Restoring the Upper Catchment Functions of Rivers: the SCaMP Experience

Peter Worrall, Andy Keen and Gene Hammond Penny Anderson Associates.

“Restoring Back is Not the Way Forward:
Achieving a functioning ecosystem in the contemporary landscape
with reference to the trajectory of change”

University of Exeter, 16th - 17th April 2008
SCaMP Vision

Sustain economically viable farming/land practices in the uplands

Improve water quality and water resource management

To achieve favourable status on upland SSSI sites

Meet United Utilities biodiversity policies and aspirations
FARM PLANS

Farm rationalisation and diversification

Livestock management procedures

Fencing

Grip blocking

Blanket bog restoration (4000ha on Ashway Gap)

Clough woodland planting (>300,000 trees by 2010)

Rush pasture and hay meadow management for key breeding bird species
Hypothetical catchment discharge hydrographs for pre and post treatment moorland grip blocking sites.
Vegetation Obstacles: Force – Resistance – Climate Change?

- Flow direction
- Stoss
- Obstacle
- clast
- Wake

Obstacle = Rooted Clod (*Juncus* spp)

Obstacle = Sprouting Tree (*Salix alba*)

Obstacle = Emergent macrophytes (*Sparganium erectum*)

Obstacle = Sprouting Tree (*Salix alba*)
Learning from Semi-Natural Reference Systems 1

River Tagliamento, Italy

Geomorphology and Biocomplexity driven by:

RIPARIAN TREES

(Black Poplar)

Research funding: Natural Environment Research Council
IMPACT OF RIPARIAN TREE MANAGEMENT?

Learning from Semi-Natural Reference Systems 2

Rivers Frome & Tern England

Geomorphology and Biocomplexity driven by:

EMERGENT MACROPHYTES

Research funding: Natural Environment Research Council
River Deposition of Viable Seeds?
104,818 viable propagules
172 species

On average ca.
1500 props / m²
and 40 species deposited every 4 months

Differences in species composition from channel to bank top
Different in species composition between rivers

..... and between seasons

..... most species deposited in winter
Where on the river bed are the propagules stored?

<table>
<thead>
<tr>
<th>Class</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed Sediment Calibre</td>
<td>silt</td>
<td>sand</td>
<td>gravel</td>
<td>sand /gravel</td>
<td>silt</td>
<td>gravel</td>
</tr>
<tr>
<td>Surface Sediment Calibre</td>
<td>silt</td>
<td>sand</td>
<td>sand</td>
<td>sand /gravel</td>
<td>silt</td>
<td>gravel</td>
</tr>
<tr>
<td>Nearest vegetation</td>
<td>emergents</td>
<td>trees/</td>
<td>riparian</td>
<td>aquatics</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Position w.r.t. vegetation</td>
<td>Within &lt;1m DS</td>
<td>&lt;1m DS</td>
<td>within /edge</td>
<td>edge /between</td>
<td>no veg</td>
<td>no veg</td>
</tr>
<tr>
<td>Nearest macrophytes</td>
<td>Sparganium erectum</td>
<td>Phalaris arundacea</td>
<td>Ranunculus penicillatus</td>
<td>Ranunculus penicillatus</td>
<td>Myriophyllum spicatum</td>
<td>no macrophytes</td>
</tr>
<tr>
<td>Location w.r.t. macrophytes</td>
<td>within /between</td>
<td>none /upstream of macrophytes</td>
<td>within /between</td>
<td>between /upstream</td>
<td>no macrophytes</td>
<td>no macrophytes</td>
</tr>
<tr>
<td>Number of species</td>
<td>11</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Propagules/m²</td>
<td>660</td>
<td>320</td>
<td>360</td>
<td>167</td>
<td>300</td>
<td>65</td>
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</table>
4-stage biogeomorphological sequence: bank aggradation / migration

- Water (baseflow stage in cross-profiles)
- Vegetated bank top
- Fine sediment and propagule accumulation
- Root-reinforced, aggrading fine sediment and propagule accumulation
- Surface aggraded to support ruderal wetland species
- Surface aggraded to support more competitive riparian species

FLOW DIRECTION

Emergent aquatic species
Ruderal wetland species
Competitive riparian species
Plant Engineering in River Restoration

River Cole, West Midlands, UK

In collaboration with: Environment Agency and RMC Aggregates
Research funding: Natural Environment Research Council
Urban catchment

New Channel

Historical sinuosity

Cut in intact floodplain sediment, surroundings mined and back-filled

Channel wide enough for internal adjustment

Trapezoidal cross section

No seeding or planting

Fencing
The vegetation after 2 years is most similar to seed species deposited in the 2 winters and intervening summer.
Vegetation Obstacles Stage 1 - 0.5 YEARS
VEGETATED CLODS on the inside of Bends
Vegetation Obstacles Stage 2 - 3 YEARS
EMERGENT MACROPHYTIES

& some Trees
Vegetation Obstacles Stage 3 - 4 YEARS

RIPARIAN TREES

- Tree Planting by River
- Tree Planting by People

- Riffle
- Emergent macrophytes
- Bank toe extension
- Pool
- Well-vegetated banks (but turnover commencing)
- Complex and diverse vegetation cover (>150 mainly native species, including oak)
- Willow trees starting to engineer bank and channel form (channel bed deepening around larger root boles)
- No Himalayan balsam
### Research Collaborators:

