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Scottish Alliance for Geosciences, Environment and Society SAGES

Improving the Physical Environment

Scottish Freshwater Group / CREW

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Trevor Hoey
University of Glasgow

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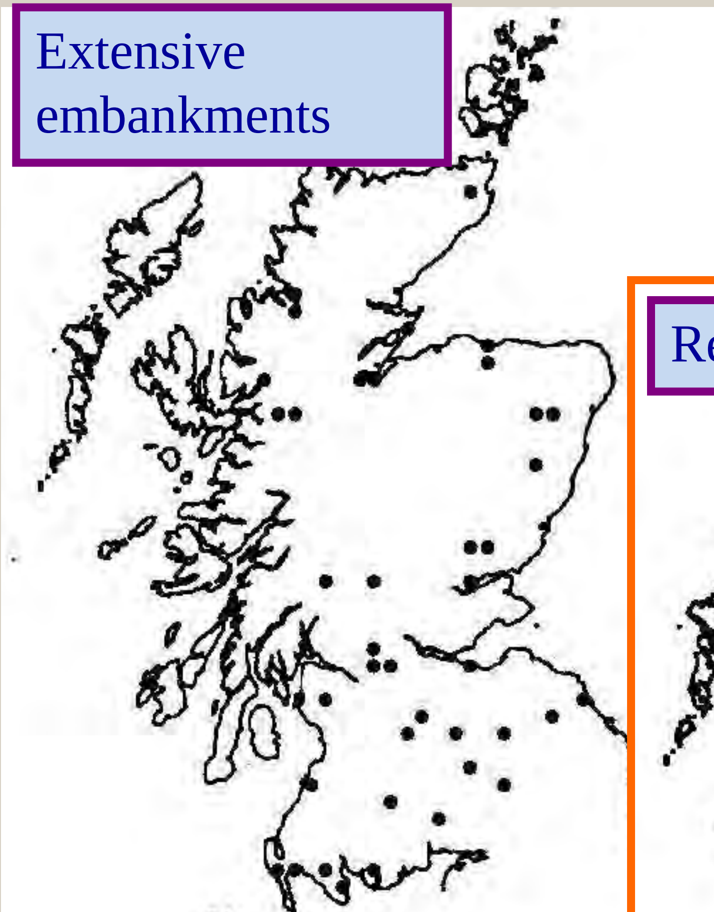
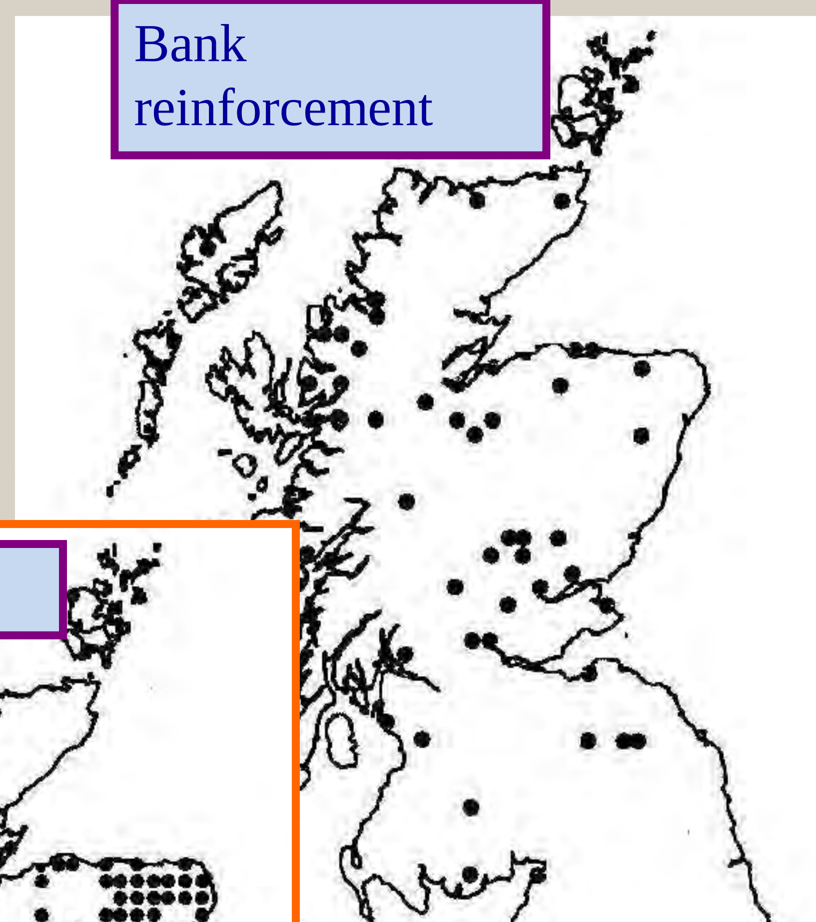
The condition of the beds, banks and shores of 22% of our rivers, estuaries and coastal waters has been adversely affected by a wide range of historical and current land uses…





RHS 1998

Types of modification in Scottish upland rivers

Modification type	Upland (%)
Channel straightening	0.0
Bank resectioning	17.0
Bank reinforcement	23.1
Embankments	4.4
Weirs or sluices	3.3
Culverts	0.0
Bridges	27.5
Fords	6.6
Extensively poached banks	1.1

