterion is that ecological assessment should be carried out.

Table 2. Theoretical assessment of the timescale for which any damage and levels of benefit are likely to be observed (Scale/location dependent)



* If only 1 eradication action is undertaken, potential of recolonisation / repopulation exists.

2.4. Timescales over which river restoration can bring about beneficial change

The time dimension relates to process of biological community development and sediment transfer through the system. At the reach scale, river systems have also been described as shifting habitat mosaics (Stanford *et al.*, 2005) emphasising spatial and temporal variability and the need for dynamism in our rivers. In terms of the time dimension the impact of restoration will be seen in some cases instantaneously but in others decades may be required. We have approached this theoretical in Table 2 whereby the various activities and benefits described in Table 1 have been assessed in relation to the timescale over which the full beneficial impact of that activity is likely to be observed with the pathway to that benefit also being shown.

Once again timescales will vary according to particular river characteristics and where the benefit is measured on the river network, but the theoretical process provides a temporal framework that can be used in strategic catchment scale river restoration decision making. Fencing of rivers and riparian planting, for example, may not bring appreciable benefit until the trees are mature and shed large volumes of leaf litter and cause significant area of shadow to be cast across the river. The example of the time required for downstream sediment transport to impact on downstream sites following weir removal has already been mentioned (see Figure 1). In this case time may not be measurable in years but by the chronology of competent floods to transport sediment. In a flood-rich period the time for the beneficial impact to be felt at distance may be short but in a flood-poor period the time period long. The same applies to substrate replenishment schemes. A precise timescale over which benefit will be observed or measured will not only be flood chronology dependent, but also depend on distance from the reach of replenishment. Nearly all restoration activities will have a suite of beneficial impacts, but some will be realised in the short-term and others in the long-term.

Figure 1 does illustrate however, how restoring process can result in benefit propagating through the network bringing about large scale benefit. Restoring process however in many cases does not result in immediately recreating good or high ecological status at the site or elsewhere, with the benefits only being apparent over

longer timescales. Restoring process will often not show short-term success but will still be the most effective approach long-term.

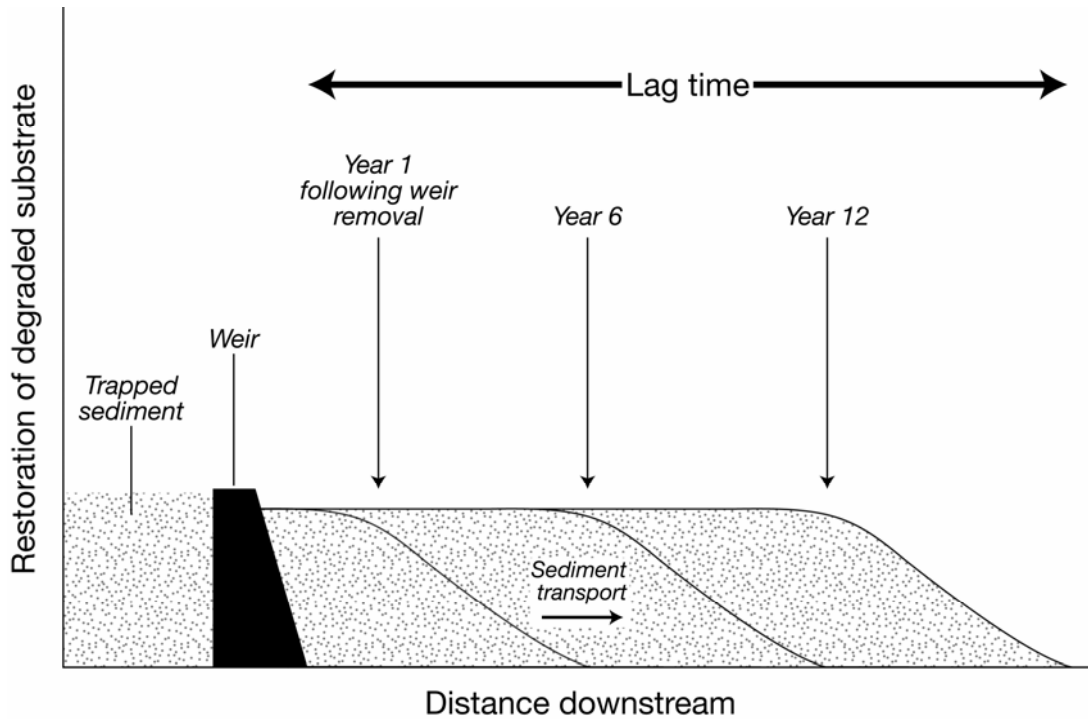


Figure 1. A conceptual model of how timescale of benefit varies with distance, due to transit time of the sediment wave, following weir removal

II. METHODS

3. Phased methodology

The project methodology consisted of the following phases:

Phase I. Identification of key organisations and individual players

Phase I consisted of identifying key organisations and individual players who are or might wish to promote or deliver river restoration in Scotland, either by having a requirement for a strategic view of catchment scale river restoration or by potentially leading a field based project. This first step was done in consultation with senior staff within SEPA. This was followed by networking in the first instance through SEPA's river basin planning co-ordinators in an attempt to identify all individuals who we should consult. Appendix 2 shows all the organisations and individuals identified and contacted.

Phase II. Production of a standard questionnaire, establishing contacts and assessing potential respondees

A standard set of questions was produced to be used at the interviews and approved by SEPA. The complete standard questionnaire can be found in appendix 3; this was divided into the following 6 sections:

- *Understanding of river restoration:* Comprising two questions on current knowledge and approach to river restoration.
- *Organisation and its river restoration approach:* a total of 9 questions regarding organisational approach and commitment to river restoration.
- *Specific restoration project characteristics:* comprising 38 questions on characteristics of specific river restoration initiatives.

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- *General views on river restoration in Scotland:* opinions on strategies, approaches and the current situation regarding river restoration at the catchment scale in Scotland were sought in this section through 4 key questions.
- *River restoration drivers:* three general questions regarding general views of drivers for river restoration in Scotland were asked, together with a total of 5 questions regarding opinions on benefits and roles of a specific chosen driver.

A first list of potential contacts was given by SEPA and this was further expanded as the project evolved.

Phase III. Data collection

Interviews were conducted from 19th February to 7th May 2008. They were undertaken over the phone or via video conference, “face to face” or via email dialogue. The time duration of each interview was from 20 minutes up to 3 hours, depending on the nature of the discussions. The average duration was 1h 25 minutes.

Not all respondents were asked all the questions, this depending on their background, specific area of knowledge or position in key organisations. All of the interviewees were also given the opportunity to add any extra comment to the interview.

Appendix 4 provides information about dates, duration and type of interviews as well as number of sections completed by the respondents.

Phase IV. Data collation and processing

Once the information was gathered, two sorts of information were collated and processed:

- *River restoration initiatives database:* A database was compiled and processed within Excel containing a list of broad river restoration initiatives reported by the interviewees. The database was organised in terms of respondent’s answers to a number of questions and concepts put to them. A number of river restoration

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projects became apparent independent of these interviews and details on these were also recorded in the database. Due to the few strategically based catchment scale initiatives, large reach scale river restoration projects were incorporated in our database. The database is not exhaustive and nor could it ever be given poor reporting of many projects, but it has been quality controlled and is by far the best database available for Scotland given that no historic recording of restoration projects at the national scale has taken place.

- Organisational and individual opinions on river restoration at the catchment scale - understanding its current situation and drivers in Scotland.

III. RESULTS

4. Results of the consultation process

4.1. Response rate

A total of 107 individuals and 39 organisations were contacted. Eighty two individuals responded to that first contact, representing a total of 37 of the organisations. Finally, information from of a total of 51 individuals and 26 organisations were gathered via interview. Below, Figure 2 and Table 3 illustrate and provide information on the response to the process by classified groups of organisations.

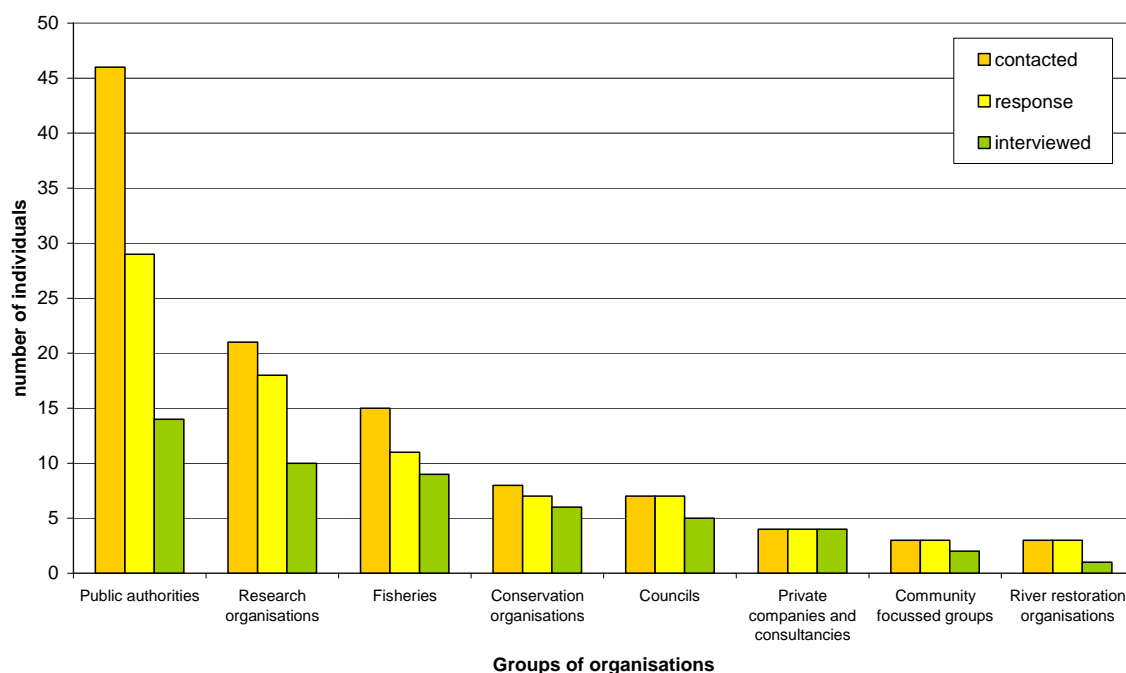


Figure 2. Response to the process by groups of organisations.

The complete list and details of the response process can be found in Appendix 3.

Different individuals were asked different questions from the standard questionnaire. The data has been processed in a way to safeguard anonymity where individuals were concerned about giving personal views or when they were not speaking officially on

behalf of their organisation. The full list of responses gathered from each individual questioned is not presented in the current report.

Table 3. List of organisations classified by groups and their number of individuals contacted, who responded and finally interviewed.

Organisation	Classification group	Individuals contacted	Individuals response	Individuals interviewed
Dee Catchment Management Plan Tweed Forum Ythan Project	Community focussed Groups	3	3	2
RSPB Scottish Wildlife Trust WWF	Conservationist organisations	8	7	6
Aberdeenshire Council Argyll & Bute Council Clackmannanshire Council Fife Council Scottish Borders council	Councils	7	7	5
Annan Distric Salmon Fishery Board Argyll Fisheries Trust Association of Salmon Fishery Boards Atlantic Salmon Trust Ayrshire Rivers Trust Galloway Fisheries Trust Locharber Fisheries Trust RAFTS Scottish Fisheries Coordination Centre Spey Fishery Board Research Office The River Dee Tweed Foundation Wester Ross Fisheries Trust	Fisheries	15	11	9
Mountain environments Scottish & Southern Energy Scottish Water	Private companies and consultancies	4	4	4
Scottish Government SEPA SNH	Public authorities	46	29	14
CEH Centre for Mountain Studies. Perth college - UHI Forest Research McCaulay Institute Scottish Agricultural College University of Aberdeen University of Dundee University of Stirling	Research	21	18	10
RRC	River Restoration focussed organisations	3	3	1
Totals		107	82	51

4.2. Interviewees key areas of involvement and interest

Interviewees were instructed that the individual responses would be confidential and they were given the opportunity to make their responses either on behalf of their organisation or as from their own point of view.

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Obviously, the organisations and individuals involved in river restoration activity approach the area from a range of different points of view and areas of expertise. For the purposes of this investigation, the interviewees from a range of organisations were considered as individuals and responses broadly categorised based on their own key areas of involvement and expertise in river restoration activities (Figure 3).

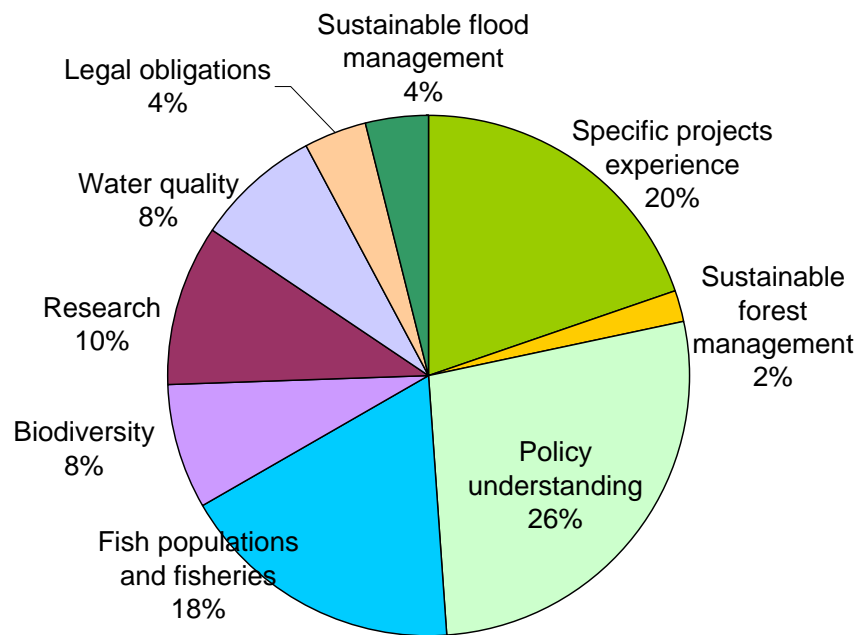


Figure 3. Interviewees key areas of involvement and interest in river restoration activity.

Figure 4 demonstrates and to an extent supports the data presented in Figure 2 in that it shows a dominance of people working in fisheries followed by biodiversity and water quality. The graph also shows a significant number of individuals in the policy arena. Low numbers of individuals working in the area of sustainable flood management is noted.

4.3. Understanding of River Restoration and the catchment scale approach

Thirty nine people were asked about their understanding of river restoration. Eighty two percent describe river restoration in similar terms as the CRESS definition given in

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page 5. Further detail and linkage was given in the following areas when addressing general questioning about river restoration:

- (i) WFD: 13% of the respondents directly linked river restoration to WFD requirements.
- (ii) Fluvial processes and ecosystem function: 23% of the respondents stressed the importance of process and function in relation to restoration actions.
- (iii) Single focus: 13% of the respondents linked their understanding of river restoration with a single improvement (e.g. fish populations or water quality improvement)
- (iv) Historical perspectives: 39% of the respondents considered river restoration primarily as a reduction of historical human activities (e.g. engineering works) and renaturalisation of river systems.
- (v) Socio-economic constraints: 10% of the respondents highlighted the constraints of human development when undertaking restoration.
- (vi) A wider scale and integrated approach: 13% of the respondents mentioned the importance of the scale and the integrated approach when defining river restoration.
- (vii) Education: 3% stressed an important requirement to link environmental education with river restoration activity (particularly when trying to undertake the activity at the catchment scale).

A total of 14 individuals were asked about their understanding of the catchment scale approach to river restoration. Their responses have been analysed against the CRESS definition of “catchment scale” on page 5. Sixty four percent of the respondents acknowledged it was about taking in account all the environmental processes present within the catchment. Responders provided the following additional information regarding the definition of a catchment scale approach:

- (i) Appreciation of processes: when defining river restoration at the catchment scale approach, 29% recognised their activities, although not catchment wide could influence catchment wide processes (i.e. including an appreciation of the importance of location in the catchment).

