Restoring the Upper Catchment Functions of Rivers: the SCaMP Experience

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

***the* River Restoration Centre**
9th ANNUAL NETWORK CONFERENCE

"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

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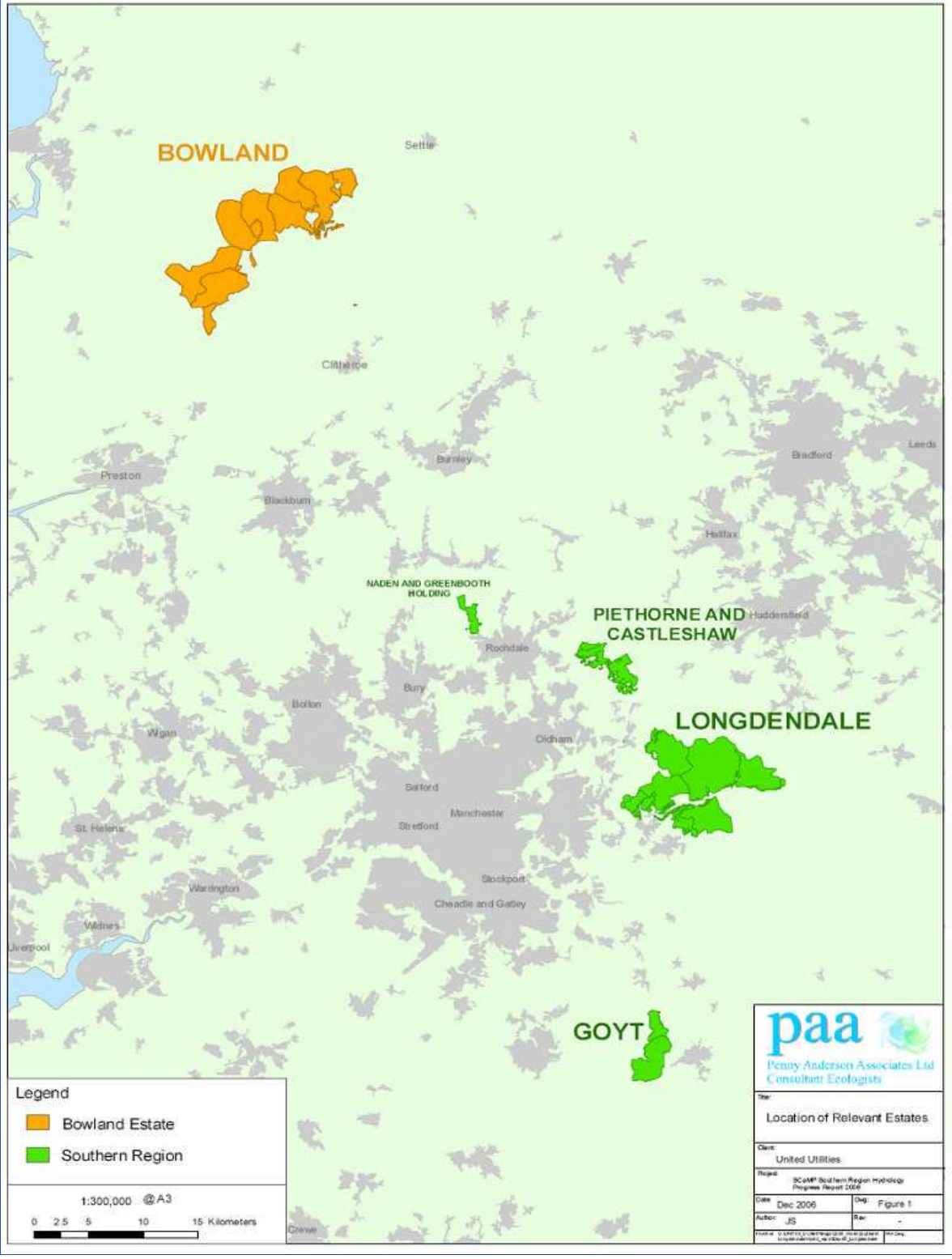
SCaMP Vision

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


BOWLAND
Settle
Clitheroe
Burnley
Preston
Blackburn
Bradford
Leeds
Halifax
NADEN AND GREENBOOTH HOLDING
PIETHORNE AND CASTLESHAW
Huddersfield
Rochdale
Bury
Bolton
Wigan
Oldham
LONGDENDALE
Salford
Manchester
Stretford
St. Helens
Stockport
Warrington
Cheadle and Gatley
Widnes
Liverpool
GOYT
Crewe
Legend
Bowland Estate
Southern Region
1:300,000 @A3
0 2.5 5 10 15 Kilometers
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Title:
Location of Relevant Estates
Client:
United Utilities
Project:
SCAMP Southern Region Hydrology Progress Report 2006
Date: Dec 2006
Dwg: Figure 1
Author: JS
Rev: -