% of reference sites affected

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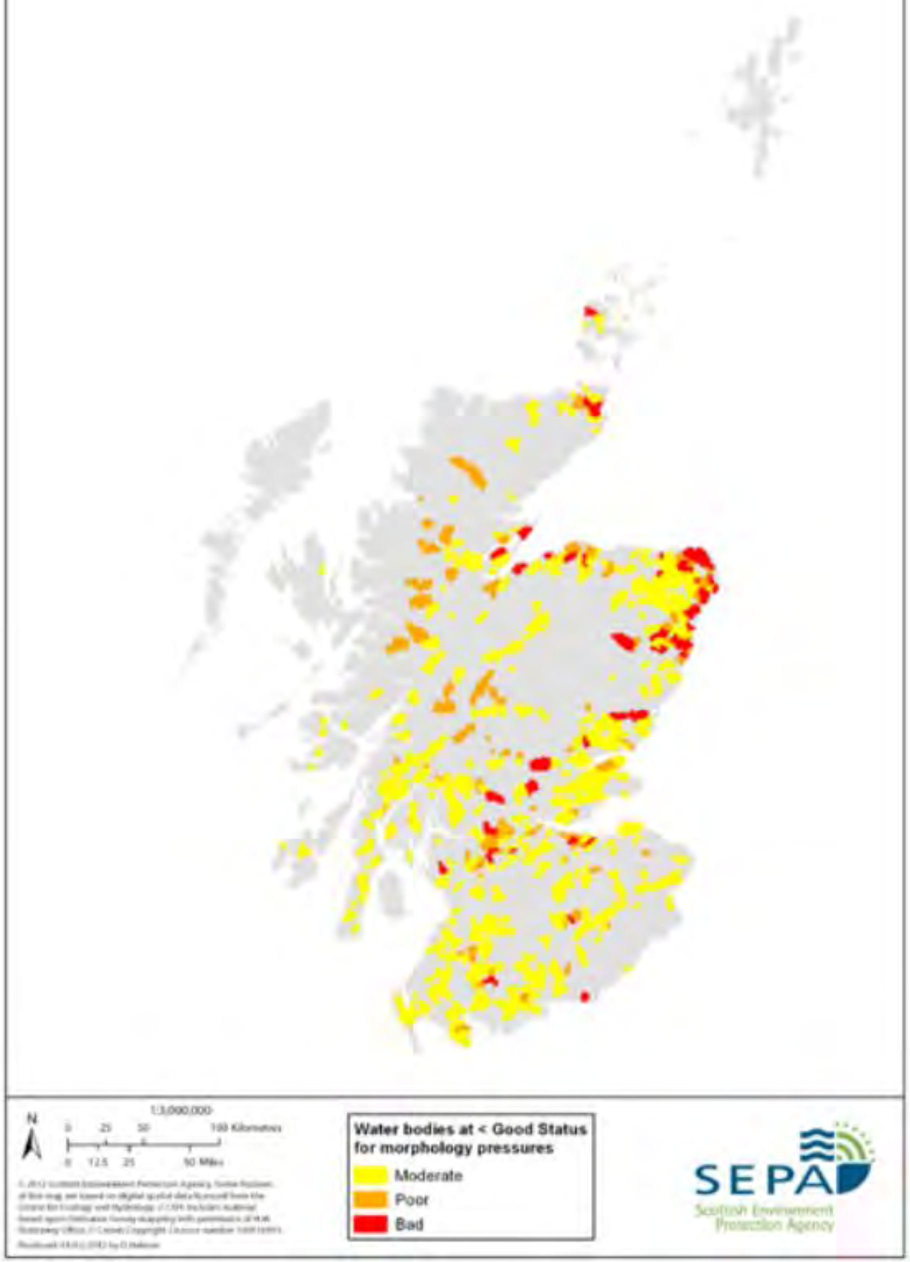
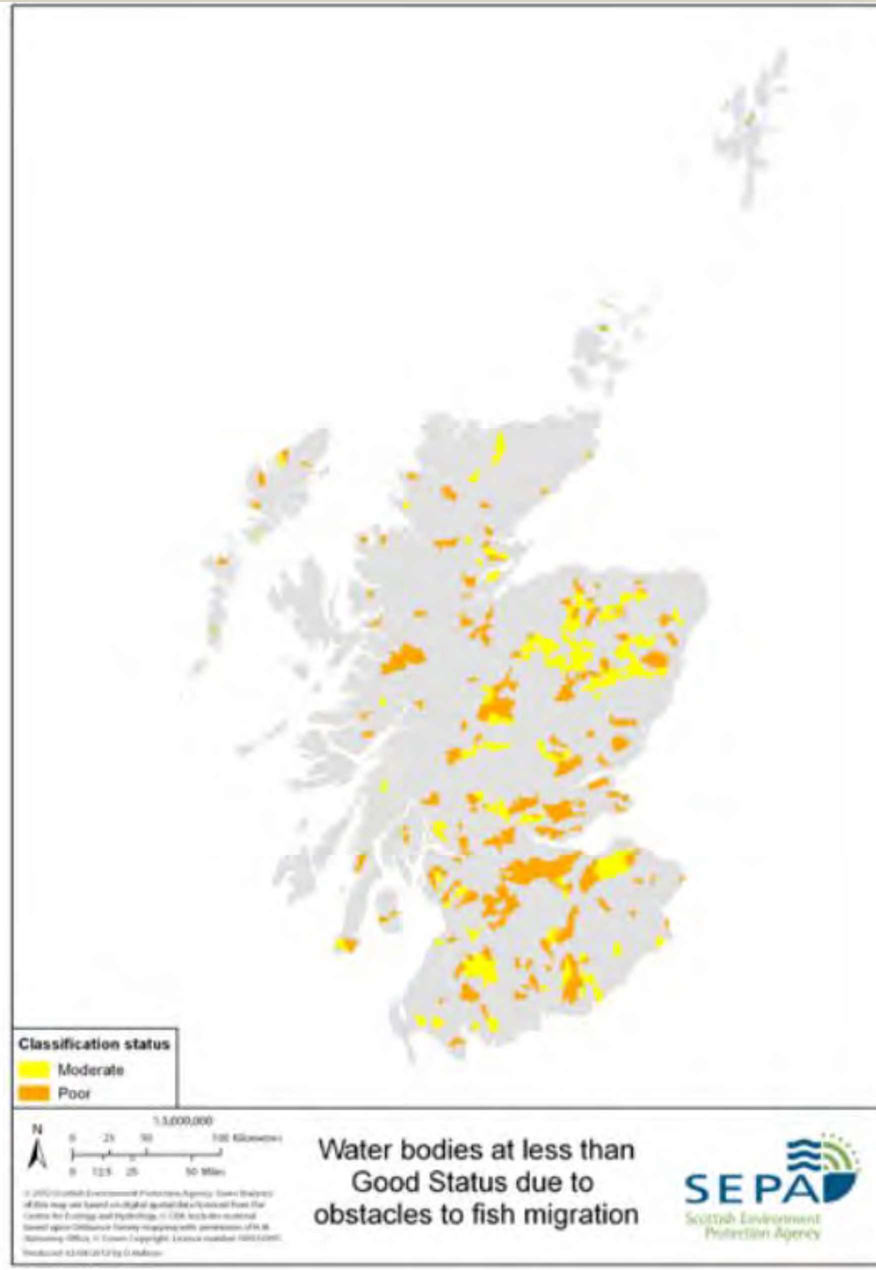
Table 1: Summary of pressures affecting Scotland's surface water bodies[9]