- (ii) Identification and prioritisation: 57% pointed out the importance of understanding all the issues within the catchment and the need to prioritise accordingly.
- (iii) Broad-scale benefits: 43% of the respondents considered this approach was focussed more on the sum of the parts rather than the individual activities themselves.
- (iv) Temporal scale: only 7% of respondents explicitly mentioned the importance of the timescale over which environmental assessment is undertaken as a full indication of the benefit a river restoration activity creates.
- (v) Responsibility: 3% of respondents considered that the responsibility for catchment scale restoration lay entirely with statutory organisations and it was their responsibility to coordinate and communicate with smaller/local organisations.

5. Views on river restoration in Scotland

5.1. Strengths and weaknesses of current situation

Figures 4 and 5 summarise what respondents believed were the strengths and weaknesses of the Scottish national picture that need to be taken into account when creating a national strategy for river restoration.

Ten distinctive strengths were identified (Figure 4). The main strength of the current situation for river restoration in Scotland was identified as the existing legislative framework. Included in legislative framework, respondents specifically mentioned WFD, River Basin Management Planning process and the Floods Directive. Education, awareness and enthusiasm, together with existing knowledge were considered important strengths.

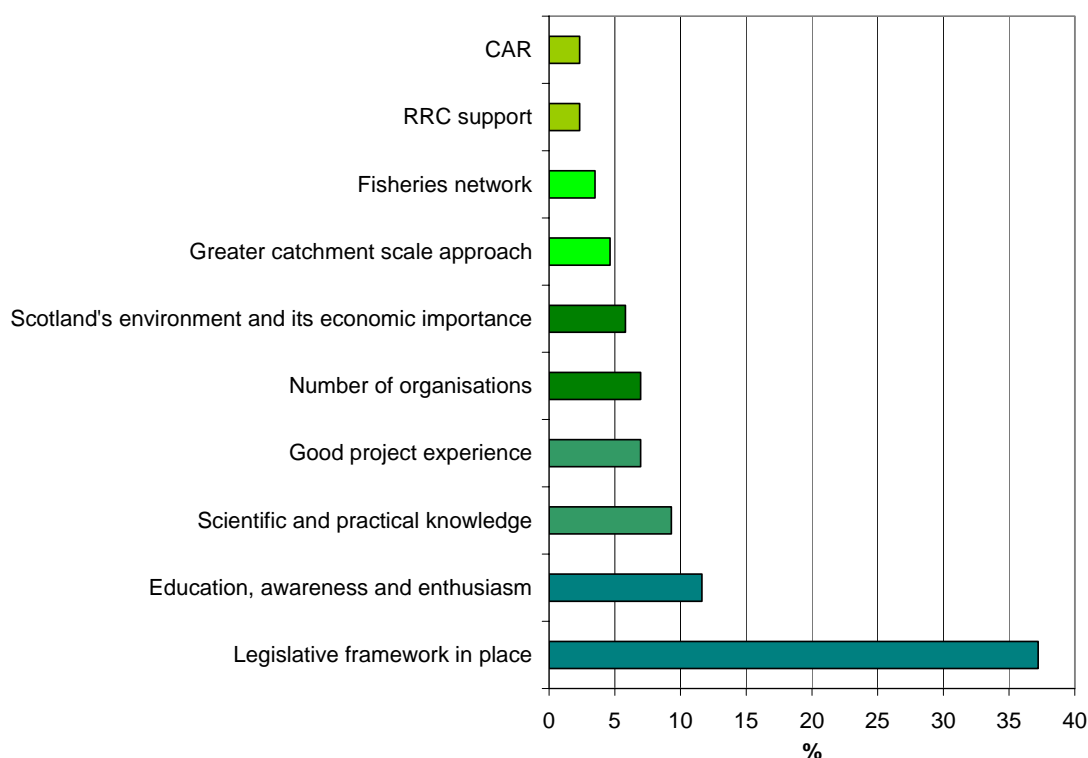


Figure 4. List of main strengths identified in the Scottish national picture for promoting river restoration “at a strategic level”.

A lack of coherent strategy at the national scale was identified as the major weakness (Figure 5). It is interesting to note that although the existence of a legislative framework was most commonly considered a strength, a lack of a coherent strategy (presumably related to the implementation of the legislation) was considered a major weakness. Delivery of a strategy and a lack of clarity, devolved roles and procedure were seen as holding individuals' own initiatives back. Sufficient funding was also highlighted as an important weakness, with respondents pointing out that no national funding mechanism was available to give incentive to developing large scale schemes. Regional budgets, lacking direction from national priorities, were seen as a main funding source to undertake river restoration actions. The large number of organisations involved in river restoration although identified as a strength by some, was also seen as a significant weakness by others, as detracting from National priorities.

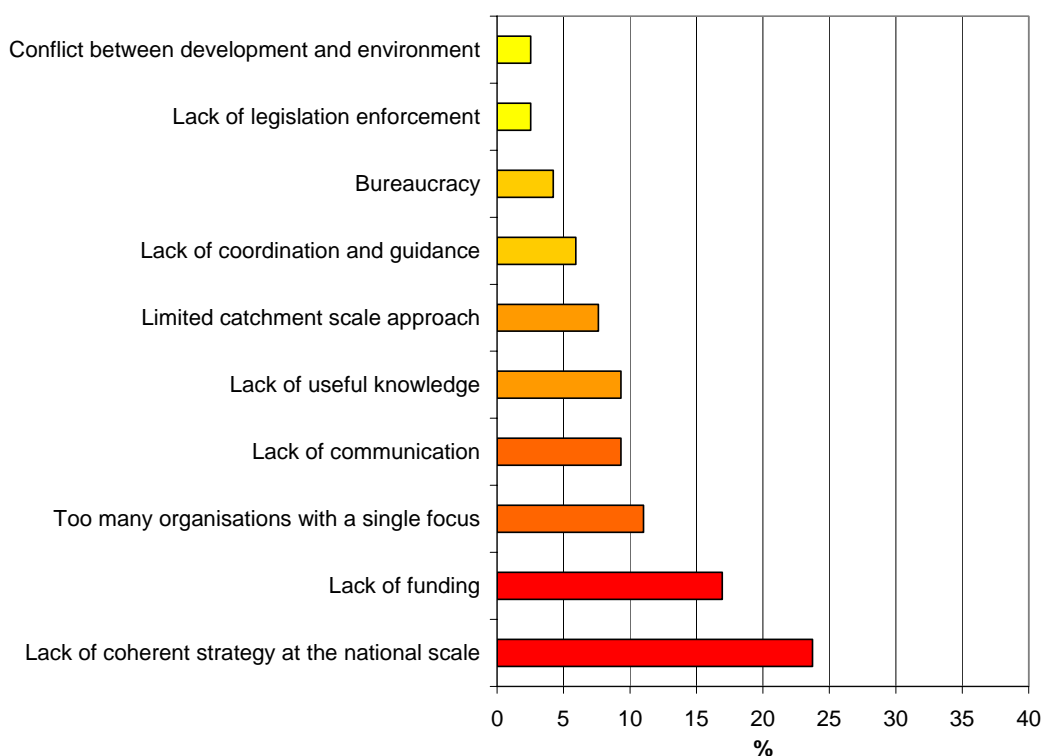


Figure 5. List of main weaknesses identified in the Scottish national picture for promoting river restoration “at a strategic level”.

5.2. Drivers for river restoration in Scotland

We consider a driver to be the current mechanism that enables certain river restoration activities to be prioritised and advanced at that time. For the purpose of this report we have considered the followings as drivers:

- Water quality improvement
- Fish population enhancement and fisheries viability
- Sustainable flood management
- Climate change concerns
- Hydromorphology objectives
- Biodiversity objectives
- Achievement of WFD objectives
- Landscape objectives
- Socio-economic objectives

5.2.1. Primary driver for river restoration at the catchment scale in Scotland

A total of 34 respondents were asked (as an open question) what would be the real key driver for river restoration at the catchment scale to happen. Only 6 of the 9 drivers considered for the purpose of this report were mentioned (Figure 6). The main driver for river restoration in Scotland was overwhelmingly (47%) viewed as being the achievement of WFD objectives. Sustainable flood management was a main driver by 24% of the respondents; they specifically referred to flooding concerns and the Floods Directive. National governmental priorities and the new Rural Development programs (grouped as socio-economics) were highlighted as well, as potentially able to push river restoration. Biodiversity objectives were considered a main driver by 9% of the respondents, who in all cases linked it to Habitats and Species Directives objectives. Fish and fisheries viability and climate change concerns were also mentioned.

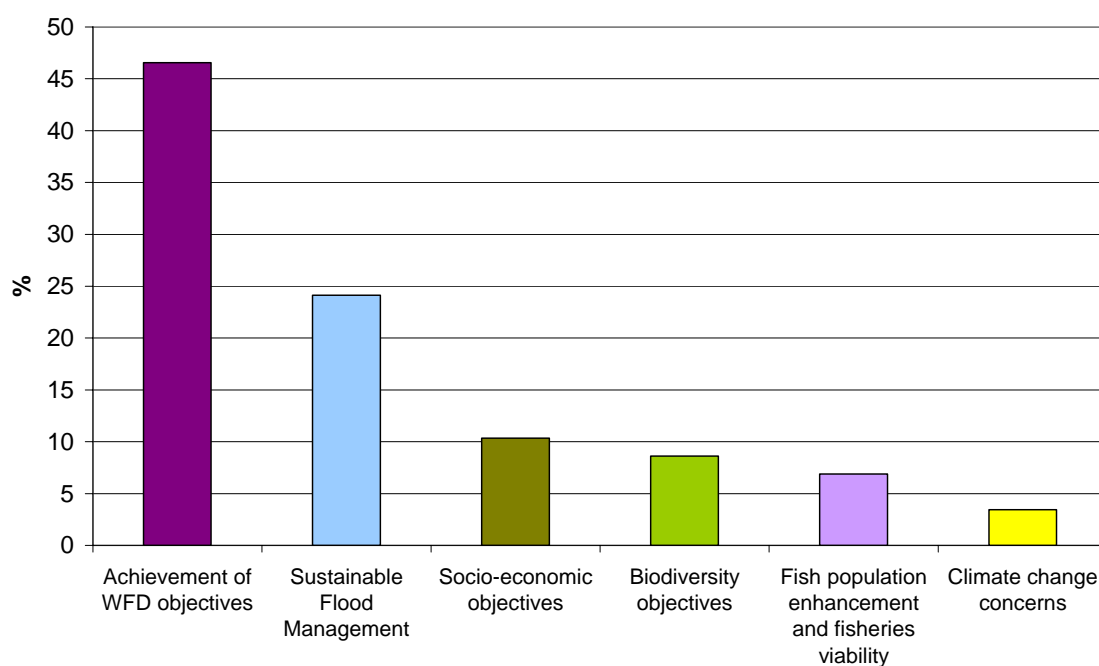


Figure 6. Opinions on drivers considered as the most likely to achieve significant river restoration activities at the catchment scale in Scotland.

5.2.2. Drivers that can achieve multiple secondary benefits

We consider secondary benefits as the achievements that a river restoration activity can undertake as a complement to its main driver. We consider that secondary benefits can be achieved in the following areas:

- Water quality
- Fish populations and fisheries viability
- Sustainable flood management
- Climate change adaptation/mitigation
- Hydromorphology
- Biodiversity
- WFD objectives
- Landscape
- Socio-economics

Respondents were asked to identify the key drivers that could bring about more multiple secondary benefits from a list of the 9 drivers (see section 5.2) and 9 areas of secondary benefits considered for the purpose of the report. They were asked to state their order of preference. Figure 7 illustrates that achieving WFD objectives was considered by 28% of the respondents to be the driver that has the potential to achieve more multiple benefits. Sustainable Flood Management (18%) and hydromorphology (15%) were also considered to achieve more multiple benefits.

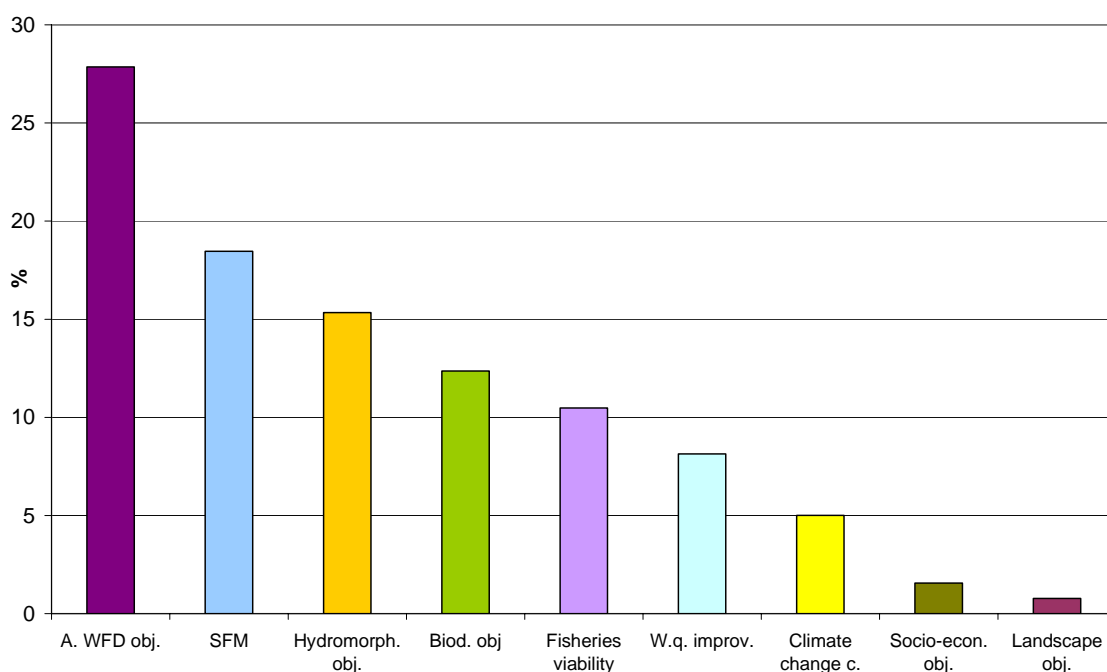


Figure 7. Opinions on drivers considered as the most likely to achieve a large range of secondary benefits when undertaking river restoration activities.

Respondents were also asked to rate the benefits that river restoration could bring if actions on the ground were undertaken under a specific driver. They were given the choice to focus on a single driver preferably representing their background and area of interest. Information on the following identified drivers was gathered: water quality improvement and hydromorphology objectives (represented by 2 respondents each); fish and fisheries viability (represented by 7 respondents); biodiversity objectives (represented by 3 respondents); sustainable flood management and achievement of WFD objectives (represented by 4 and 8 respondents). Only 6 out of the 9 drivers identified was gathered, as none of the respondents provided information on socio-economics, climate change concerns or landscape drivers. Based on respondent's opinions, Table 4 shows that water quality improvement was considered to provide high benefits to the largest number of areas; followed by biodiversity objectives, hydromorphology objectives and the achievement of WFD objectives. Respondents identified hydromorphology objectives as providing a low level of benefit for the areas of water quality and climate change mitigation/adaptation. In terms of the areas that could benefit better from any activity, respondents identified hydromorphology and WFD objectives.

Table 4. Level of potential secondary benefits that river restoration can bring to different areas when activities are undertaken under 6 recognised drivers (climate change concerns, landscape and socio-economics are not represented).