<table>
<thead>
<tr>
<th>Institution</th>
<th>Collaborators</th>
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</thead>
<tbody>
<tr>
<td>Atkins:</td>
<td>Ian Morrissey</td>
</tr>
<tr>
<td>CEH:</td>
<td>Patrick Armitage, Owen Mountford</td>
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<tr>
<td>Entec UK Ltd:</td>
<td>Jo Goodson</td>
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<tr>
<td>ETH Zurich:</td>
<td>Peter Edwards</td>
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<tr>
<td>IGB Berlin:</td>
<td>Klement Tockner</td>
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<td>Jacobs UK Ltd:</td>
<td>Angela Boitsidis</td>
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<tr>
<td>King’s College London:</td>
<td>Rob Francis, Helen Moggridge</td>
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<tr>
<td>University of Nottingham:</td>
<td>Nick Clifford</td>
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<tr>
<td>University of Sheffield:</td>
<td>Ken Thompson</td>
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<tr>
<td>University of Trento:</td>
<td>Luca Zanoni</td>
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<td>University of Westminster:</td>
<td>Geoff Petts</td>
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River Restoration in a Global Context - how do we compare?

Martin Janes and Jenny Mant
River Restoration Centre

Annual Network Conference 2008
Dominated by WFD work.
- Better use of science and planning.

European Centre for River Restoration
- International RR conference in June (Venice)
- Top 3 themes for presentations (250 total)
  1- Biodiversity and hydromorph processes
  2- Evaluation and monitoring success
  3- Managing physical habitat and sediment
the River Restoration Centre
Australia

- Driest continent
  - Shortages, efficiency, flooded kms vs muddy pools. Very different systems - valuable approaches.

- Local community involvement – ‘our’ problem
  - Development/planning - Water use, flood storage, recycling and amenity
  - Use of local advocates to ‘sell’ the message of science and practice
  - Water trading for wetlands – time your use
  - From local council education projects (healthy catchments) to national R&D programmes
Science and people

- National Riparian Lands, 13 year R&D:
  - Good science available, but overlooked the social and economic community constraints

- 5 P’s – Building capacity (farmers/owners)
  - Profit – in environmental, economic and social terms
  - Proof – in the science to provide confidence to act
  - People – valuing knowledge and understanding the context within which people live and work
  - Place – the connection people have with their rivers
  - Promise – to work for improved (on-farm) outcomes

- ‘Resources’ seen as money, but more often is time
  - 5 years to build a relationship, then start to work together
Australian River Restoration Centre

Support, facilitate and provide opportunities for Australians to work together to protect, maintain, restore and celebrate our riverine environments.
2006: formation of the ARRN
- Japan – (RFC) Secretariat
- Korea (KICT) and China (IWRH).

Key issues
- **Japan** - loss of habitat through construction,
- poor integration of engineering and ecology. RFC active since 1990’s.
- **Korea and China** – Water quality & water use
- Interest from scientists,
- Dependant on political will,
- Support for high profile projects (Seoul City),
Urban space and flood design

- History of formal landscape management
  - Early schemes very stylised

- Flood storage in the urban catchment
  - Land purchased by government bodies

- Integrating flood storage and public access
  - Flood storage and creation of public space
  - Formal in urban areas (parks, sports pitches)
A problem shared is a problem halved?

- Floodplain lake reconnection on the Yangtze, China

- Government/local community/WWF
- 62 km² river-lake reconnection
- Climate change/water quality
Options for connections – 3 years
A time for reflection! – 3 Gorges Dam

Facts:
- Built on a fault line
- 2300m wide
- Crest – 185m
- Flood control capacity 22.15 billion m\(^3\)
- Electricity (3%) – 18200 megawatts

Environmental issues:
- No fish passage
- Disconnection of ox bow lakes
- Change in flood hydrograph – impact on staple crops (rice, oil seed rape and sweet potato)
- Backwater approx 180km
- Climate change?

NGO Aspirations:
- Monitoring impact
- Reconnect oxbows - wetland
North America and Canada

Criteria to measure ecological success of river restoration

- Palmer et al (2005) – 5 key points
  - Design to improve dynamics and health
  - Show measurable improvement
  - Resilience to natural perturbations
  - Ensure construction has no lasting negative impact
  - Make pre- and post-monitoring data publically available

- National River Restoration Science Synthesis
  - Was project built as designed; were objectives achieved
  - Is adaptation needed
  - Answer? Proposals not clearly defined; incompatible objectives
  - Watershed issues not considered; few full PPA (10 years+)
Now you see it, now you don't (Mackay Creek)
Inception, completion and beyond

- River Thur, Switzerland – pilot project example (from decision support to monitoring)

Adapted from Reichert et al 2007 – Aim: high objectives/rank
River Thur – project and monitoring
Monitoring objectives

- Element of planning process
- Quality control and cost
- Control of original objectives
- Effectiveness of measures
- A learning process
- Communication
- Stakeholders satisfaction
- Adaptive management
- EAWAG *(Swiss federal science of technology) – call for European observatory*
UK restoration ‘network’ well developed........
BUT...........questions

- Is restoring back the best way forward?
- How can we, as a restoration community develop sound knowledge?
- What is the best way forward for river restoration – key elements?
- What is your own/your company’s/your agency’s commitment to River restoration?
- What should RRC be doing (that perhaps it isn’t at the moment) to help river restorers?
- And finally........