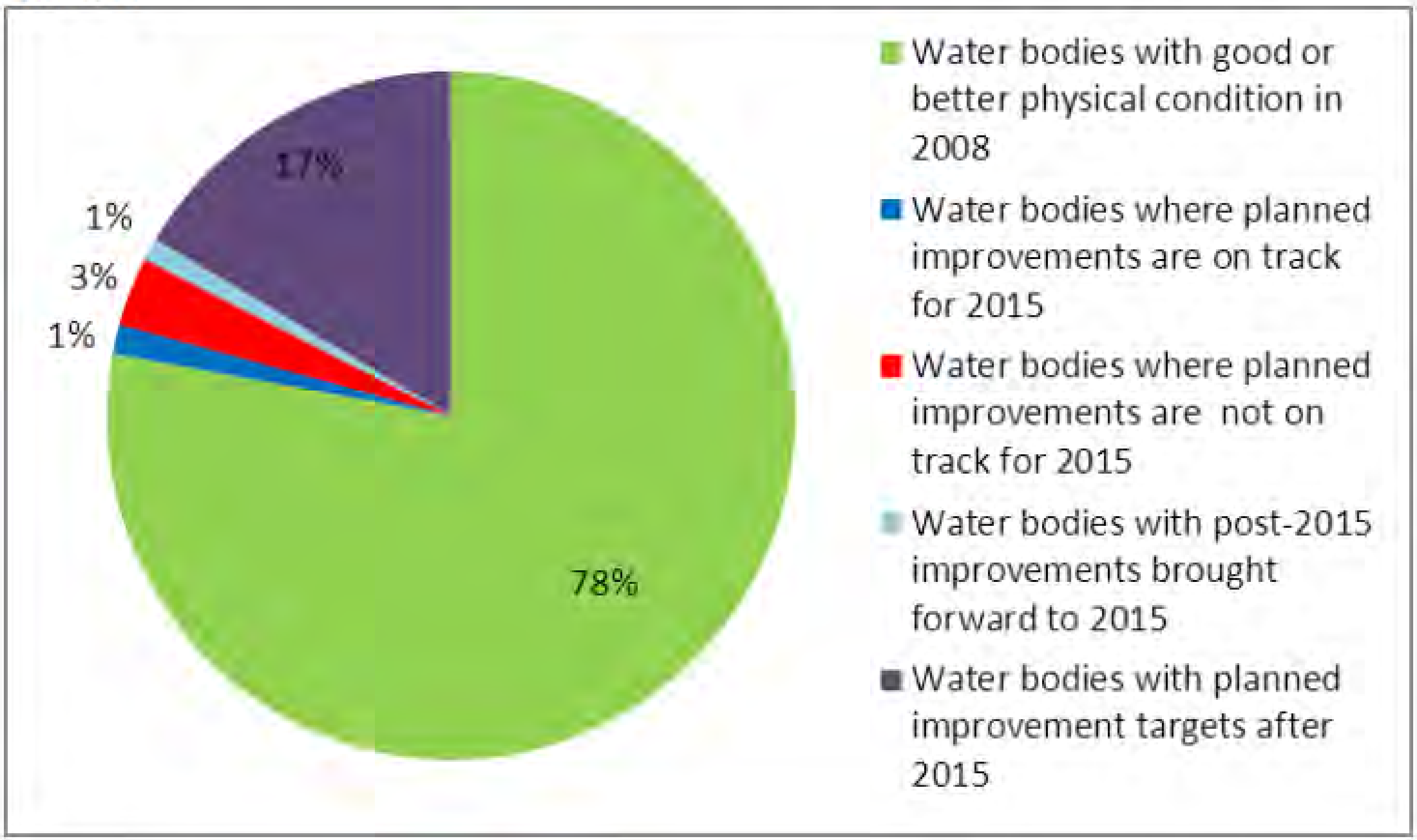
	Total number of surface water bodies	Percentage of number of surface water bodies
Surface water bodies in Scotland (excluding groundwater)	3233	100%
Surface water bodies at less than good ecological status / potential	1261	39%
Water bodies at less than good ecological status / potential because of physical changes (including changes to beds and banks, and fish barriers)	830	25%
Water bodies at less than good ecological status / potential because of changes to physical condition of beds and banks	546	17%
Water bodies at less than good ecological status / potential because of barriers to fish migration.	375	12%


1:3,000,000
N
0 25 50 100 Kilometres
0 12.5 25 50 Miles
Water bodies at < Good Status for morphology pressures
Moderate
Poor
Bad
SEPA
Scottish Environment Protection Agency

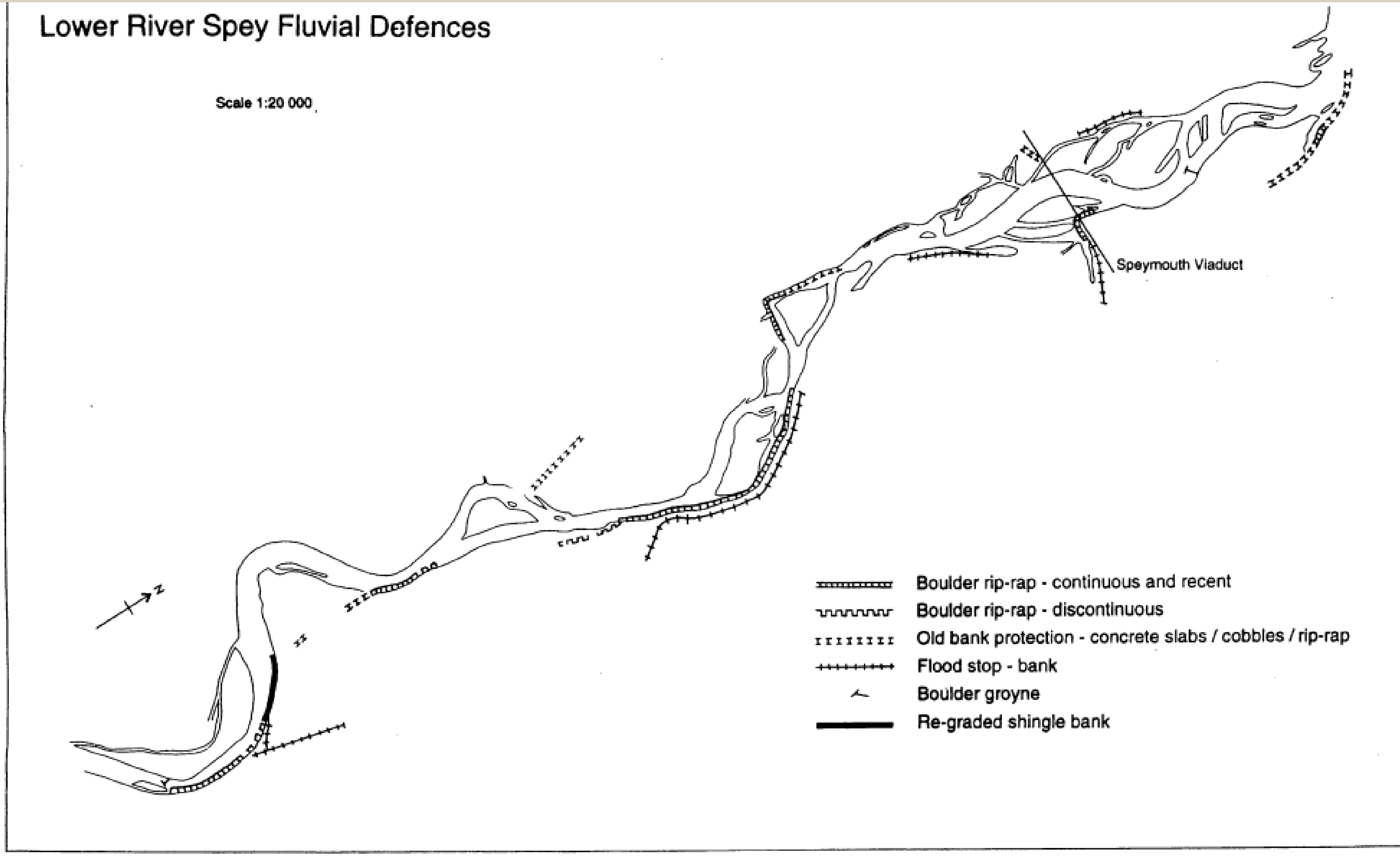

Classification status
Moderate
Poor
1:3,000,000
N
0 25 50 100 Kilometres
0 12.5 25 50 Miles
Water bodies at less than Good Status due to obstacles to fish migration
SEPA
Scottish Environment Protection Agency

Our understanding of the extent of alterations to the physical condition of water bodies is still developing. Designing effective improvements can take time because of the need to consider the implications of any changes in a catchment context.