		Potential areas of secondary benefit								
		Water quality	Hydromorphology	Fish populations and fisheries	Biodiversity	Sustainable Flood Management	WFD objectives	Climate change mitigation	Landscape	Socio-economics
Drivers	Water quality improvement	x	High-medium	High-medium	High-medium	High-medium	High-medium	High-medium	High-medium	High-medium
	Hydromorphology objectives	Low	x	High-medium	High-medium	High-medium	High-medium	Low	Medium-low	Medium-low
	Fish and fisheries viability	High-medium	High-medium	x	High-medium	High-medium	High-medium	High-medium	High-medium	High-medium
	Biodiversity objectives	High-medium	High-medium	High-medium	x	High-medium	High-medium	High-medium	High-medium	High-medium
	Sustainable Flood Management	High-medium	High-medium	High-medium	High-medium	x	High-medium	High-medium	High-medium	High-medium
	Achievement of WFD obj.	High-medium	High-medium	High-medium	High-medium	High-medium	x	Low	High-medium	High-medium

High
High-medium
Medium
Medium-low
Low
x not applicable

6. Organisations and their river restoration approach

A total of 26 organisations were interviewed from a broad variety of backgrounds but having some kind of involvement, and being directly or indirectly linked to river restoration activities in Scotland.

6.1. Organisational roles and commitment

Despite all organisations having some kind of involvement in river restoration, when asked about their specific commitment to river restoration only 54% were recognised to undertake, support or promote river restoration activities (see Table 5). From these, many organisations have a commitment to undertake river restoration actions only at a local level and limited to their own resources (e.g. fisheries groups) or specific area of interest (e.g. SAC). Eleven organisations (42%) despite not having a specific commitment to undertake river restoration activities recognised a commitment for broader environmental objectives (e.g. Councils). The Scottish Government as yet does not have a specific commitment to river restoration, but they stressed that it is working towards developing a national strategy.

In terms of including river restoration terms in the organisation's mission statements, only the River Restoration Centre does so and none of the other organisations specifically include it. In that sense, some of the major organisations may include a commitment to river restoration activities in their strategy, but only as part of broader environmental objectives.

Table 5. Organisations and their level of involvement and commitment regarding river restoration

Organisations	Involvement regarding river restoration		Specific commitment to river restoration	River restoration as part of broader environmental objectives
	Scale	Area of interest		
Aberdeenshire Council	local	sustainable development		x
Annan District Salmon Fishery Board	local	fish populations and fisheries	x	
Argyll Fisheries Trust	local	fish populations and fisheries	x	
Association of Salmon Fishery Boards (ASFB)	national	fish populations and fisheries		
Atlantic Salmon Trust	national	fish populations and fisheries		
Ayrshire Rivers Trust	local	fish populations and fisheries	x	
Centre for Ecology and Hydrology	national	research		
Clackmannanshire Council	local	sustainable development	x	
Dee Catchment Management Plan group	catchment	catchment focussed management	x	x
Forestry Research	national	sustainable forest management		x
Macaulay Land Use Research Institute (MLURI)	national	research		
Rivers and Fisheries Trusts Scotland (RAFTS)	national	fish populations and fisheries		
The River Restoration Centre	national	catchment focussed management	x	x
Royal Society for the Protection of Birds	local	biodiversity		x
Scottish Agricultural College	national	water quality management		x
Scottish Government	national	sustainable development		x
Scottish Water	local	legal obligations		x
Scottish Environment Protection Agency (SEPA)	national	broad environmental objectives	x	x
Scottish Fisheries Coordination Centre	national	fish populations and fisheries		
Scottish Natural Heritage	national	broad environmental objectives		x
Scottish and Southern Energy	local	legal obligations		x
Scottish Wildlife Trust	local	biodiversity	x	x
The River Dee	local	fish populations and fisheries	x	
Tweed Forum	catchment	catchment focussed management	x	x
Tripartite Working Group	local	fish populations and fisheries	x	
World Wide Fund for Nature (WWF)	national	broad environmental objectives		x

In terms of the organisations' roles regarding river restoration, 88% viewed themselves as an important player in the river restoration context. For example WWF (Scotland) believe they are exerting a strong influence on policy change at the national level, while others recognise their role at a local level (fisheries, councils). The organisations not involved with on the ground "works" see their role as advisory (SEPA, RRC), supportive (SNH, RAFTS), or to generate the basis for understanding (MLURI, SAC, CEH).

Thirty one percent of organisational responses indicated that their level of involvement and areas of activity in river restoration could be increased if funding was available, and 27% of the organisations stated that increased involvement would ideally be partnership-based.

Ninety two percent believed that it is SEPA's responsibility to coordinate river restoration activities in Scotland. The consensus was also that the Scottish Government should be developing the mechanism, tools and funding to support river restoration over a range of scale, whilst SEPA should be responsible to deliver and implement it.

6.2. Organisation motives

We considered organisation motives to be the specific reasons why an organisation would consider undertaking certain river restoration activities. An organisation's motives might be less fluid or responsive to current needs or interests than drivers, as defined in section 5.2. A total of 6 main organisational motives were identified for the purpose of this report:

- Fish population enhancement and fisheries viability
- Broad environmental improvements
- Understanding to influence policy
- Sustainable development
- Catchment focussed management
- Meeting of legal obligations

* Sustainable development and meeting of legal obligations can be grouped as socio-economics, but have been kept separate for the purpose of this report.

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Fish population enhancements and fisheries viability were identified by 31% of the organisations as the main organisations motives. Broad environmental objectives were identified with fish population enhancement and fisheries viability, representing 31% of the organisations, and general environmental improvement making up 50% of the total (Figure 8).

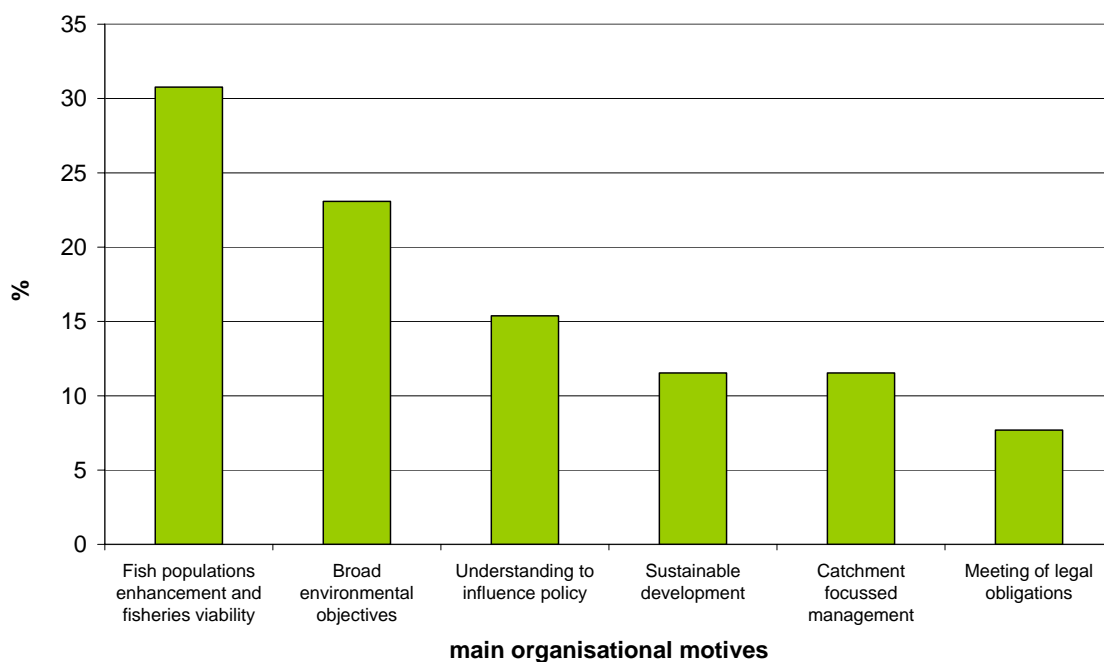


Figure 8. Primary motives behind organisations strategy.*Sustainable development relates to both local and national initiatives

6.3. Synergies with organisations' main strategy

We consider synergies as secondary benefits (as defined in section 5.3) and organisations' main strategy as organisational motives (as described in section 6.2.).

Respondents were asked to identify synergies additional to their organisations main remit. The results can be seen in Figure 10. For example, organisations where their main motive was fish population enhancement could often see a clear secondary benefit in the area of biodiversity and to a lesser extent landscape and WFD objectives. A number of other synergies are apparent. It is interesting to note that

socio-economics and biodiversity have been mentioned across the board as a secondary benefit. Water quality has also been mentioned considerably.

Organisations with broad environmental objectives as a main motivation identified a higher percentage of total secondary benefits (27%), whilst those organisations with a main motivation to meet legal obligations identified only 8% of secondary benefits.

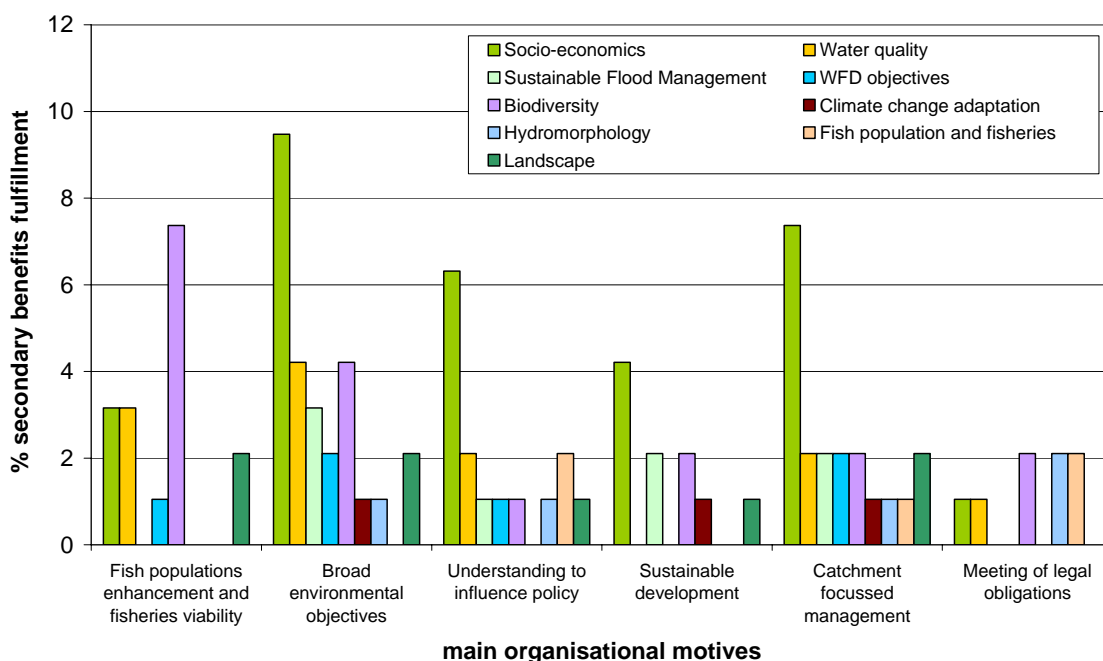


Figure 9. Key identified synergies between main organisational motives and secondary benefits.

All organisations appreciated that targeted river restoration can have benefits beyond the scope of the works and there are synergies within the use of river restoration as a tool for bringing about environmental improvement (Figure 9). The fisheries organisations generally believed that Atlantic Salmon is a good environmental quality indicator. However some respondents had concerns over an over-reliance on Atlantic Salmon abundance as an indicator of good ecosystem health. Two respondents stated that the status of the Atlantis Salmon should not be at the expense of other species (e.g. the beaver). More generally, respondents saw synergies between river restoration, whatever the driver, and biodiversity. Another respondent also specifically mentioned that river restoration in the long-term could bring about benefits to farmers by reducing environmental problems.

6.4. Organisational protocols and advisory literature

A total of four organisations were identified by practitioners as providing guidelines for river restoration or monitoring that could be used by others. The organisations cited were RRC, Forestry Commission, SEPA and Scottish Fisheries Co-ordination Centre. Almost half (46%) of the organisations recognised the usefulness of obtaining input from a variety of sources (individual experience, expert opinion and existing published guidelines). Although guidelines were mentioned, they were not seen as being the main supporting mechanism for activities, partly due to a lack of step by step guidance.

The respondents mentioned the following in relation to providing good sources of information:

- The RRC - “Manual of River Restoration Techniques”
- SEPA - “Managing River Habitats for Fisheries”; “Ponds, Pools and Lochans”
- SEPA - Guidelines in preparation to support CAR
- Forestry Commission – “Forestry and Water Guidelines” (2003)
- Scottish Fisheries Co-ordination Centre – Protocols for monitoring

7. River Restoration initiatives in Scotland

Current knowledge of information on river restoration projects was gathered and compiled in a database (Appendix 5). These included reach-scale projects to catchments scale initiatives that have been undertaken or planned across Scotland between 1990 and 2008.

7.1. Number and geographical distribution of river restoration projects

Information on a total of 141 projects was gathered including different types of initiatives across 9 different SEPA areas as defined by the River Basin Management Planning process (Figure 10). A wide distribution is present, with only a few areas

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under represented. The river restoration initiatives were distributed into a total of 63 catchments, with 22 of the projects occurring in the Tweed catchment, 15 in the Dee (North East), 12 initiatives in the Tay and 11 in the Forth catchment.

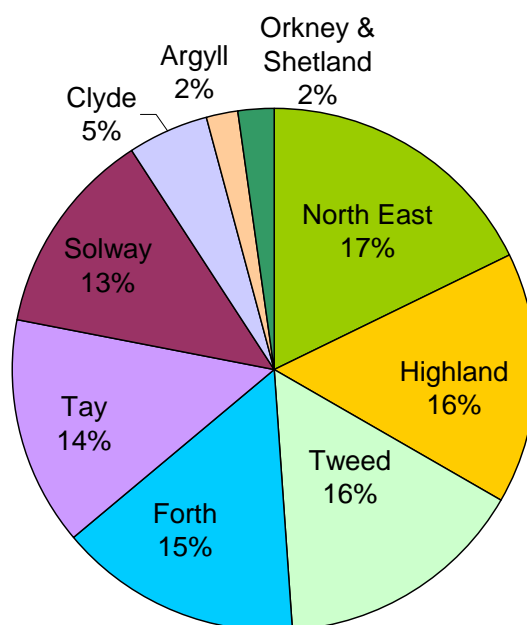


Figure 10. Percentage of river restoration projects by SEPA areas in Scotland:

7.2. Drivers for river restoration initiatives

Although the naming was different in some occasions, in order to establish a standardised terminology, the same 9 drivers as the ones listed in section 5.2. will be used for the analysis of this section.

In terms of the key main drivers of river restoration, fish populations and fisheries is easily dominant (35%), followed by biodiversity objectives (related to achieve most of Habitats and Species Directives objectives in half of the cases). Hydromorphology objectives only represent 11% of projects although works will have been undertaken in relation to biodiversity and fisheries driven projects (see Figure 12). Of all projects, 36% were documented as having multiple drivers (combination of several drivers), but for the purpose of this analysis, Figure 11 only considers the main driver for each

initiative. Also, only main drivers will be considered for the following sections of the report.

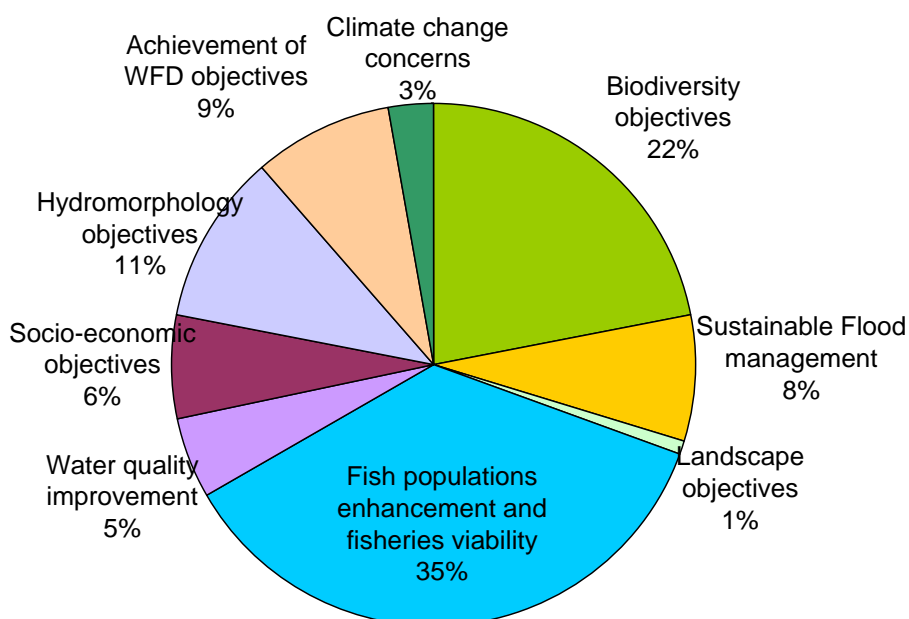


Figure 11. Percentage of river restoration projects undertaken under each main driver

7.3. Spatial scale of river restoration initiatives

For the purpose of this report, the following spatial scales have been considered and defined:

- *reach scale initiatives*: focussed on a length of river of no more than 25 channel widths in length, with little impact on adjacent reaches.
- *sub-catchment initiatives*: work undertaken on catchments containing only 1st and 2nd order tributaries and often focussed on a single pressure.
- *catchment initiatives*: attempting to improve the status of large river systems draining multiple land uses and having multiple pressures.