Figure 8: Progress towards improvements to the physical condition of the water environment

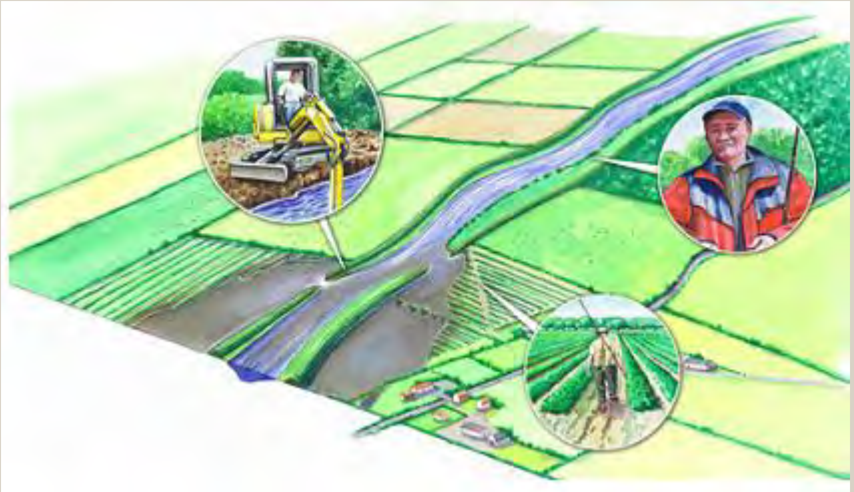


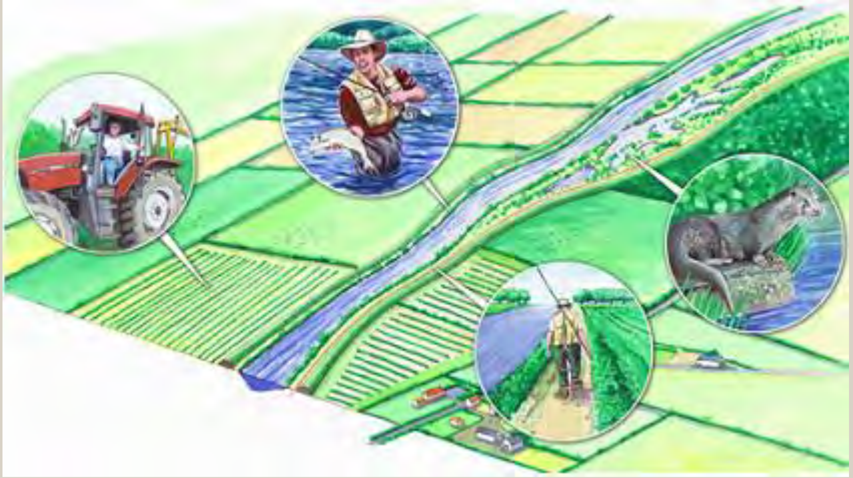
Lower River Spey Fluvial Defences



•*…setting out our strategy for improving the physical condition of water bodies to encourage and support projects to reinstate fish passage and improve damaged habitats*

•*Pilot projects to demonstrate combining restoration of habitats and flood risk reduction in three river catchments, the Glazert Water, River Dee and the River South Esk*





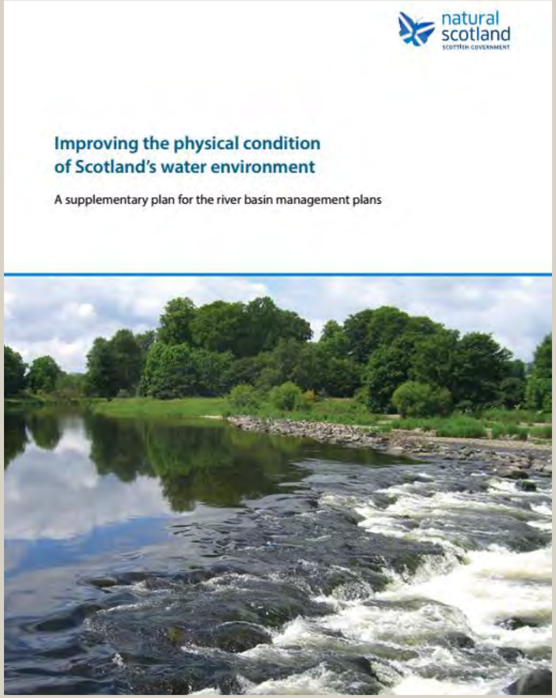
•*links our goals for the water environment with wider goals for biodiversity; woodland creation; fisheries; flood risk management; urban regeneration; and green-space and green network provision in and around our towns and cities.*

•*management of built structures in the water environment (such as road and rail crossings, etc) to embed environmental improvements into the maintenance programmes for those structures.*

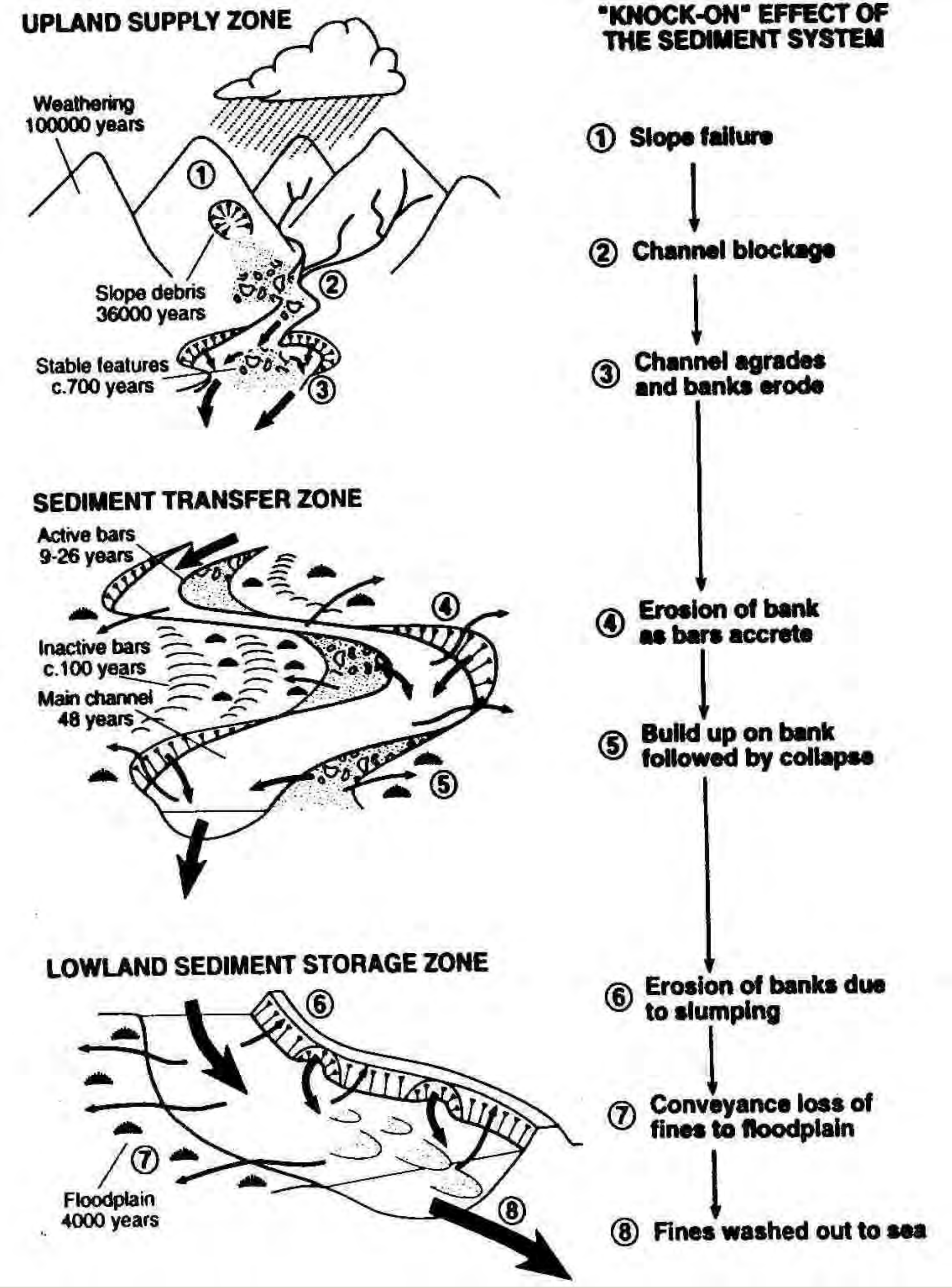
Principles

• **Plan at the catchment scale.** Physical pressures on habitats operate at the catchment scale and therefore require solutions to be developed at a catchment scale.