- *multiple catchment initiatives*: implementation of a range of measures that are applicable to the pressures acting on a number of catchments within a specific region.

From all projects, a total of 68 were reach scale projects, 40 sub catchment scale, 30 catchment scale, 3 multiple sub-catchments. Figure 13 below shows their distribution by main drivers. Only water quality currently appears to consider restoration at the catchment scale. As in other areas however there are problems in definition as to whether a given works might constitute a reach scale or catchment scale project (e.g. weir removal). The key question is not the scale of the works but whether the works bring catchment wide benefit.

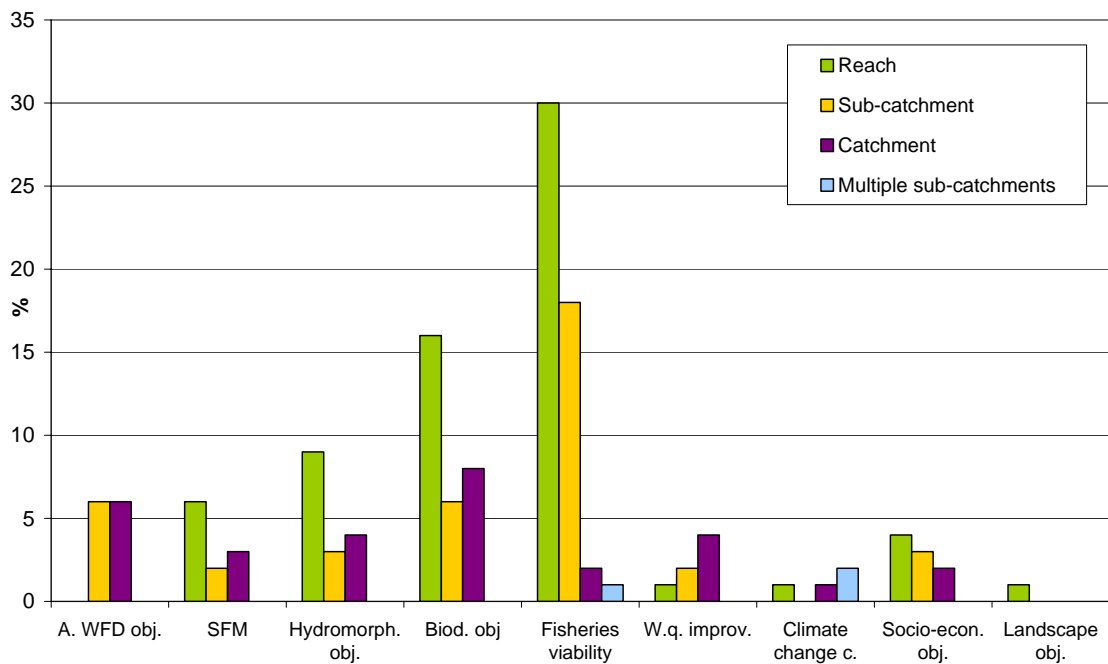


Figure 12. Distribution of river restoration projects at different scales by driver.

7.4. Temporal scale of river restoration initiatives

Only 101 of the projects were dated, those were analysed to provide the following information illustrated in Figures 14 and 15.

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Figure 14 shows the cumulative increase in river restoration projects using 1990 as a starting date. The graph shows a rapid increase in the number of projects post 1998 principally at the reach and sub-catchment scale. Post 1999 there has also been an increase in catchment scale initiatives. More strategic approaches to multiple catchments are only being listed from 2008.

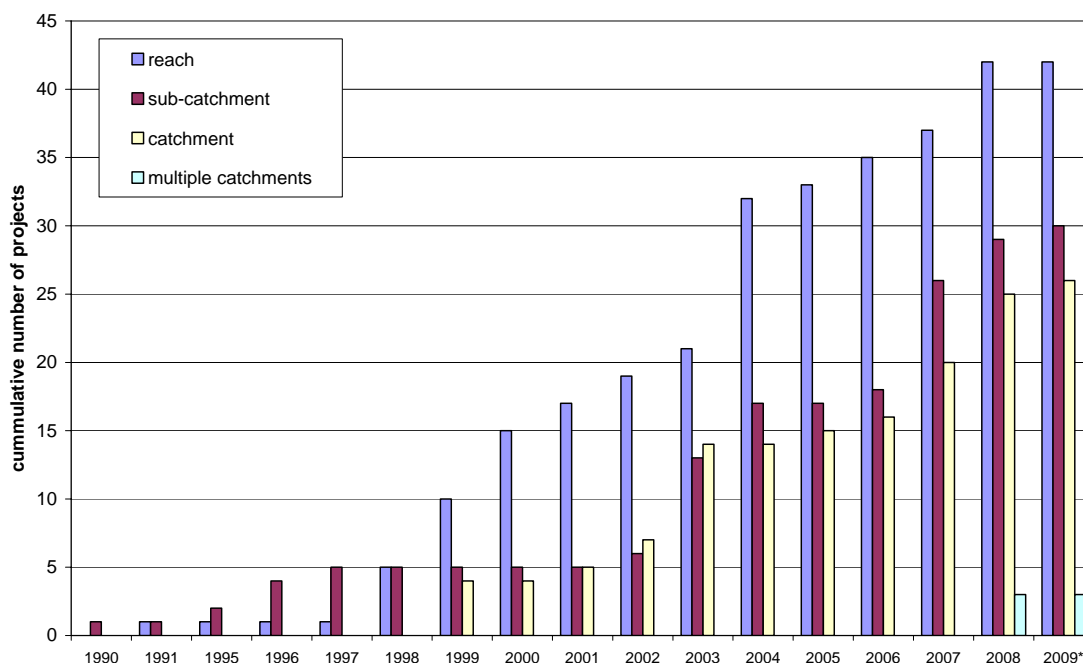


Figure 13. Cumulative number of projects at different scales along time. *(planned for 2009 onwards).

In terms of the drivers of projects (see Figure 15 below), in the 20th century river restoration was dominated by fisheries but with the number of new projects apparently levelling off. Biodiversity led projects have increased rapidly in number post 2000 as has the diversity of drivers.

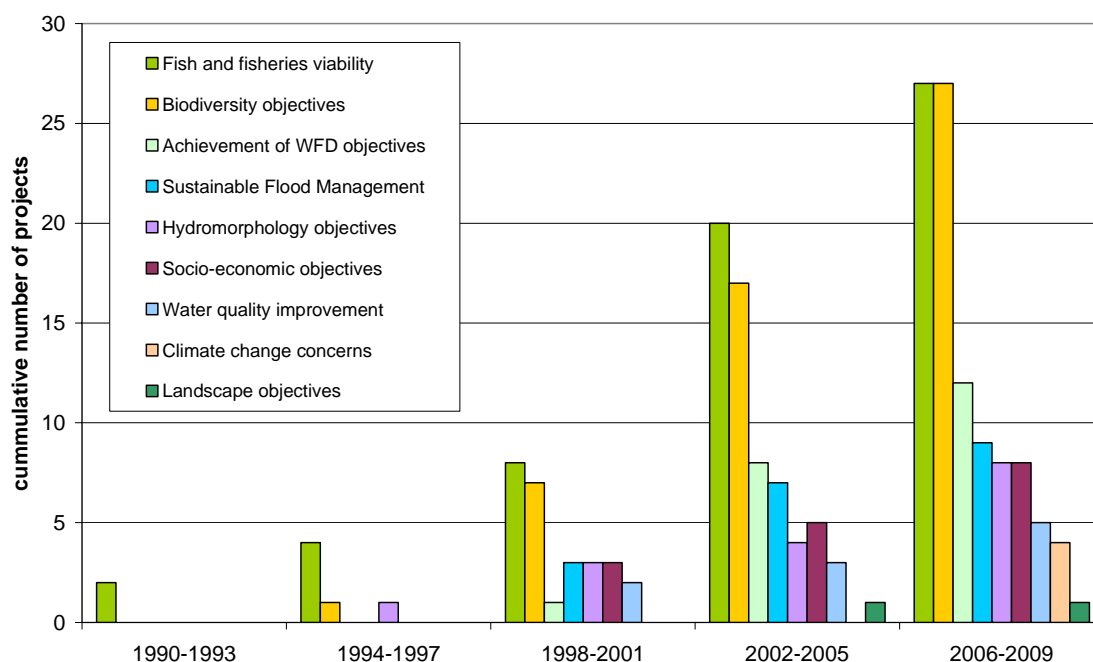


Figure 14. Cumulative number of restoration projects under different main drivers (multiple drivers accounted as main driver) along time

7.5. Activities undertaken on restoration projects

A total of 128 of the projects provided specific information about activities undertaken. Below, Table 6 shows a ranked grouped-list of all these activities. Bankside habitat improvement type activities were the most frequently undertaken (28%), followed by instream habitat works (21%) and monitoring and research type activities.

Table 6. Grouped-list of activities undertaken on river restoration projects in Scotland

Strategies for river restoration at the catchment scale in Scotland: current status and opportunities

Activities	Group	%
Native riparian woodland planting and management	Bankside habitat improvement	28
Riparian fencing		
Natural bank protection		
Buffer strips		
Access improvement / amenity area creation		
Instream habitat improvement	Instream habitat works	21
Engineering removal and control		
Actions for fish pass improvement		
Desilting (i.e. siltation traps)		
Stream crossings best practice actions		
Water quality monitoring	Monitoring and research activities	10
Targeted species monitoring		
Habitat surveys and hydrological monitoring		
Flood risk studies		
Research on agricultural land use effects on rivers		
Best management practices on forestry	Catchment land-use change	9
Conifer removal		
Catchment land use change		
Drainage systems blockage		
Wetland creation	New habitat creation	9
Open water creation		
Targeted groups awareness raising and education	Education and awareness raising	8
Education and community involvement actions		
Best management practices on agriculture		
Invasive plant species removal and monitoring	Invasive species management	4
Non-native animal species management		
Remeandering	Physical processes restoration	3
Floodplain connection		
Meander reconnection		
Actions yet to define	Actions yet to define	2
Strategic planning actions	Strategic planning actions	2
Fish restocking	Fish restocking	2
SUDS and reed treatment	SUDS and reed treatment	2

In order to appreciate the scale of these activities, the top 6 activities were analysed against the scale of the restoration project (Figure 15). Bankside habitat improvement and instream habitat works are the most frequently undertaken activities across all scales. However research and development and monitoring activities have a very low representation in the reach-scale projects, but are seen to be incorporated more in sub-catchment and catchment type activities.

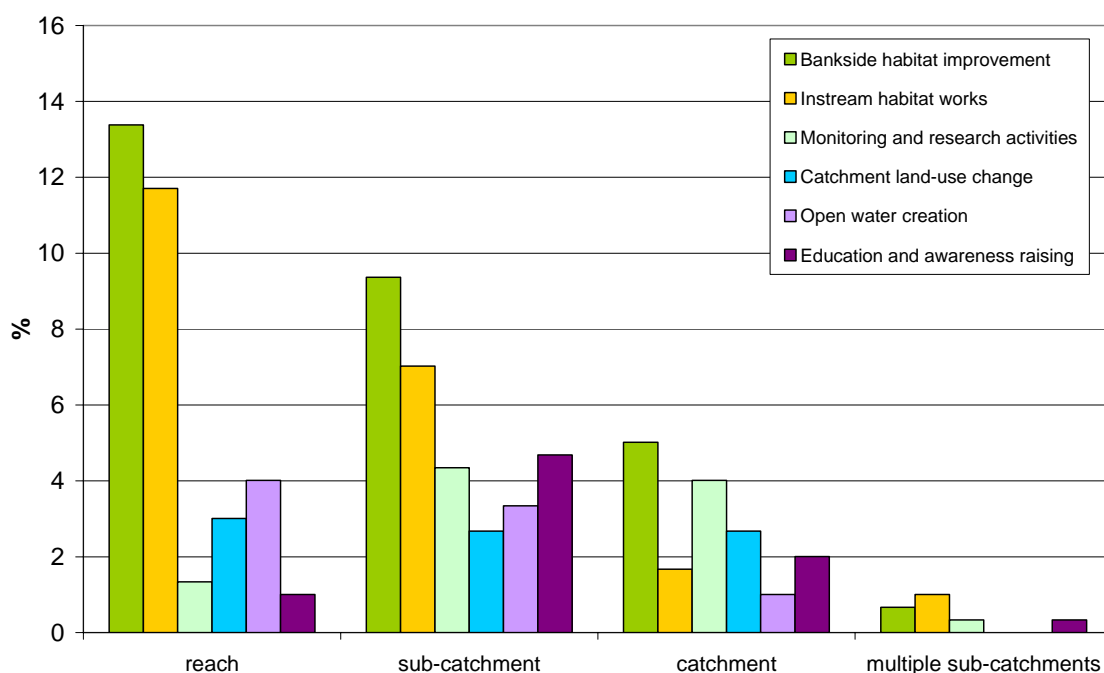


Figure 15. Top six grouped-activities undertaken at different scales

In terms of river restoration activity in relation to drivers, the top 6 grouped-activities have been analysed against their main drivers (Figure 17). Bankside habitat improvement activities are dominant when the restoration activities have been undertaken for fisheries drivers; and to a lesser extent for biodiversity and sustainable flood management drivers. Bankside habitat improvement especially includes relatively low cost actions such as riparian fencing and native riparian planting.

In contrast, for water quality improvements, targeting awareness of impacts of activities and environmental education dominate the approach, together with the use of buffers. The possible synergy between buffer creation and riparian planting benefiting fisheries, biodiversity and water quality and, possibly sustainable flood management is apparent here.

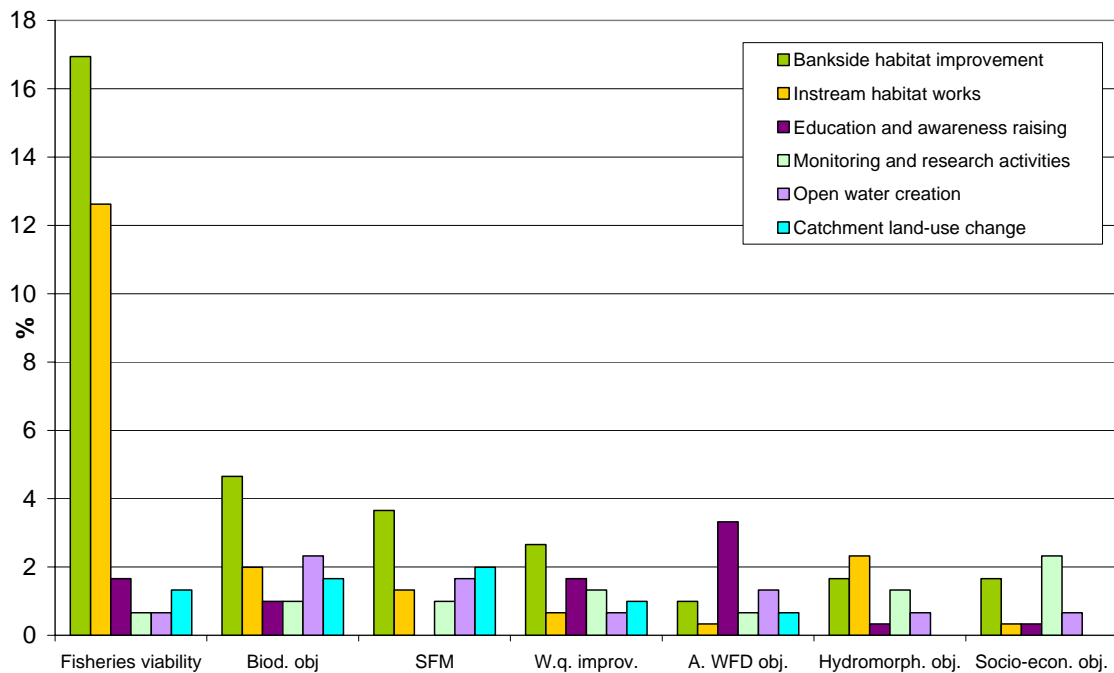


Figure 16. Top six grouped-activities undertaken under 7 of the 9 identified drivers (climate change concerns and landscape objectives have appeared to not be relevant for this analysis).

7.6. Organisations linked to river restoration initiatives in Scotland

A total of 59 organisations were identified as having led or currently leading river restoration projects (information regarding leading organisations available on 112 projects); Table 7 lists those organisations and gives information on the number of projects they led for different scales.

The main organisations leading any kind of river restoration initiatives are SNH, Galloway Fisheries Trust, MLURI, SEPA, RSPB and WWF, representing half of the projects. However, when looking at the organisations leading catchment scale initiatives, SEPA and RSPB are no longer in the list, whilst Forestry Commission and Scottish Agricultural College have a fair representation.

Table 7. List of all leading organisations (out of 112 projects from the database) and the number of projects undertaken at different scales

Leading organisation name	number of projects by scale:					Total number of projects
	reach	sub-catchment	catchment	multiple sub-catchm.	multiple catchm.	
SNH	11	3	4		2	20
Galloway Fisheries Trust	4	5	1			10
Macaulay Institute		4	3			7
SEPA	5	1				6
RSPB	1	4				5
WWF	4		1			5
Scottish Wildlife Trust	4					4
Tweed Forum		3	1			4
Aberdeenshire Council	1	1	1			3
Clackmannanshire Council	2		1			3
Forestry Commission	1		2			3
Scottish Agricultural College		1	2			3
Scottish and Southern Energy		3				3
Community groups		2				2
Annan District Salmon Fisheries Board		1				1
Argyll & Bute Council			1			1
Auch Estate		1				1
Ayrhire Rivers Trust		1				1
Borders Forest Trust		1				1
Cairngorms Partnership			1			1
Carmmond Angling Club		1				1
Central Scotland Countryside Trust	1					1
Clackmannanshire Heritage Trust	1					1
Conon District Salmon Fishery Board	1					1
Edinburgh City Council	1					1
The Voluntary Initiative			1			1
Fife Council		1				1
FWAG			1			1
Glasgow City Council		1				1
Locharber Fisheries Trust	1					1
Mountain Environments			1			1
Perth & Kinross Council	1					1
Scottish Borders			1			1
Scottish Water	1					1
Slammanan Angling Club	1					1
SNIFFER					1	1
Spey Fishery Board	1					1
Tay Ghillies Association		1				1
The River Almond Forum			1			1
The River Dee				1		1
Tweed Foundation		1				1
UHI Millennium Institute	1					1
Ullapool Angling Club	1					1
West Lothian Council		1				1
Wester Ross fisheries Trust	1					1
Loch Lomond & The Trossachs National Park			1			1
Scottish Native Woods			1			1
Dee-Ken Catchment Management Plan group			1			1
Total	45	37	26	1	3	112

From all of these, a total of 78 projects (70%) were found to be undertaken under some kind of partnership. A total of 57 organisations had a participative role in these initiatives (including organisations that could have had a leading role in other initiatives). Table 8 gives information on the 10 organisations which most participated in any type of river restoration initiatives. The full list of participant organisations can be found in Appendix 6.

SEPA and SNH appear to be the organisations with most participation in river restoration initiatives (41% and 37% respectively). These are mainly sub-catchment scale initiatives, but also catchment scale ones. It is interesting to see that SEPA is one of the organisations who have most participated in river restoration projects, but has however led only a few very small projects.

Table 8. List of the top 10 organisations participating in river restoration initiatives organised by scale.

Participant organisation name (not leading)	number of projects by scale:					Total of projects participated
	reach	sub-catchment	catchment	multiple sub-catchm.	multiple catchm.	
SEPA	5	15	10	1	1	32
SNH	4	16	7	1	1	29
The River Restoration Centre	6	5	1			12
Farmers/land owners	2	2	5			9
Macaulay Institute		5	3		1	9
Association of Salmon Fishery Boards	5	3				8
Fisheries Research Services	5	3				8
Scottish Executive Environment and Rural Affairs Department	5	3				8
Scottish Water		6	2			8
Forestry Commission	2	3	2			7

7.7. Funding and costs of river restoration initiatives

Information about funding was gathered on 71 river restoration initiatives. As shown in Figure 18, the main sources of funding for those projects were the actual leading or participating organisations (44%). EU funding support, such as INTERREG and LIFE programs and European Rural Development Fund represent 26% of the funding sources for these projects.

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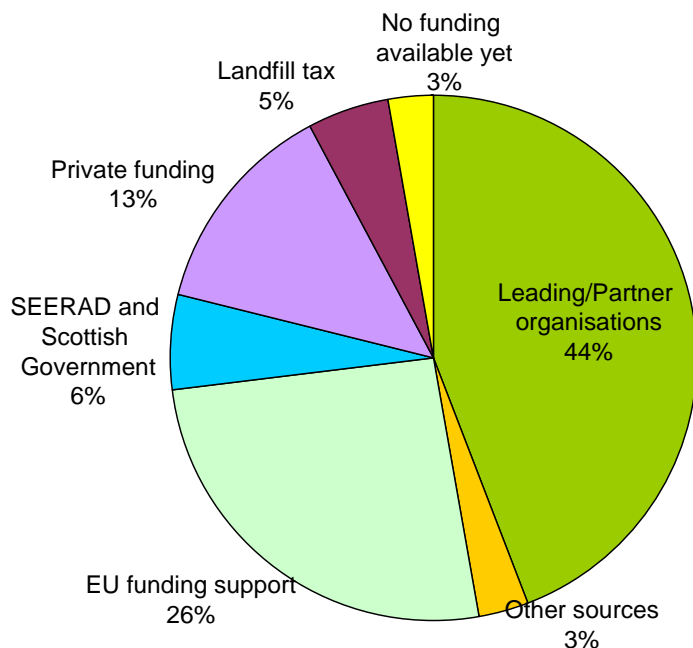


Figure 17. Distribution of the main funding sources for river restoration initiatives in Scotland

Information on cost was only gathered on 38 projects. Costs of river restoration initiatives varied between £3,600 (i.e. open water creation works) to £ 5M (i.e. River Dee Fisheries Management Plan). The full list of projects, activities and its costs can be found in Appendix 5.

External funding sources for catchment management projects have included LIFE Environment, Recite II, Heritage Lottery funding, INTEREG, Objective 5B funding and European Agricultural Guidance and Guarantee Fund.

7.8. Objectives, specific targets and measures of success

A total of 127 projects out of the 141 (90%) gathered in our database had an objective defined. However, only 25 (20%) of these had set up specific targets. A total of 62 projects (48%) anticipated monitoring, but only 41 of them (32%) had set up indicators or ways to measure the success or failure of the project.

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In terms of indicators, Figure 18 illustrates the distribution of all identified indicators used to measure the success of river restoration initiatives. In 32% of the 41 projects, biological indicators such as fish populations, macroinvertebrates, macrophytes, insects' colonisation, native riparian vegetation growth and migratory birds' numbers were considered. Due to the nature of some funding structures, in 16% of the projects indicators of success were specific actions and timescales specified in the plan. In 13% of the projects meeting financial targets was the primary objective. Physical habitat indicators were considered in 14% of the projects. This included general habitat and bankside improvement assessment to geomorphological processes monitoring. Social indicators referred to number of people involved and people's response.

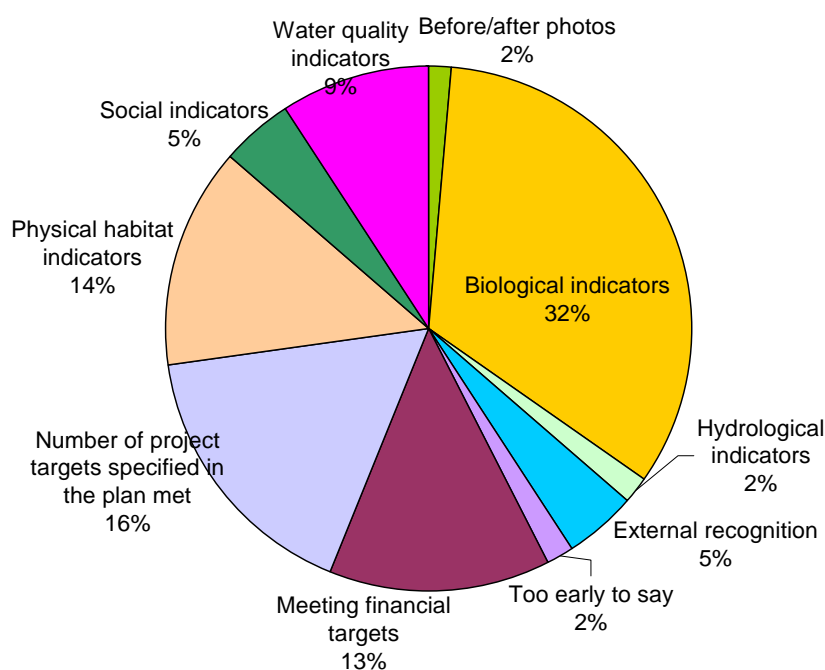


Figure 18. Distribution of the identified indicators for the assessment of a river restoration initiative success.

There are a huge range of measures of success, but a lack of standardised approaches and techniques in terms of assessment. The lack of monitoring has hampered evaluation of synergies in this study and will become important in confirming the effectiveness of invested funds. A standardised monitoring approach for river restoration activity should be developed for Scotland and built into the costs of restoration.

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Biological monitoring, although used as the most common form of assessment (Figure 19), it is clear that it has been only applied at the reach and sub-catchment scale (Figure 19). Examples of this type of projects are the RSPB and SWT nature reserves. Bankside and general habitat improvement are the physical habitat indicators represented at the reach scale. At the sub-catchment scale, however, fluvial geomorphology processes are to be monitored through Scottish and Southern Energy substrate replenishment initiatives on the rivers Garry, Morriston and Black Water.

As scale increases, there appeared to be a tendency to focus less on individual target species monitoring and more on overall water quality (i.e. Monitored priority catchments by SEPA) and meeting predetermined project targets, largely dictated by financial commitment (i.e. CASS LIFE project by SNH).

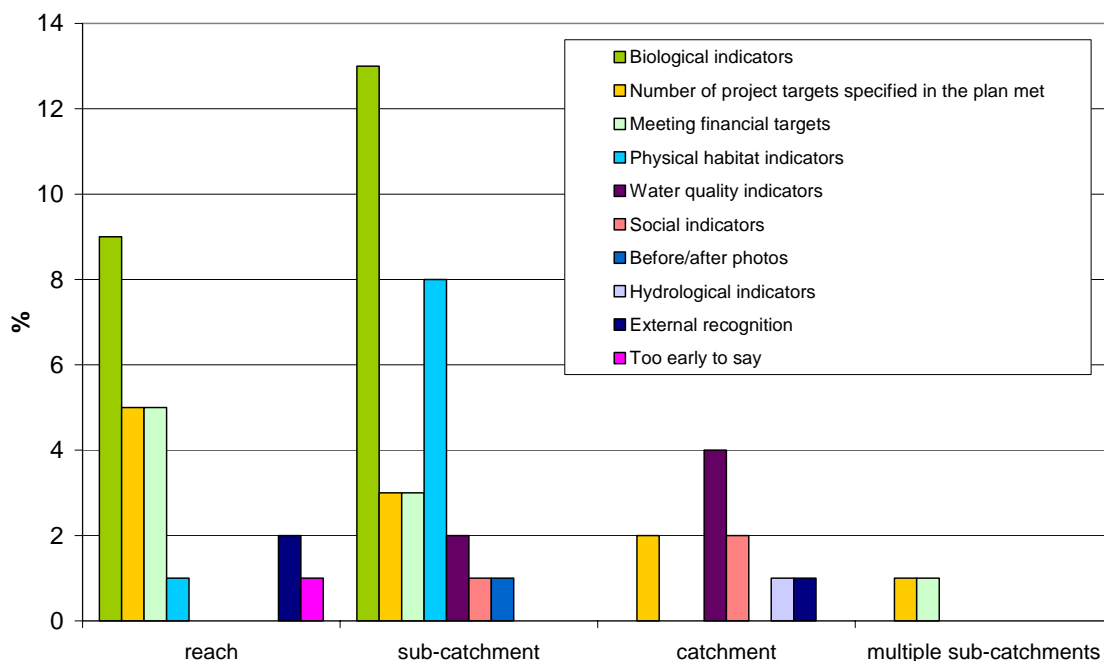


Figure 19. Identified indicators for the assessment of a river restoration initiative success at different scales

7.9. River restoration initiatives undertaken under broader initiatives

Forty four from the total number of river restoration initiatives were undertaken through broader initiatives and had an important impact across a wide geographical area in Scotland. These broader initiatives vary from big European projects to those started

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within the context of catchment management plans. Table 9 illustrates and below briefly describes the most significant ones:

Table 9. Number of projects classified by scale that have been undertaken under broader initiatives.

Broader initiatives		number of projects by scale				
		reach	sub-catchment	catchment	multiple sub-catchments	multiple catchments
UK Adapt			1	3		
Catchment Management Plans		1	5	2		
Fisheries Initiatives			4	3	1	
The Long March						1
Cairnorms quick wins						1
SNIFFER WFD project						1
LBAPs			1	2		
Glasgow Strategic Drainage Plan			1			
cSAC Conservation Strategies				4		
European framework initiatives	CASS LIFE project	5	3			
	Clim-ATIC					
	4 Dee Vision		4			
Tay hydrological observatory					1	
Total		6	19	14	2	3

44

UK Adapt

UK-ADAPT is a resource to make researchers and funders aware of projects that contribute to the understanding of managing catchments to decrease diffuse pollution from agriculture. UK-ADAPT consider projects at the catchment scale or at the field scale where the latter can clearly be scaled up to inform at the catchment scale. In Scotland, a total of 4 research projects linked to river restoration with the main driver of water quality issues understanding were undertaken, those including 3 research-led studies and the implementation of the Loch Lomond Catchment Management Plan. www.uk-adapt.org.uk

Catchment Management Plans

Catchment management plans which mention river restoration include the Dee-Ken, Annan, Almond, Tweed and Dee catchments. They are in the process of undertaking or planning to undertake river restoration actions on the ground within the Catchment Management Plan framework.

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Fisheries initiatives

Some fisheries initiatives such as those undertaken by Galloway Fisheries Trust, Tweed Foundation, the River Dee, Ayrshire Rivers Trust and Argyll Fisheries Trust have a component of holistic and integrated catchment-scale restoration.

“The Long March” and the “Cairngorms quick wins”

These two SNH initiatives are examining potential species movement in response to climate change and identifying constraints on movement such as habitat fragmentation. “Quick Wins” is looking explicitly at fragmentation within and around designated nature conservation sites and identifying best value actions on the ground. Obviously the role of the river network and linking and restoring high quality river habitats should be explored.