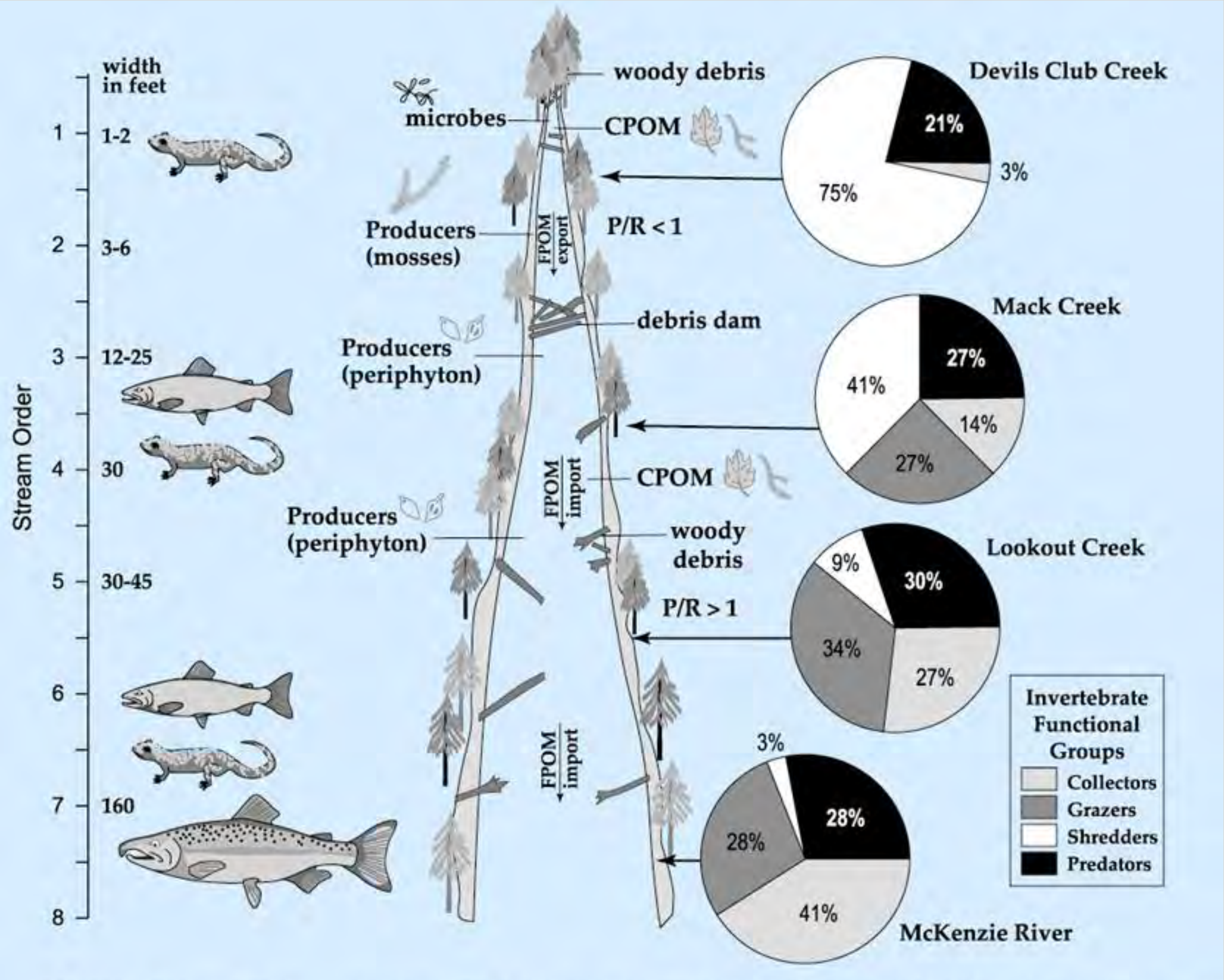
• **Support nature to do the work.** In many cases the environment will improve by itself if the pressures causing harm are removed.



Considerations of sediment in river management (Sear, Newson & Brookes)



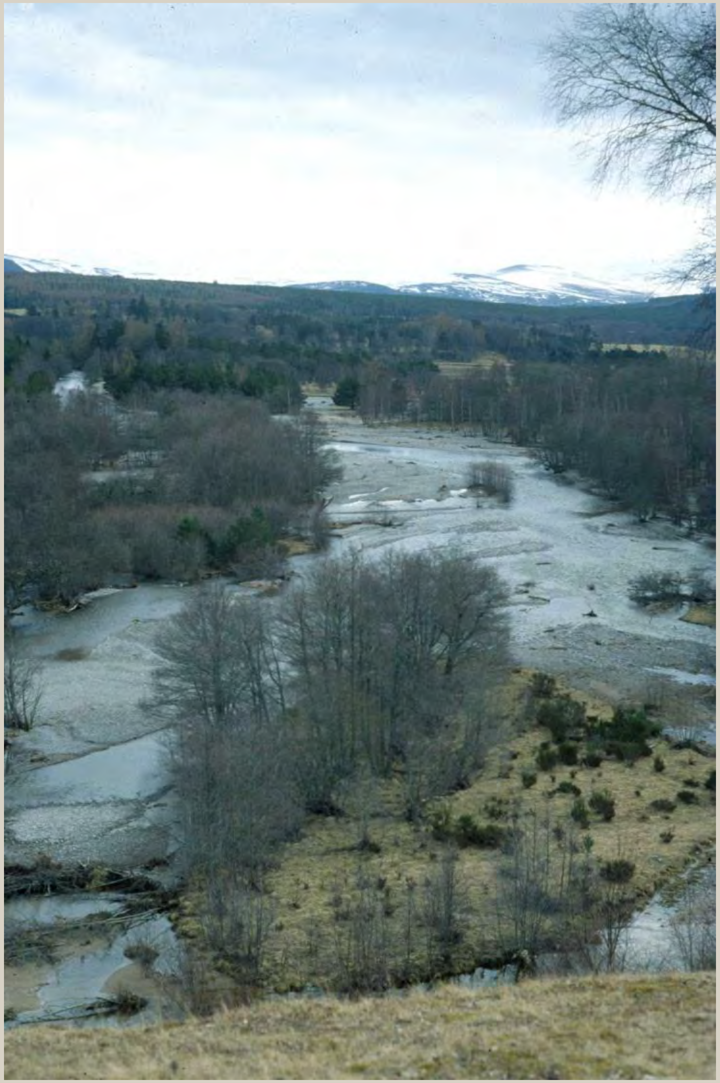
The river continuum concept (Vannote et al 1980)