SNIFFER WFD94 project

This project undertaken by the Macaulay Institute is aimed at developing a broad based approach towards prioritisation of river restoration at the catchment scale within a GIS framework.

Glasgow Strategic Drainage Plan

The Glasgow Strategic Drainage Plan is a multi-million pound project examining both the artificial and natural drainage infrastructure of this urban area, especially in relation to flooding.

cSAC Conservation strategies

A total of 4 cSAC Conservation strategies with river restoration included have been identified; namely on the rivers Kerry, Moidart, Endrick and Borgie. The strategies rely on partnership-based approaches and have the potential to deliver joined-up river restoration.

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LBAPs

Local biodiversity Action plans, of which there are about 25 in Scotland are one possible process to which river restoration could be strategically linked. The Argyll and Bute LBAP and Fife LBAP are two of the relevant examples that undertook river restoration initiatives at the sub-catchment and catchment scales.

European framework initiatives

3Dee Vision

The 3 Dee Vision Project was part of a wider European initiative aimed at sharing best practice information concerning water quality management and stakeholder involvement, with other North Sea countries. Through engagement with the local community, the project raised awareness of the river environment and encouraged good environmental practice amongst those living and working in Deeside. The project was part funded by the European Community's INTERREG IIIB North Sea Programme and ran until 2006. www.3deevision.org

Climate Change: Adapting to The Impacts on Communities in Northern Peripheral Regions

CLIM-ATIC is a preparatory project with the aims of establishing a transnational network and developing a multi-partner project focussed on the potential impacts of climate change on small rural communities. This addresses how these communities could adapt to avoid or reduce the negative impacts of climate change, while taking advantage of opportunities. This project includes a river restoration project at the reach scale on the river Endrick, Glen Urquhart. www.clim-atic.org/scotland.html

CASS LIFE project

The Conservation of Atlantic Salmon in Scotland (CASS) life project starting in 2004 and is the single most significant salmon conservation project ever undertaken in Scotland. The project includes partners from both the public (District Salmon Fisheries Boards, Fisheries Trusts, Scottish Natural Heritage, Scottish Executive, Forestry Commission, Crown Estate) and private sectors (Scottish Hydro Electric). It has an

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overall objective to safeguard and maintain the abundance and diversity of Atlantic salmon in Scotland by improving freshwater habitats and salmon management regimes through joint working and partnership initiatives on eight key Scottish salmon rivers. www.snh.org.uk/salmonLIFEproject/

Tay hydrological observatory

The Tay has been identified as one of only three UK catchments within the Hydrological observatory network for Europe (H0-net) and as such will be a long-term research and monitoring site for such organisations as SEPA, CEH and MLURI. The Tay catchment has also been identified by the Scottish Alliance for Geographical Sciences as a region of focus in relation to landscape dynamics and processes. As such the effects of river restoration would be monitored at the catchment scale.

7.10. Number of river restoration projects at the catchment scale

A total of 20 out of 141, were identified as significant catchment, sub-catchment and multiple catchment scale initiatives. The full list of river restoration projects with all their characteristics can be found in Appendix 5. A selection of representative projects is shown below:

River restoration initiative	Part of a broader initiative	Catchment	Pressure	Impact	Driver / Main motivation	Objective	Actions	Scale	Leading organisation
Cessnock Environmental Focus Farm Project	Monitored Priority Catchments	Cessnock	agriculture	Diffuse pollution	WFD (water quality)	To recommend practical, effective and affordable ways to help to reduce the likelihood of polluting reaching waterways and groundwater from farming operations	* Programme of monitoring water parameters to establish baseline "before" and "after" * changes to field practice or to steading arrangements (increase slurry storage capacity on the steading)	catchment	SAC
Craik Forest management options for flood mitigation	INTERREG	Tweed	Climate change	Flooding	Climate change Sustainable Flood Management	To understand the effects of climate change on flooding and possible forestry management techniques to mitigate its effects	not started on the ground yet	catchment	Mountain Environments
Cree Valley- EU Life Sustainable Forestry Project	EU LIFE project	Cree	Forestry (road and track construction, haversting, restock)	soil disturbance and erosion	Biodiversity Legislation	To identify a number of measures designed to protect soil and water in order to demonstrate developments in best forestry practice	* Forest harvesting: exclude machinery from riparian areas, avoid stream crossing * Restock cultivation: excavator mounding rather than ploughing, restricting lengths of spoil trench and excavate pits rather than trenches * Road and track construction: separate drains from natural watercourse, use of silt traps, direct seeding of steep embankments, avoid use of sand, stone ramps to protect access points, restrict drain depth on tracks.	catchment	Forestry Commission
Loch Strathbeg	RSPB nature reserve	Savoch Burn	agriculture	Diffuse pollution	Biodiversity Legislation (Special Protection Area under Natura 2000)	To improve water quality and loch feature	* riparian planting * instream habitat improvement	sub-catchment	RSPB
Lunan Environmental Focus Farm Project	Monitored Priority Catchments	Lunan	agriculture	Diffuse pollution	WFD (water quality)	To recommend practical, effective and affordable ways to help to reduce the likelihood of polluting reaching waterways and groundwater from farming operations	* minimum tillage in the in-hand arable fields * 2m grass margins around headlands in all cultivated fields * Farm Waste Management Plan * Diffuse Pollution Audit * nutrient budget	catchment	SAC

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River restoration initiative	Part of a broader initiative	Catchment	Pressure	Impact	Driver / Main motivation	Objective	Actions	Scale	Leading organisation
River Dee Fisheries Management Plan	Dee Catchment Management Plan (to some extent)	Dee	agriculture climate change overgrazing man-made obstructions water abstraction upland drainage predators	Loss of fisheries	Fisheries	To restore the Dee catchment for its suitability to sustain fish populations (not only salmonids)	<ul style="list-style-type: none"> * fencing and planting * physical habitat enhancement * farmers education * legislation enforcement through CAR * native trees plantings for shading * reduce pressure of overgrazing in identified areas * fish pass obstructions removal * reduce run-off from upland drainage * identify and reduce point source pollution * nominated predators for fish management and control 	multiple catchments	The River Dee
River Devon and Black Devon LIFE + catchment Project	Clackmannanshire Council Catchment Action Plan	Devon & Black Devon	Multiple pressures in a catchment	<ul style="list-style-type: none"> * flooding * alien species * climate change 	Sustainable Flood Management + Biodiversity	To achieve multiple environmental aims through a catchment scale action project	<ul style="list-style-type: none"> * Catchment land-use change * River corridor restoration * Instream Habitat improvement * Bankside Habitat improvement * Processes restoration 	catchment	Clackmannanshire Council
River Devon Project	WWF Natural Flood Management	Devon	<ul style="list-style-type: none"> * overgrazing * woodland clearing * water courses artificial blockage * erosion * floodplain disconnection 	Flooding	Sustainable Flood management	To demonstrate that sustainable flood management means taking a catchment approach and working with stakeholders can bring resilience against flooding	<ul style="list-style-type: none"> * to restore natural dams * to restore natural sponges * to replant woodland protection * to manage forestry drains * to undertake soft engineering downstream * to reconnect rivers with floodplains * to replant natural barriers 	catchment	WWF
SAFER project: Strategies and Actions for Flood Emergency Risk management	INTERREG IIB NEW	Enrick			Sustainable Flood management		<ul style="list-style-type: none"> * Integrated Catchment Management Plan * Forest management concept development * Bank protection actions and natural protection measures to reduce flooding * Vegetation survey and RHS * Flood emergency development 	catchment	Forestry Commission
Tay Western Catchments Project	Scottish Native Woods	Tay	Several	Loss of physical habitat and biodiversity	Physical habitat Biodiversity		<ul style="list-style-type: none"> * surveys in all the catchment for geology, land use, water quality and WFD classification 	catchment	

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River restoration initiative	Part of a broader initiative	Catchment	Pressure	Impact	Driver / Main motivation	Objective	Actions	Scale	Leading organisation
The Ettrick Marshes		Tweed	Coniferous Forest Agriculture	Loss of biodiversity (woodland habitat)	Biodiversity	To restore floodplain and enhance riparian habitat	<ul style="list-style-type: none"> * remove mature conifers from the floodplain * willows planting * hydrological studies * mini agri-environment scheme * community involvement 	sub-catchment	Borders Forest Trust
The Ythan Project	The Ythan Project	Ythan	Agriculture	Diffuse pollution	Water quality	To improve the Ythan river quality involving local community and make them aware of the value of the river	<ul style="list-style-type: none"> * riparian fencing * conifer removal * riparian trees planting * fish pass creation * spawning bed creation * wetlands creation * farm visits 	catchment	Aberdeenshire Council
Tweed invasive Species	Tweed Catchment Management Plan	Tweed	Invasive species	Loss of biodiversity	Biodiversity	To eradicate non-native plants	<ul style="list-style-type: none"> * Invasive species surveying eradication and vigilance 	catchment	Tweed Forum

IV. DISCUSSION AND CONCLUSIONS

8. Catchment Scale River Restoration - A discussion

8.1. Policy and regulatory framework for river restoration

SEPA and the Scottish Government are working on an initiative to help deliver restoration measures principally to support the achievement of WFD objectives. At the same time consideration is being given to broadening it to include other benefits, such as sustainable flood management given the forthcoming Floods Bill. Current estimates by SEPA indicate that under the new WFD classification system, 40% of the water Environment will be classified as not good the key impacts being diffuse pollution, point source pollution, water resources, morphology and to a much lesser extent alien species.

However it should be pointed out that the emphasis in the past on focussing on water quality as the sole indicator of satisfactory status has not always brought about expected improvements because of the quality, quantity and level of fragmentation of habitat. In relation to this, *ad hoc* measures do not optimise use of resources and a catchment scale assessment of what biologists would call “bottlenecks” to improving catchments needs to be undertaken. The sorts of measures currently being considered are removing abandoned structures, tackling mine water discharges and improving/creating habitats.

SEPA’s River Basin Management Planning National Advisory Groups provide the framework for high level strategic approaches to river restoration. At the catchment scale the Area Advisory Groups have a similar role to play. They are useful in that the majority of key partners and stakeholders are present and they are addressing the key pressure son catchments. What would ideally be required is Sub catchment river restoration working groups producing sub basin restoration action plans (SBRAPS) similar to the Environment Agency Local Environment Action Plan set-up.

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The keying in of river basin planning to Scottish Rural Development Programme (£2.6 billion) (SRDP) could be important in helping create “joined-up thinking”, and a potential funding stream, with SEPA informing the Scottish Government on priorities for Rural Development Contracts. The Forestry Commission in Scotland is looking to consider compliance on a wide range of water issues via the SRDP. In particular they propose to revive Forest Design Plans and support measures to restore river banks through Rural Development Contracts. SNH also proposes to seek to identify measures and priorities with the SRDP which deliver water quality and biodiversity/conservation improvement. The NFU and Scottish Rural Property and Business Association also propose to encourage membership to take up such measures as buffer strips and riparian woodlands creation, through tier 3 of SRDP. There thus seems to be a consensus on the potential value of SRDP to river restoration. Hopefully the priorities set by the Scottish Government for each region will tie up closely with the needs for river restoration (e.g. Water quality in intensive farmed catchments in the east of Scotland).

With regard to agri-environment schemes Dutton *et al.* (2008) that suggested that their use could be enhanced in terms of reconnecting valuable habitats at the catchment scale, by identifying farmers in priority areas and then working with them on a one-to-one basis to align their needs with wider scale strategic thinking. This could equally work in the field of river restoration. Such an approach on the Chichester plain with a focus on the river systems led to a significant recovery of the water vole population (Dutton *et al.*, 2008). In terms of diffuse pollution, improved compliance with GAEC – good agricultural and environmental conditions (GAEC) would also assist restoration efforts.

8.2. Some potential initiatives to support river restoration

The analysis highlights that river restoration is principally being undertaken for salmonid habitat enhancement and for biodiversity objectives. In the former case fisheries organisations are taking the lead and in the second SEPA. A number of one-off catchment scale initiatives which include river restoration as a component are also evident, across Scotland, such as The River Devon Sustainable Flood Management

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Project. In total, numerous catchment scale initiatives have appeared (and sometimes faded) to which river restoration restoration could be aligned.

Fisheries Trusts within Scotland appear to be most active in undertaking river restoration at the catchment scale, via their habitat enhancement initiatives. In many cases although directed at improvement to fisheries habitat, the works bring about benefit for biodiversity in general although this is not always the case, and rarely if ever quantified. A number of fisheries trusts, are doing good work and their impact could be increased if there was a broader appreciation of multiple benefits and greater funding. The Galloway fisheries Trust, for example are well advanced in taking catchment scale approach. In Tayside they are also working with the Scottish Native Woodlands Trust in a catchment wide initiative aimed at habitat and fisheries so that they are appreciating the wider aspects of healthy stream ecosystem and fisheries enhancement. Furthering the knowledge of fisheries trust staff in river restoration in general and findings way of increasing their potential to carry out restoration that meets multiple benefits would be useful. In terms of practical on the ground works the Fisheries Trusts are best placed to undertake the work but they need guidance if they are going to undertake a holistic approach and there will need to be coordination of the process by another organisation such as SEPA if they are to undertake works that bringing full benefit across the spectrum of drivers.

In terms of restoration to mitigate diffuse pollution, a catchment scale appraisal of best management practices (BMP) was undertaken on the Brighthouse catchment in SW Scotland (SEPA Report, 2005; Tender reference 230/4187). A range of BMP ranging from ponds collecting yard water, stream side fencing, buffer zones, risk assessments for manures and slurries were implemented. Monitoring was undertaken but results inconclusive, due to limited baseline data and a short period of monitoring serving to illustrate the need for long-term monitoring and long-term planning. High quality intensive monitoring capturing high flow events is often required to fully assess the efficiency of BMPs in relation to diffuse pollution (Ferrier *et al.*, 2005). Similar work was also carried out on the Etrick Bay, Cessnock, Sandyhills and River Nairn focussing on faecal micro-organisms. SEPA currently have two priority monitored catchments for examining the impact of BMPs on diffuse pollution; namely on the Lunan Water and

Cessnock. They have focussed attention on the Langton Burn in the Borders in relation to piloting catchment management agreements.

Other examples of groups wishing to develop a catchment approach to restoration are apparent. For example, Clackmannanshire Council, via their Clackmannanshire Biodiversity Partnership (Water and Wetland Group and SNH, SEPA, WWF, RAFTS, RSPB etc), wish to have a five year programme of catchment management with enhancement of river corridors and riparian woodland being a central component. It would link in to the Clackmannanshire LBAP and the project would focus on biodiversity, sustainable flood management and river users as the drivers for change on the River Devon and Black Devon. Funding is an issue and opportunities under EU LIFE were being considered. Another interesting project started up in 2007 was the Tay Western Catchments Project led by Scottish Native Woodlands, but in partnership with key stakeholders. The project is currently undertaking baseline surveys on erosion, alien species and a range of other issues to assess the extent of any problems with an aim to addressing them via river restoration. Some funding has been achieved via private donations. A number of other welcome initiatives are around but all are hampered by limited funding to help them meet their objectives. Work on two tributaries of the Tweed in relation to sustainable flood management are also worthy of note. Scottish and Southern Energy propose to re-water 30 km of dry river (Garry, Morriston and Blackwater) with SEPA/DSFBs.

There is the need for a number of catchment scale restoration pilot projects to be supported where additional funding will facilitate advancement from planning to action, and for projects that are active but whereby extra support would allow them to achieve multiple benefits, rather than their current focus on a single driver.