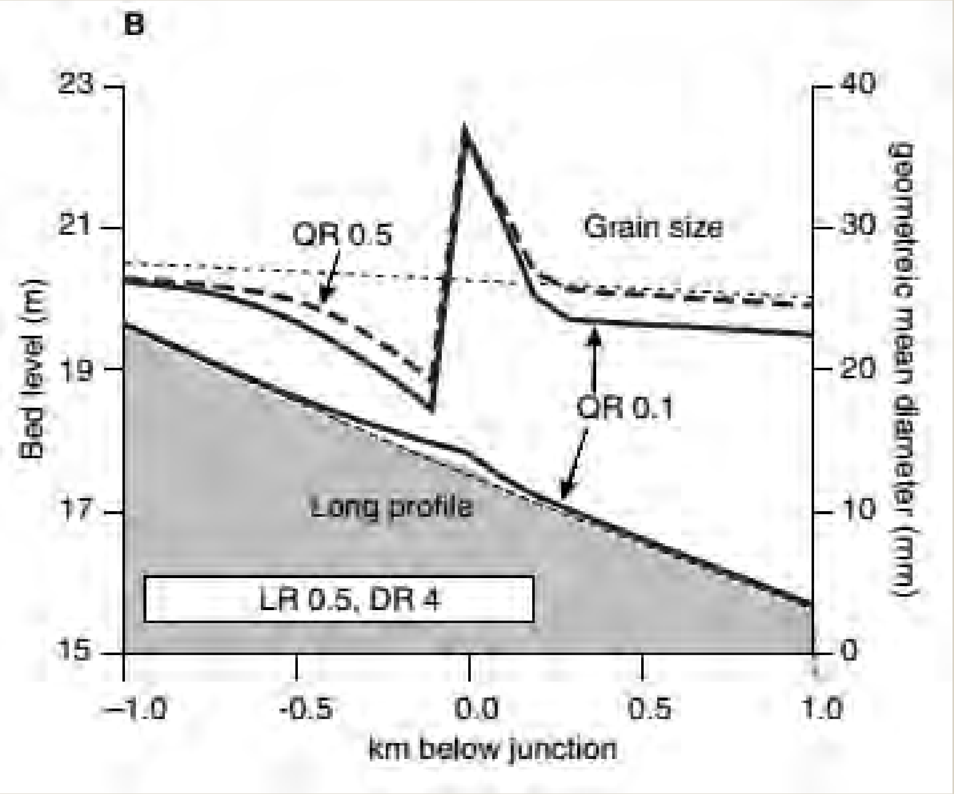


FPOM is fine particulate organic matter; CPOM is coarse particulate organic matter; P/R is the production/respiration

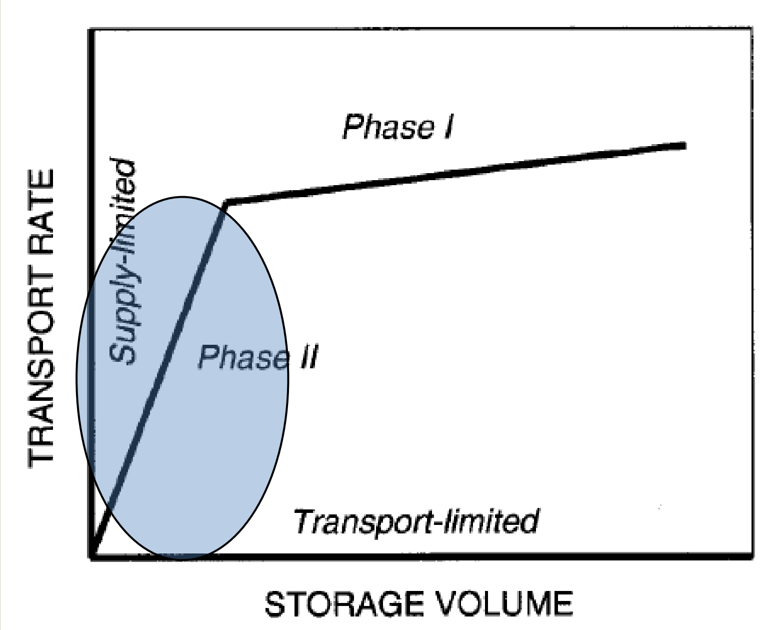
Image from Long term Ecological Research Network

Tributaries and network structure



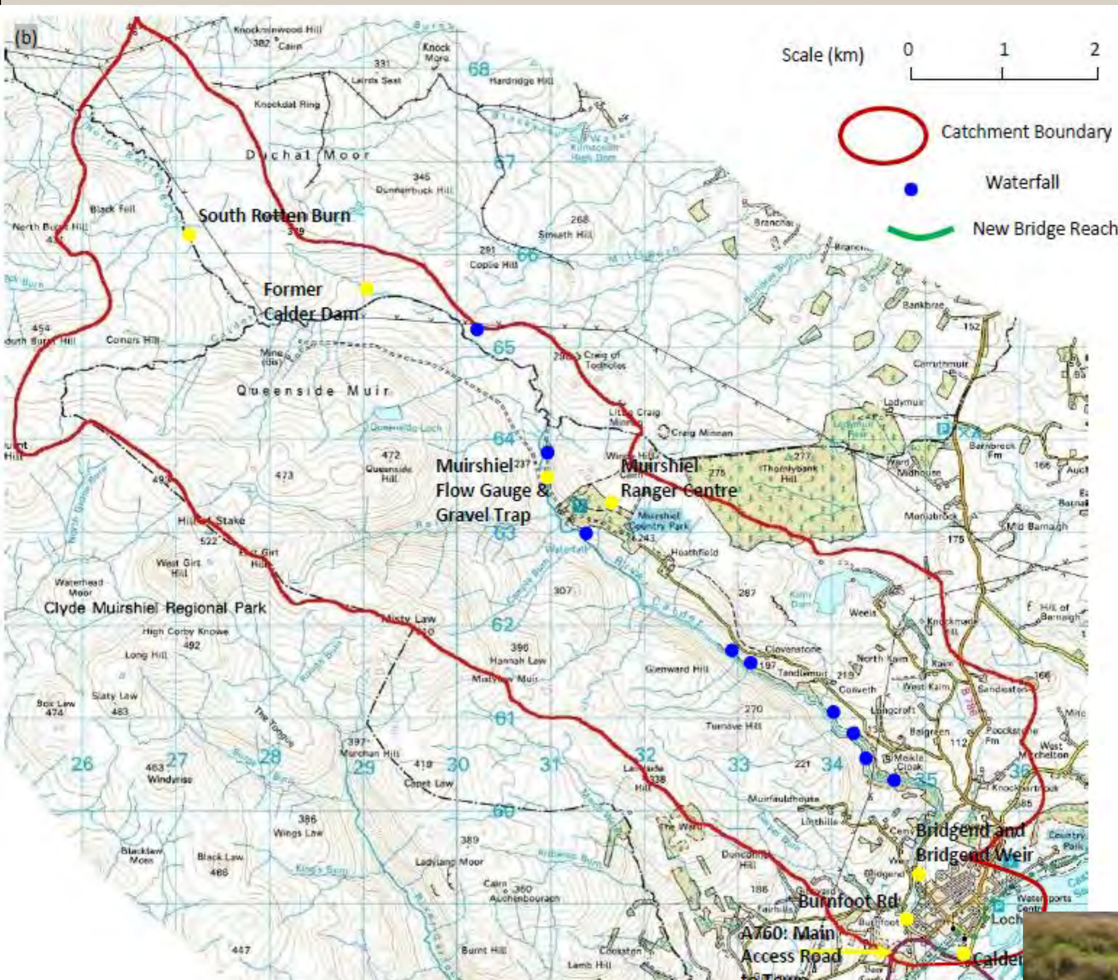


Sediment in Scottish rivers



Lisle & Church, 2002

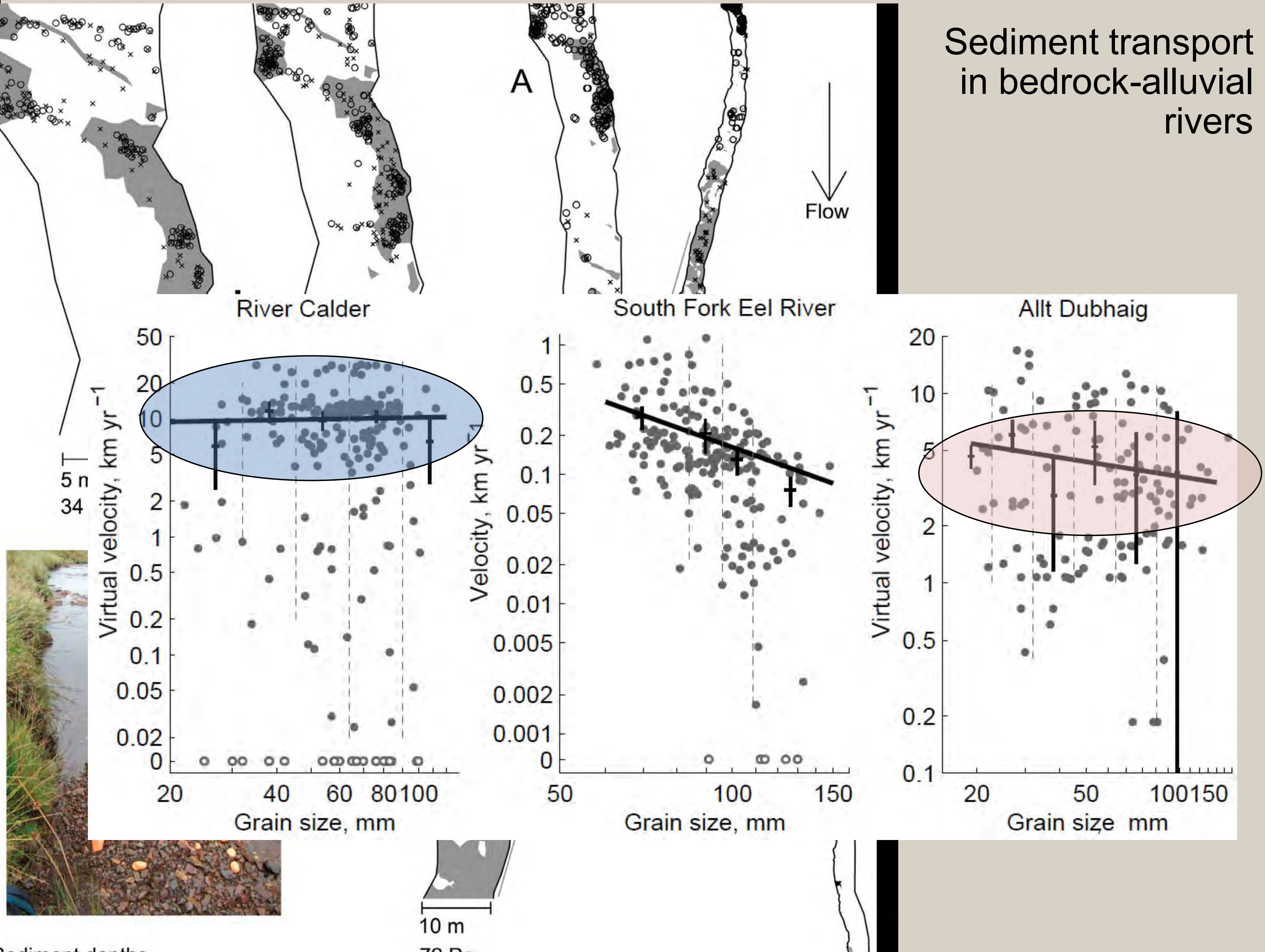
River Calder dam removal



- dam c.1850 – 1983
- after breach, released sediment has migrated downstream
- gravel front now c.4km from dam