9. Main conclusions and recommendations

9.1. Conclusions

This report has examined the state of the art in relation to catchment scale restoration in Scotland. On the one hand, it has solicited the views of river restoration practitioners

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and policy makers and this is been collated to create a national picture of river restoration at the catchment scale in Scotland. On the other hand, it has attempted to develop theoretical approaches towards examining synergy between restoration activities and pressures facing Scotland's rivers. The main findings of this work are outlined below:

An ecosystem based approach

- River restoration is best implemented in the context of a sound understanding of catchment processes, and appreciation of the longitudinal, lateral and vertical connectivity within river systems.
- River Restoration can only be viewed as successful and sustainable if it restores natural processes, improves one attribute to a river without detriment to another (or without significant impact on the ecosystem), or alleviates an environmental problem for society.
- The fact that the impacts of reach scale activities take time to propagate through the system and that the full benefits of some river restoration activities at a site cannot be seen for a number of years also needs to be appreciated.
- River restoration projects that target more than one outcome are the goal. Some restoration projects will bring short-term gain, but it must be realised that others require time before the full multiple benefits are realised. Just in the same way the cumulative effect of various adverse impacts can suddenly lead to a river system becoming highly degraded, the cumulative benefit of a number of projects in one catchment could suddenly create good ecological status (e.g. having improved habitat and water quality, it would make sense to remove a weir but removing a weir without improvement in physical habitat might not be worthwhile).

Understanding of river restoration at the catchment scale

- CRESS has defined catchment scale river restoration as “*any river restoration activity that singly, or in combination, restores natural catchment processes and a naturally functioning ecosystem and brings benefit or environmental services to the whole catchment and not just to the site of restoration*”. The large majority (over 80%) of individuals interviewed broadly agreed with this definition.
- Over 60% of interviewees specifically acknowledge the need to take into account environmental processes occurring at the catchment scale when undertaking river restoration.
- Only a few individuals appeared to fully recognise the fact that river restoration success may need to be measured over a long timescale.

Views on river restoration in Scotland

- Most individuals and organisations with interests in river restoration support the need for catchment scale river restoration and acknowledge that river restoration can meet multiple environmental objectives.
- A number of limitations were identified as hindering river restoration in Scotland. The most important is a perceived lack of a national strategy and coordination. Another key limitation is funding. In both cases, the sector looked to SEPA and the Scottish Government for direction and support.
- SEPA's River Basin Planning process was seen as potentially being able to provide a framework for the delivery of river restoration at the catchment scale.

Drivers for river restoration at the catchment scale in Scotland

- Traditionally, the major driver for river restoration in Scotland (based on the information of our database) has been fish populations and fisheries enhancement. Biodiversity and mitigation of diffuse pollution were also identified as important.
- The main driver identified in terms of developing catchment scale restoration was overwhelmingly viewed to be the achievement of WFD objectives. Sustainable flood management and climate change adaptation were also seen as emerging drivers.
- Hydromorphology is seen as important in bringing about multiple benefits, but was not viewed as a national driver for river restoration per se.

Organisational roles to river restoration in Scotland

- Over 50% of organisations interviewed recognised their commitment to undertake, support and promote river restoration activities.
- Most organisations stressed the importance of partnerships in delivering river restoration, but a few organisations wished to have the responsibility of coordinating river restoration and undertaking the lead role.
- At present, there does not appear to be one lead organisation in terms of river restoration in Scotland.
- Interviewees generally perceived that it was the role of the Scottish Government to develop the mechanisms and funding streams, and for SEPA to deliver river restoration at the catchment scale in Scotland. Ninety two percent believed that is SEPA's responsibility to coordinate these activities.
- Despite a large number of organisations involved in river restoration, few have specific and detailed guidelines on how to plan and undertake river restoration.

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- The lack of a centralised river restoration database for Scotland and location from which to gain guidance in ‘best practice’ river restoration was also noted as a constraint. Some acknowledgement of the work of the River Restoration Centre, Scottish Fisheries Co-ordination Centre and SEPA in this area was apparent.

Synergies from main drivers and organisational motives

- Most organisations undertaking river restoration appreciated the fact that there are secondary benefits to their main motive for restoration. These, however are rarely mentioned or reported.
- Biodiversity is a catch-all phrase for many river restoration projects but is not particularly useful in identifying target species.
- A theoretical assessment of river restoration activities suggests most can bring benefit to two or three pressures on rivers with combined buffer strip creation and riparian planting of native trees, re-meandering and floodplain forest having the most universal benefit.

Specific river restoration projects

- This study has shown that the number and diversity of river restoration projects in Scotland is on the increase. It has also highlighted however that they are generally undertaken in piecemeal fashion and a lack of a reporting structure makes assessment at catchment, regional and national levels problematic.
- Post 1999 there was an increase in catchment scale river restoration initiatives, but they are still few in number. Multiple catchment approach for river restoration is now just emerging.

- To date, bankside habitat improvement and instream habitat works are the most frequently undertaken activities across all scales.
- Few restoration projects appear to have adequate monitoring or have been underpinned by a sound scientific basis.
- A minority of projects had specific targets and indicators or measures of success set-up.

9.2. Recommendations

- Restoration needs to be centred on restoring hydrological, chemical, geomorphological and ecological processes based on a sound conceptual model of how a particular river functions as an ecosystem. The strategy should be to identify the limiting factor in each of the catchments. This for example could lead to a desire to restore rivers for invertebrates and organic matter retention as they lie at the base of the food chain rather than fisheries based focus *per se*.
- There is the need for two or three catchment scale river restoration projects to act as demonstration sites and a model for others to follow. A number of candidate catchments, initiatives or projects are apparent. These should ideally build upon catchments where an initiative is already in place and/or good background environmental data is present. Biodiversity, sustainable flood management, diffuse pollution, fisheries an alien species should all be included in at least one of the catchments. Effective environmental and hydrological monitoring of these is absolutely essential.
- There is the need for a River Restoration project database for Scotland to be maintained with quality control applied to allow appraisal of it at the national and catchment level. This database would also need to report on the success of schemes. An on-line forum for sharing good practices on river restoration and documenting the success of projects also needs to be created.

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- There is need for long-term hydromorphological, chemical and biological of river restoration projects to advance knowledge and allow adaptive management to be practiced. There is a real need for an evidence base in performance and success of restoration measures. In particular, there needs to be a standardised protocol for monitoring river restoration projects and evaluating success, so that comparisons can be made at the national level and the effectiveness of investment appraised.
- River basin management planning may be the catalyst for planning but funding and a mechanism for delivering tangible improvements is needed. This lack of action on the ground is a pity in that there is a consensus among the community involved with delivering environmental improvement to Scotland freshwaters that river restoration is able to bring about multiple benefits alleviating some of the pressures.
- Many of the mechanisms for delivery are in place but better co-ordination is required. SEPA via the river basin planning process are well placed to provide the coordination and strategic view. Both SEPA (Habitat Enhancement) and Scottish Natural Heritage have promoted river restoration and been core funders of the River Restoration Centre, which has been used opportunistically rather than within a strategic set-up.
- There needs to be strict enforcement of legislation that has been implemented to protect our rivers (e.g. SAC status, CAR Regulations etc). River restoration needs to bring about real improvement and not just offset un-licensed derogation. Protection of streams in good condition should take precedence over investment in river restoration.
- Increased support and guidance needs to be provided to fisheries organisation actively undertaking work so as to maximise the benefits of their work across multiple drivers.
- SEPA should have overall responsibility for coordination on river restoration in Scotland and play a key role in identifying priorities and the strategic directions.

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- There is a need for creation of River Restoration Working Groups within the SEPA National Advisory Group and Area Advisory Groups within the River Basin Management Planning process.
- European Union Funding may support few initiatives but river restoration needs to be seen as integral to rural development and urban generation with concomitant levels of funding released for the purpose.
- More funding should be made available and prioritisation given to organisations that have match funding, high quality projects addressing multiple drivers that have reached the end of the planning and baseline survey cycle and need support for action on the ground.
- Prioritisation for funding should be made where projects are able to show measurable benefits.

9.3. CRESS vision

The CRESS vision is that river restoration operating at the catchment scale will over the next 25 years bring about substantial improvement in the environmental quality of river corridors, together with linked environmental services and help the Scottish Government meet many of its obligations associated with EU Directives and climate change.

In terms of river restoration priorities we would encourage:

- Restoration that tackles multiple drivers
- Restoration of riparian margins and floodplains
- Restoring continuity in flow and sediment transport
- Restoring processes that reinstate longitudinal, lateral and vertical connectivity in terms of physical and biological fluxes.
- Self recovery of river systems by abandonment of intervention and management
- Preference be given to upstream versus downstream projects.

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Our vision is that by restoring the longitudinal sediment flux (via substrate replenishment schemes and weir removal) and ecologically acceptable flows, instream physical habitat will undergo self recovery and with time create high quality instream habitat. Removal or just letting bank protection works fail in reaches where infrastructure is not at risk, would also create channel instability, creating a morphologically diverse, biologically rich and resilient river margin that could adapt to environmental change. On some low energy stream systems that have been highly canalized direct intervention and for example re-meandering might be necessary to restore physical habitat. Similarly by riparian fencing, agricultural flood embankment removal and hence restoring lateral connectivity with the floodplain, wooded riparian corridors with beads of wet woodland on the floodplain with high nature conservation value and some flood attenuation potential would be created. Similarly to above, in some cases intervention might be necessary; for example destroying underlying drainage to allow a buffer strip to have a nutrient uptake capability. Such naturalised river systems would be self sustaining, resilient to climate change and require much reduced river management over current practice in many areas.

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11. Appendices

Appendix 1. *A summary of selected restoration activities and impacts on environmental and ecological processes.*

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Appendix 2. *A list of all organisations and individuals identified, contacted and interviewed.*

Appendix 3. *Complete standard questionnaire*

Appendix 4. *Details on dates, duration and type of interviews and number of sections (from the standard questionnaire) completed by respondents.*
(supplied in electronic format only)

Appendix 5. *Database on all identified river restoration initiatives in Scotland, their characteristics and details.*
(supplied in electronic format only)

Appendix 6. *Full list of participant organisations in river restoration initiatives.*



Appendix 1. *A summary of selected restoration activities and impacts on environmental and ecological processes.*

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Re-meandering – Reduction in channel bed slope and average flood velocities leading to modest flood attenuation. Increase in flow heterogeneity leading to instream habitat diversity (increasing patch dynamics)

Buffer strip creation and revegetation – Potential uptake of nutrients and trapping of fine sediment leading to improved water quality. Reduction in erosion and bed siltation reducing hazards and improving habitat. Increase in organic matter input to the river improving food supply for organisms.

Flood embankment removal – Increased flood storage providing modest flood attenuation. Increase in potential area for fluvial processes to dominate improving lateral connectivity and riparian habitat development (reconnecting one dimension of the fluvial hydrosystem concept – the lateral).

Culvert removal – Improvement in fish passage allowing fish to access headwaters under a range of flows. Increased flow conveyance reducing localised flooding

Weir Removal - Improvement in fish passage allowing fish to access headwaters under a range of flows. Reconnection of longitudinal connectivity and potential for sediment to replenish habitat starved of sediment leading to improved substrate conditions and possibly reducing downstream erosion problems (reconnecting one dimension of the fluvial hydrosystem concept – ie the longitudinal).

Reconnecting old channels – Improvement in lateral connectivity providing valuable habitat for a range of species of high nature conservation importance and a refugia and nursery for a number of main channel species (reconnecting one dimension of the fluvial hydrosystem concept – the lateral).

Riparian conifer removal – Improvement in light conditions allowing photosynthesis either within the water column or on the stream bed improving stream productivity. Modest reduction of input of acidifying particles and hence slight improvement in water quality status.

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Riverine wetland recreation – Creation of damp areas for wetland loving plants and birds increasing biodiversity. Potential uptake of nutrients and trapping of fine sediment leading to improved water quality. Possibly a slight improvement in flood storage potential.

Substrate replenishment – Reinstatement of substrates and a store of sediment for onward transport downstream thus maintaining habitat quality and minimising erosional hazards (the river continuum concept).

Bank protection removal – Exposure of natural bank sediments allowing bank-side creatures to re-colonise lost habitat. Potential for migration of channels and development of high quality riparian habitat (the shifting habitat mosaic concept).

Beaver reintroduction – Creation of ponding and hence development of pools and wet areas (see above). Ponds may cause local shallow flooding but may also provide modest flood attenuation potential. Introduction of woody debris to the stream system increasing instream habitat heterogeneity and organic matter which acts as a substrate and food source for a number of organisms.

Woody debris reintroduction - increasing instream habitat heterogeneity and organic matter which acts as a substrate and food source for a number of organisms. Increased channel roughness and modest ponding possibly providing modest flood attenuation potential.

Fish Passes - Improvement in fish passage allowing fish to access headwaters under a range of flows.

Alien species removal – Removal of species that often lead to the decline of natural species by competition allowing biodiversity to be maintained.

Ecologically acceptable flow regimes – Flow availability and heterogeneity creation and sediment transport allowing creation of sufficient instream aquatic habitat to support organisms and flows that can sustain instream physical habitat.

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Less intensive land management – Reduction in input of nutrients and in some case less flashy response to rainfall leading to more subdued flood regimes.

Restoring floodplain forests – Increased floodplain roughness leading to flood attenuation. Increased structure leading to increased diversity. Increased organic matter input to the stream system improving ecological status (the flood pulse concept).

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Appendix 1



Appendix 2. *A list of all organisations and individuals identified, contacted and interviewed.*

Organisation	Contact person	First Contact	Response	Interview
Atlantic Salmon Trust	John Webb	12/02/2008	13/02/2008	19/02/2008
Aberdeenshire Council	Linda Mathieson	12/02/2008	18/02/2008	19/02/2008
Scottish Water	Neil Plane	12/02/2008	13/02/2008	20/02/2008
Association of Salmon Fishery Boards	Andrew Wallace	14/02/2008	14/02/2008	28/02/2008
RAFTS	Callum Sinclair	14/02/2008	14/02/2008	28/02/2008
Clackmannanshire Council	Guy Harewood	14/02/2008	15/02/2008	29/02/2008
Clackmannanshire Council	Gordon Roger	14/02/2008	15/02/2008	29/02/2008
Scottish Government	Maggie Gill	12/02/2008	14/02/2008	03/03/2008
Scottish Government	Liam Kelly	16/02/2008	18/02/2008	03/03/2008
Scottish Agricultural College	Bob Rees	01/03/2008	02/03/2008	03/03/2008
Centre for Mountain Studies. Perth college - UHI	Clive Bowman	01/03/2008	02/04/2008	03/03/2008
RSPB	Andrea Johnstonova	16/02/2008	18/02/2008	04/03/2008
RSPB	Dave Beaumont	16/02/2008	18/02/2008	04/03/2008
Ayrshire Rivers Turst	Brian Shaw	14/02/2008	14/02/2008	05/03/2008
Argyll Fisheries Trust	Alan Kettle White	26/02/2008	27/02/2008	05/03/2008
SNH	Ruth McWilliam	16/02/2008	21/02/2008	06/03/2008
SEPA	Tamsin Morris	08/02/2008	11/02/2008	07/03/2008
SEPA	Roger Owen	12/02/2008	14/02/2008	07/03/2008
Ythan Project	Tamsin Morris	18/02/2008	20/02/2008	07/03/2008
Spey Fishery Board Research Office	Roger Knight	17/02/2008	27/02/2008	10/03/2008
Annan Distric Salmon Fishery Board	Nick Chisholm	05/03/2008	06/03/2008	10/03/2008
Forest Research	Tom Nisbet	18/02/2008	10/03/2008	10/03/2008
Scottish Fisheries Coordination Centre	Robert Laughton	16/02/2008	03/03/2008	11/03/2008
SEPA	Mike Parker	11/03/2008	11/03/2008	11/03/2008
Tweed Forum	Luke Comins	17/02/2008	10/03/2008	13/03/2008
University of Stirling	Colin Bull	13/03/2008	13/03/2008	13/03/2008
SEPA	David Faichney	16/02/2008	18/02/2008	14/03/2008
Scottish Wildlife Trust	Johnathan Hughes	12/02/2008	19/02/2008	14/03/2008
Mountain environments	Richard Johnson	17/02/2008	20/02/2008	14/03/2008
WWF	Mike Donaghy	17/02/2008	20/02/2008	14/03/2008
SNH	Angus Tree	21/02/2008	22/02/2008	14/03/2008
The River Dee	Mark Billsby	11/03/2008	11/03/2008	14/03/2008
CEH	Matthew O'Hare	14/02/2008	15/02/2008	17/03/2008
CEH	Linda May	14/02/2008	15/02/2008	17/03/2008
McCaulay Institute	Simon Langan	12/02/2008	19/02/2008	17/03/2008
SEPA	Chris Spray	25/03/2008	25/03/2008	25/03/2008
Scottish Government	Joyce Carr	17/02/2008	13/03/2008	26/03/2008
Scottish & Southern Energy	Alastair Stephen	12/03/2008	21/03/2008	26/03/2008
Scottish Wildlife Trust	Rab Potter	26/03/2008	26/03/2008	27/03/2008
SEPA	Roy Richardson	11/03/2008	14/03/2008	28/03/2008
Scottish Agricultural College	Alex Sinclair	05/03/2008	16/03/2008	28/03/2008
University of Stirling	Nigel Willby	03/04/2008	03/04/2008	03/04/2008