Thompson, 2009

Sediment transport in bedrock-alluvial rivers



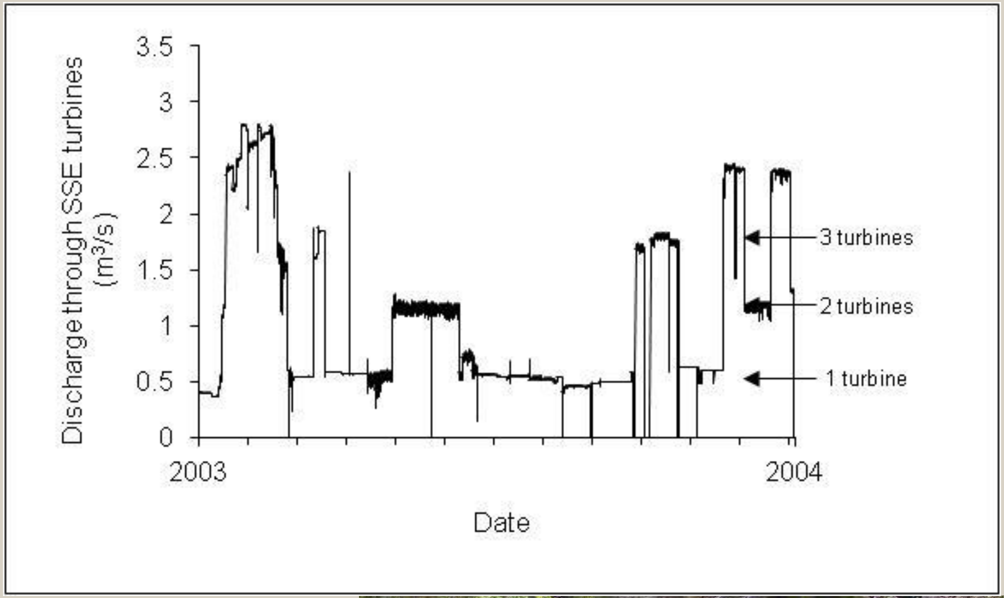
Timescales of adjustment

Active river bar: beginnings of vegetation colonisation

10-30 year old stable bar: alder, with broom and grasses

>40 year old stable bar: mature alder woodland

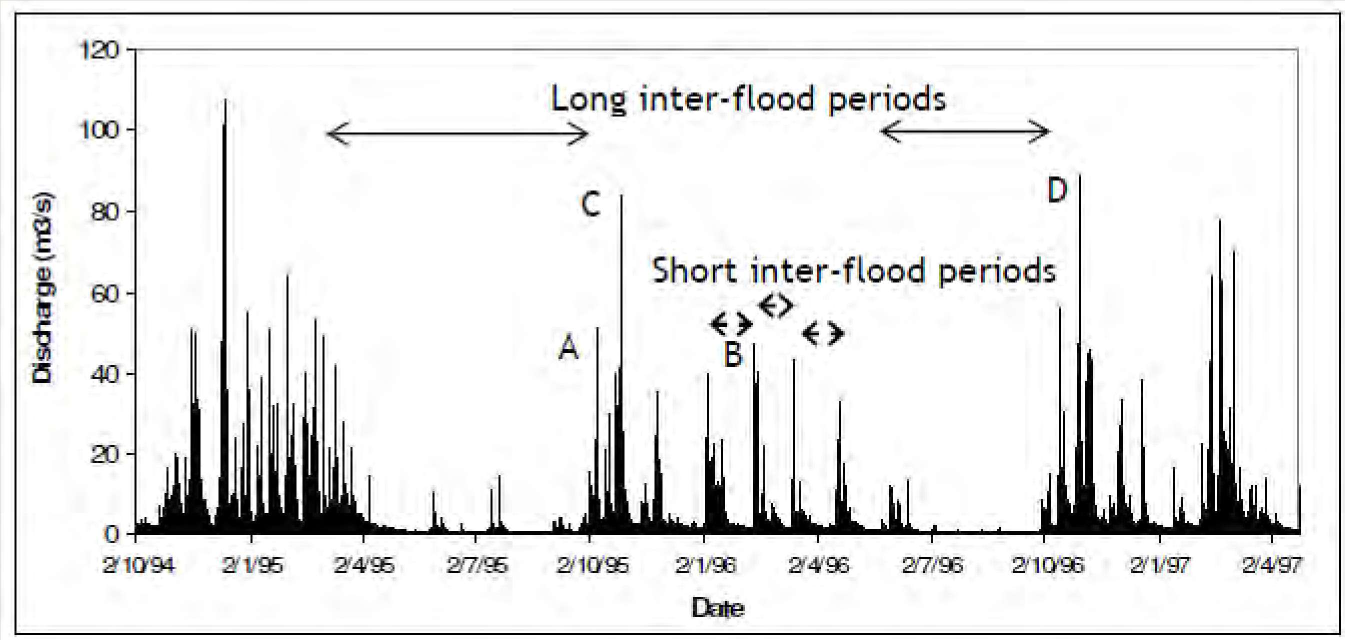
River Kerry: integrating morphology, flow regime and habitat quality



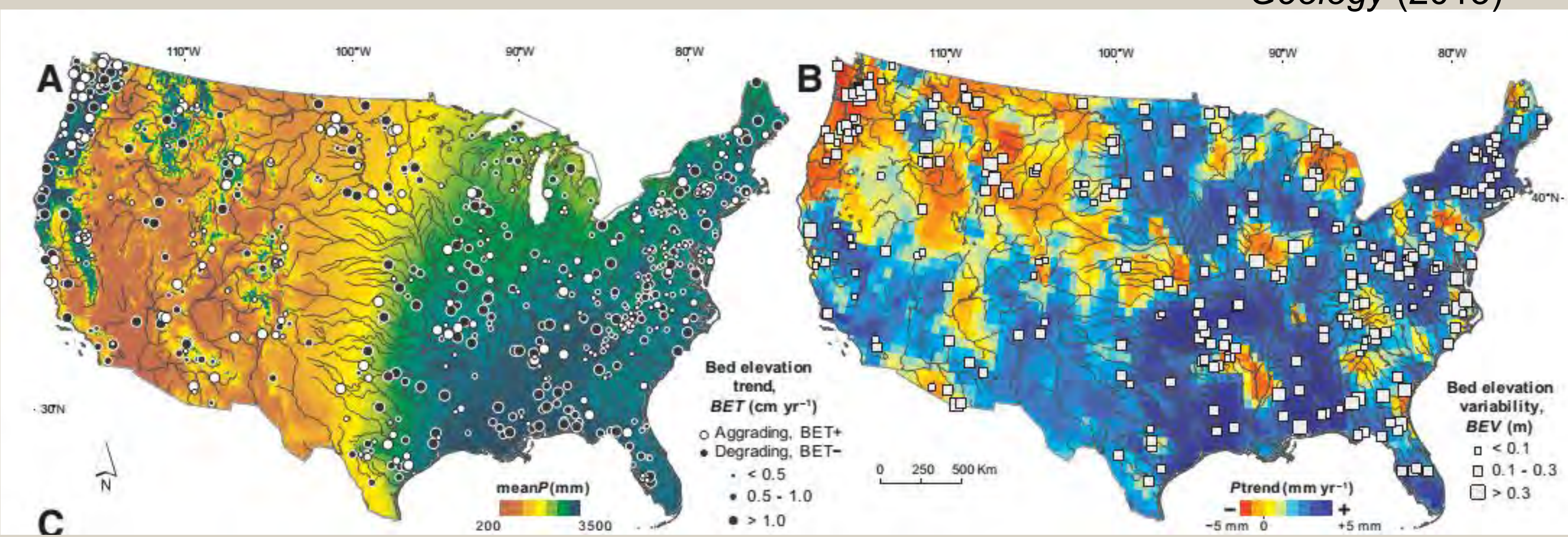



- habitat suitability controlled by:
    - flow regime
    - stable channel morphology
- flow regime favours mussel habitat because:
    - compensation flow ensures usable area
    - absence of large flood peaks

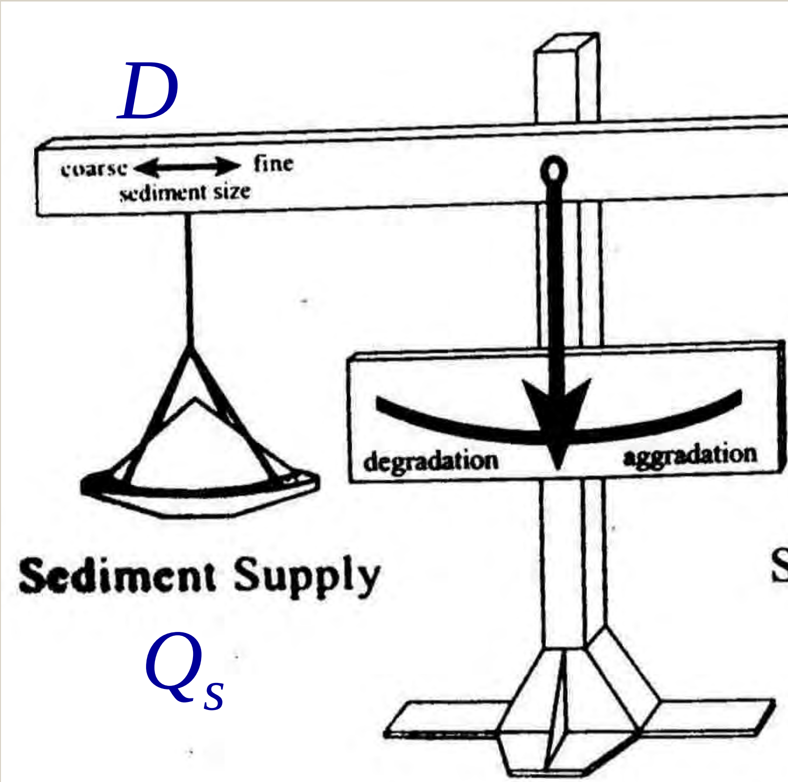
Impacts of (changing) flow regimes



Slater & Singer, *Geology* (2013)



The sediment balance: adjustment and availability



$$Q_s = f\left[\frac{QS}{D}\right]$$

Conclusions

- baseline knowledge still being acquired and interpreted
- historical impacts are complex and adjustments may be incomplete
- timescales of adjustment vary
- climate change impacts difficult to generalise
- system discontinuities significant (tributary junctions)
- catchment scale management is critical, but is it always appropriate?
- integration of issues (water quality and physical properties often related)
- urban rivers should not be over-looked