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University of Aberdeen	Chris Soulsby	26/03/2008	05/04/2008	05/04/2008
Scottish Wildlife Trust	Gill Smart	26/03/2008	04/04/2008	07/04/2008
Scottish Water	George Ponton	10/03/2008	28/03/2008	11/04/2008
Fife Council	Julie Horsburgh	05/03/2008	31/03/2008	15/04/2008
Argyll & Bute Council	Marina Curran-Colthart	19/02/2008	15/04/2008	15/04/2008
SNH	Des Thompson	25/03/2008	28/03/2008	16/04/2008
SEPA / Scottish Government	Stuart Greig	16/02/2008	11/03/2008	18/04/2008
SNH	Andrew McBride	17/04/2008	17/04/2008	18/04/2008
RRC	Martin Janes	19/04/2008	18/04/2008	07/05/2008
Scottish Agricultural College	Mike Smith	17/02/2008	03/02/2008	
SNH	Alexander Macdonald, Lesley Cranna	12/02/2008	13/02/2008	
SNH	John Uttley	12/02/2008	13/02/2008	
SNH	Mary Gibson	12/02/2008	13/02/2008	
SNH	Philip Gaskell	12/02/2008	14/02/2008	
RRC	Jenny Mant	14/02/2008	14/02/2008	
RRC	Gareth Codd	14/02/2008	14/02/2008	
Scottish Borders council	Louise Cox	14/02/2008	14/02/2008	
SEPA	Catherine Preston	08/02/2008	15/02/2008	
CEH	Bryan Spears	14/02/2008	15/02/2008	
CEH	Bernard Dudley	14/02/2008	15/02/2008	
CEH	Ian David Macadam Gunn	14/02/2008	15/02/2008	
CEH	Laurence Carvalho	14/02/2008	15/02/2008	
SNH	Stephen Austin	12/02/2008	18/02/2008	
Forest Research	Catherine MacCulloch	17/02/2008	18/02/2008	
Forest Research	Hugh Clayden	17/02/2008	18/02/2008	
SEPA	Joanne Gilvear	16/02/2008	20/02/2008	
Scottish Borders council	Andy Tharme	14/02/2008	22/02/2008	
SEPA	Elaine Hamilton	08/02/2008	25/02/2008	
Forest Research	Derek Nelson	18/02/2008	25/02/2008	
SEPA	Kiri Walker	08/02/2008	27/02/2008	
SEPA	Jackie Galley	08/02/2008	28/02/2008	
SNH	Katherine Leys	12/02/2008	29/02/2008	
Dee Catchment Management Plan	Susan Cooksley	12/02/2008	05/03/2008	
Locharber Fisheries Trust	Matthew Gollock			
Galloway Fisheries Trust	Jamie Ribbens	01/03/2008	05/03/2008	
Scottish Government	Joanna Drevit	05/03/2008	06/03/2008	
Scottish Government	Joanna Drevit	10/03/2008	13/03/2008	
SEPA	Anna Griffin	08/02/2008	26/03/2008	
Scottish Wildlife Trust	Alan Anderson	26/03/2008	26/03/2008	
SEPA	Jannette McDonald	26/03/2008	01/04/2008	
SNH	David Bale	02/03/2008	14/04/2008	
University of Dundee	Andrew Black	06/02/2008		
SEPA	Katriona Finan	08/02/2008		
SEPA	Katie Wilson	08/02/2008		

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SEPA	Rachel Harding-Hill	08/02/2008		
SEPA	Julia MacPherson	08/02/2008		
SEPA	Kenny Taylor	08/02/2008		
SNH	Angus Laing	12/02/2008		
SNH	Ross Johnston	12/02/2008		
SNH	Chris Miles	12/02/2008		
SNH	George Hogg	12/02/2008		
SNH	David MacLennan	12/02/2008		
Scottish Fisheries Coordination Centre	Hillary Anderson	16/02/2008		
Scottish Government	Scottish Biodiversity Committee	17/02/2008		
Scottish Government	David Seaman	26/02/2008		
Scottish Fisheries Coordination Centre	Ross Gardiner	28/02/2008		
Wester Ross Fisheries Trust	Peter Cunningham	01/03/2008		
SNH	Keith Dalgleish	02/03/2008		
Scottish Agricultural College	Stuart Somerville	05/03/2008		
Scottish Agricultural College	Douglas Hendry	05/03/2008		
Scottish Government	Jean Erbacher	05/03/2008		
SNH	Debbie Bassett	10/03/2008		
SEPA	Richard Jeffries	11/03/2008		
Tweed Foundation	Nick Younge	11/03/2008		
SEPA	Martin Masden	26/03/2008		
Scottish Wildlife Trust	Julian Warman	26/03/2008		
SEPA	Brian D'Arcy			

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Appendix 2

Appendix 3. Complete standard questionnaire

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Appendix 3

Centre for River EcoSystem Science,
School of Biological and Environmental Science, University of Stirling, Stirling, FK9 4LA
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The current work is looking at river restoration initiatives that are driven or set within a scientific / managerial framework operating at a catchment scale.

It is not a work looking at single projects addressing local problems with little or no consideration of impacts / benefits on the wider catchment.

Interview details:

Name:	
Organisation:	
Position:	
Date:	
Time:	
Place:	
Type interview:	

Sections completed	I, II	A	B	C	D	E	comments	F

I. What do you understand by river restoration?

II. In which terms will you speak about river restoration in this interview?

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A.THE ORGANISATION AND ITS RIVER RESTORATION APPROACH

1. Does your organisation have a commitment to integrate river restoration initiatives at a catchment scale?

(If leading an ICMP, also answer D)

2. If so, do you have a mission statement or strategy?

3. What is the primary motive behind this commitment/strategy?

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- 4. Do you see any synergy or secondary benefit from your main strategy? (i.e. biodiversity, fisheries, physical habitat enhancement)**

- 5. Does it fit or suits the current policy and related legislation (EU Habitats, LBAPS, WFD; Sustainable Flood Directive)?**

- 6. Does your organisation follow a specific River Restoration guidelines when delivering initiatives and to achieve objectives? (Do you have a strategic mission to undertake River Restoration in Scotland?)**



7. Do you think your organisation plays (or could play) an important role in terms of river restoration in Scotland? What role?

8. Do you think your organisation should have a greater role? Why?

9. Are you or have you undertaken (led) any restoration project in the ground?

(If yes, go to B; otherwise, go to C)



B. INDIVIDUAL INITIATIVE / SPECIFIC RESTORATION PROJECT

10. What is the background of the Restoration initiative? How did it start?

11. What are the characteristics of the Restoration initiative? *(type and general description)*



12. Which of these types of Restoration would you classify your project in?

Catchment land-use change	
River corridor restoration	
Instream Habitat Improvement	
Bankside Habitat Improvement	
Processes restoration	
Others: which?	

13. What is/was the major driver of the restoration project? Choose from the following:

Diffuse Pollution	
Physical Habitat (hydromorphology)	
Fisheries	
Biodiversity	
Sustainable Flood Management	
Legislation (i.e. SAC)	
Climate change (Landscape)	
(Community demand)	
(Development gain)	
Other Which?	

(the option/s chosen will define the questions to answer in section E)

14. What is the main objective of the restoration? What do you want to achieve with this action (specific targets)?

15. Does the initiative consider catchment scale factors?

16. Is the initiative based on scientific evidence of a problem and best way to address it? If yes, what evidence?

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17. Were alternatives considered?

18. Are the initiative and its objectives part of your organisation strategy?

19. What is the area (km²) of the restoration project?

20. What is the scale of the restoration project?

Reach	
Sub-catchment	
Single catchment	
Multiple catchments	
Other?	
Which	

21. Where is the restoration project/s geographically located? (Grid reference if possible)

22. Where is the restoration project located in relation to the rest of the catchment?

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23. Reason for its location.

24. When was the project started?

25. How long is it going to be for?

26. What is the current status of the project?

Just thought through	
Not started yet in the ground	
Ground action undertaken	
Maintenance period	
Finished	
Ongoing process (long term commitment)	
Other. What?	

27. Does the project will need further maintenance works? Or is it a single action? (Has the maintenance been costed for?)



28. Is your organisation leading the project alone?

29. Who decided to go along with this initiative?

30. Was the project done under any type of partnership?

31. If no, would you wish to develop partnership? Do you think this would help future restoration projects? How?

32. How is/was the project funded?

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33. How much was the actual initiative costed in?

34. How much did it actually cost?

35. If the two costs were difference, was it expected? How did you deal with it?

36. Were all the works paid for or were there any sort of voluntary works not costed for?

37. What is the expected final output of the project?



38. Are there specific targets to be achieved?

39. Is the project fulfilling the expectations? Is it working?

40. Are you actually monitoring or expect to monitor the outputs of the project? How?

41. How will you measure the success or failure of the project?

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42. Do you believe this restoration initiative is bringing any further benefit that can be achieving other objectives? (can you see any synergy?)

43. How would you measure the benefit of your initiative? (units if possible)

44. What is the scale of the restoration initiative/project benefits/success? What scale are you expecting to measure success?

Rate the benefit of the Restoration Project at the following scales:

Scale	Low	Medium	High
Catchment			
Sub-catchment			
Reach			
Other What?			

45. What is the timescale for the benefits to be obvious in this restoration project? On what timescale do you expect the benefits to be met?

Rate the benefit and the timescale of the Restoration Project for the following areas:

Areas	Benefit			Timescale		
	Low	Medium	High	Short term	Medium term	Long term
Biodiversity						
Sustainable Flood Management						
Physical Habitat						
Fisheries						
Diffuse Pollution						
Legislation						
...						

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46. Are you or have you found any obstacles to undertake this restoration initiative? If yes, what kind of obstacles?

47. Could the restoration project bring a non-benefit in any area of for anyone?



C. GENERAL VIEW ON RIVER RESTORATION

48. What are your general views of the Restoration Strategies in Scotland

49. Could you list weaknesses and strengths to put a River restoration strategy in place in Scotland? Identify gaps.

50. If you had to undertake a national restoration strategy, what would it be?

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51. How would you achieve it?



E. QUESTIONS ABOUT DRIVERS

DRIVER=

53. Which do you think is the main driver in River restoration at the catchment scale in Scotland? Why? (What do you think will push forward river restoration in Scotland?)

54. What role do you think [DRIVER] plays in the restoration national picture in Scotland?

55. Do you think [DRIVER] should have a greater role?

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56. To what extent do you think [DRIVER] is or should be a main driver for river Restoration?

57. Rate the importance of the role you think River restoration (related to [DRIVER]) have to sort out or to assist with the following issues/areas:

	High	Medium	Low
Diffuse Pollution			
Physical Habitat (hydromorphology)			
Fisheries			
Biodiversity			
Sustainable Flood Management			
Legislation (i.e. SAC)			
Climate change			
(Landscape)			
(Community demand)			
(Development gain)			
<u>Other?</u>			

58. On what timescale do you think we will see benefits in the following areas if we undertake river restoration with the [DRIVER]

Areas	< 5	5-10	10-20	20-50	>50
Diffuse Pollution					
Physical Habitat (hydromorphology)					
Fisheries					
Biodiversity					
Sustainable Flood Management					
Legislation (i.e. SAC)					
Climate change					
(Landscape)					
(Community demand)					
(Development gain)					
<u>Other?</u>					

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59. From the list below, regardless your specific projects (i.e. general terms) which of the following drivers you think can bring more benefits in terms of river restoration? Please, state your order of preference for each driver:

Diffuse Pollution	
Physical Habitat (hydromorphology)	
Fisheries	
Biodiversity	
Sustainable Flood Management	
Legislation (i.e. SAC)	
Climate change	
(Landscape)	
(Community demand)	
(Development gain)	
Other?	

60. Do you think Climate change should be a driver for undertaking river restoration initiatives? Can you see it as a major driver? How do you see climate change influencing in river restoration?



Any extra comments

*** Can you tell me of any other river restoration initiative or key person that you are aware of?**

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Appendix 6. *Full list of participant organisations in river restoration initiatives in Scotland.*

Participant organisation name (not leading)	number of projects by scale:					Total of projects participated	% of total partnership projects (78)
	reach	sub-catchment	catchment	multiple sub-catchm.	multiple catchm.		
SEPA	5	15	10	1	1	32	41.0
SNH	4	16	7	1	1	29	37.2
The River Restoration Centre	6	5	1			12	15.4
Farmers/land owners	2	2	5			9	11.5
Macaulay Institute		5	3		1	9	11.5
Association of Salmon Fishery Boards	5	3				8	10.3
Fisheries Research Services	5	3				8	10.3
Scottish Executive Environment and Rural Affairs Department	5	3				8	10.3
Scottish Water		6	2			8	10.3
Forestry Commission	2	3	2			7	9.0
Community groups	2	4				6	7.7
Forest Enterprise	3	1	1			5	6.4
University of Aberdeen		5				5	6.4
RSPB	2	1	1			4	5.1
Tweed Forum		4				4	5.1
Scottish and Southern Energy	3					3	3.8
Tweed Foundation	1	2				3	3.8
Aberdeenshire Council		1	1			2	2.6
Borders Forest Trust		2				2	2.6
Cairgorms National Park	1			1		2	2.6
Cree Valley Community Woodlands Trust			2			2	2.6
Glen Urquhart Land use Partnership	1		1			2	2.6
Scottish Agricultural College		1	1			2	2.6
Scottish Wildlife Trust	1		1			2	2.6
West Lothian Council		1	1			2	2.6
Argyll Fisheries Trust		1				1	1.3
Awe District River Improvement Association		1				1	1.3
BIOSS			1			1	1.3
Bladnoch District Salmon Fishery Board		1				1	1.3
Clackmannanshire Council			1			1	1.3
Clackmannanshire Heritage Trust	1					1	1.3
Dee District Salmon Fishery Board		1				1	1.3
East Scotland Water Community		1				1	1.3
Environment Agency		1				1	1.3
Esk District Salmon Fishery Board		1				1	1.3
Fife Biological Records Centre			1			1	1.3
Fife Coast and Countryside Trust		1				1	1.3
Fife Council			1			1	1.3
Formartine Partnership			1			1	1.3
FWAG		1				1	1.3
Galloway Fisheries Trust			1			1	1.3
Highland Birchwoods	1					1	1.3
Highland Council			1			1	1.3
Kyle of Sutherland District Salmon Fishery Board	1					1	1.3
Local authorities				1		1	1.3
Millenium Forest Scotland		1				1	1.3
Morrison construction	1					1	1.3
NFU			1			1	1.3
North Ayrshire Council	1					1	1.3
Perth and Kinross Council	1					1	1.3
River Ness District Salmon Fishery Board	1					1	1.3
Scottish Government			1			1	1.3
Scottish Native Woods		1				1	1.3
Tay District Salmon Fishery Board	1					1	1.3
Tayside Biodiversity Partnership	1					1	1.3
The Coal Authority		1				1	1.3
WWF					1	1	1.3

Strategies for river restoration at the catchment scale in Scotland: current status and opportunities

Appendix 6