FARM PLANS

Farm rationalisation and diversification

Livestock management procedures

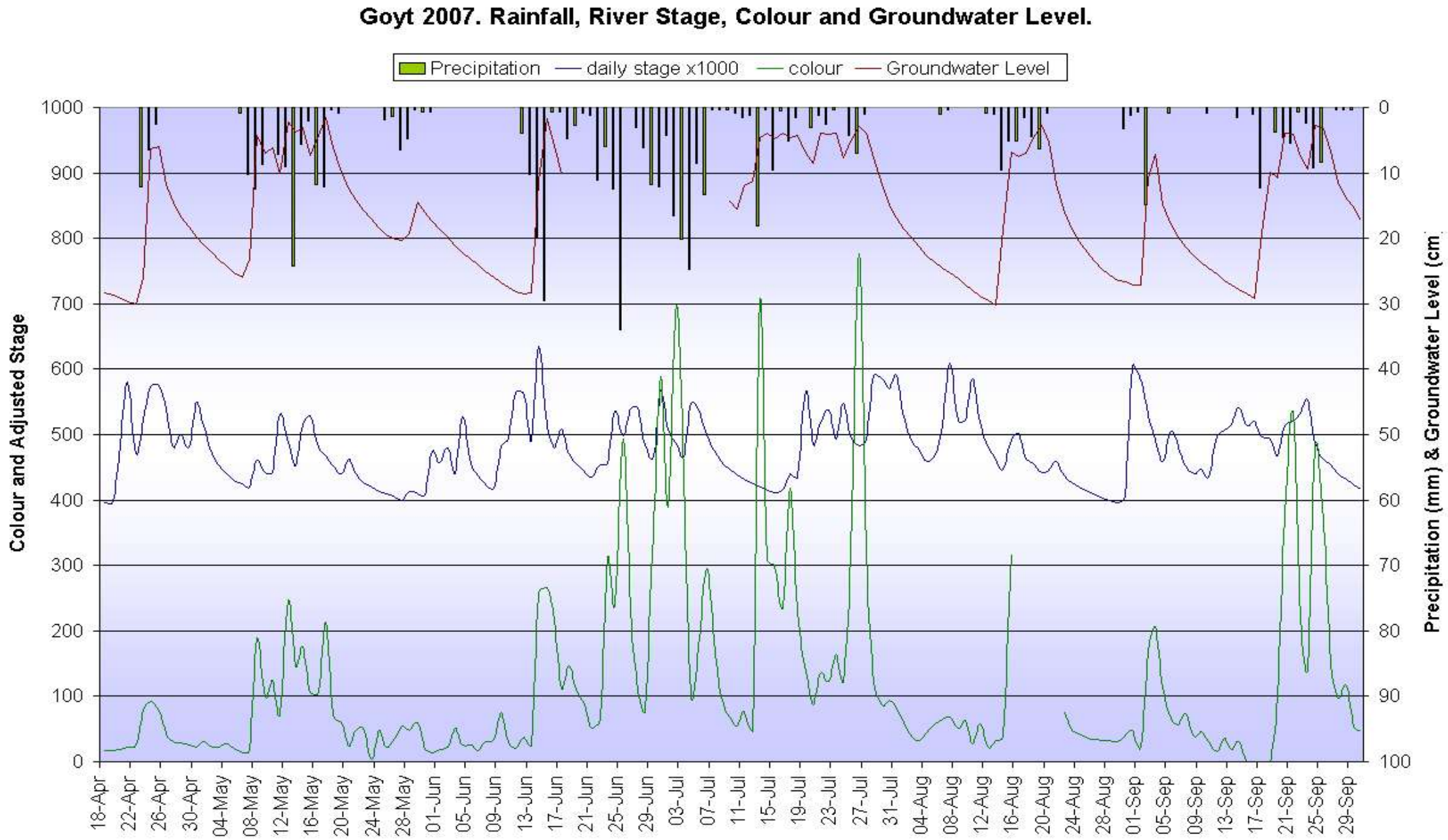
Fencing

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


Goyt 2007. Rainfall, River Stage, Colour and Groundwater Level.
Precipitation
daily stage x1000
colour
Groundwater Level
Colour and Adjusted Stage
Precipitation (mm) & Groundwater Level (cm
1000
900
800
700
600
500
400
300
200
100
0
0
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20
30
40
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60
70
80
90
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18-Apr
22-Apr
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01-Jun
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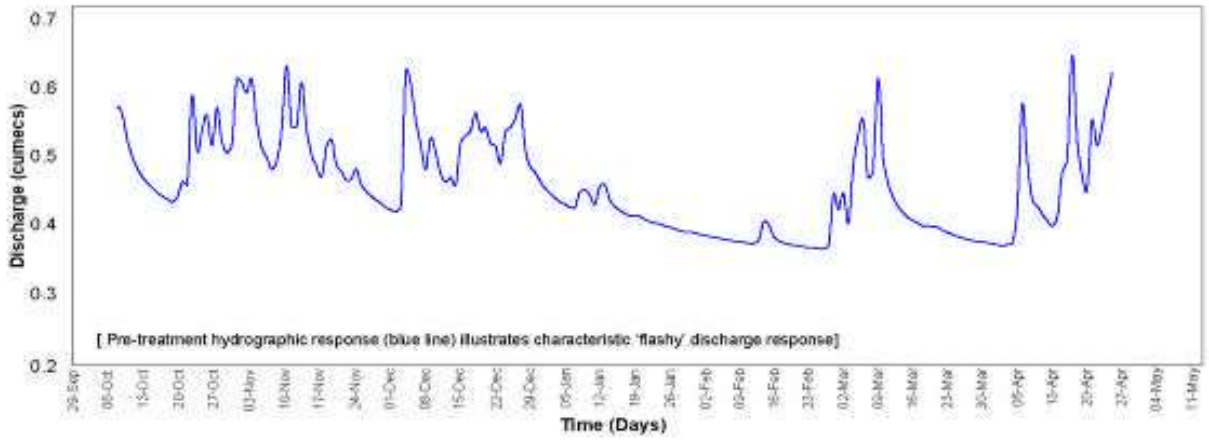
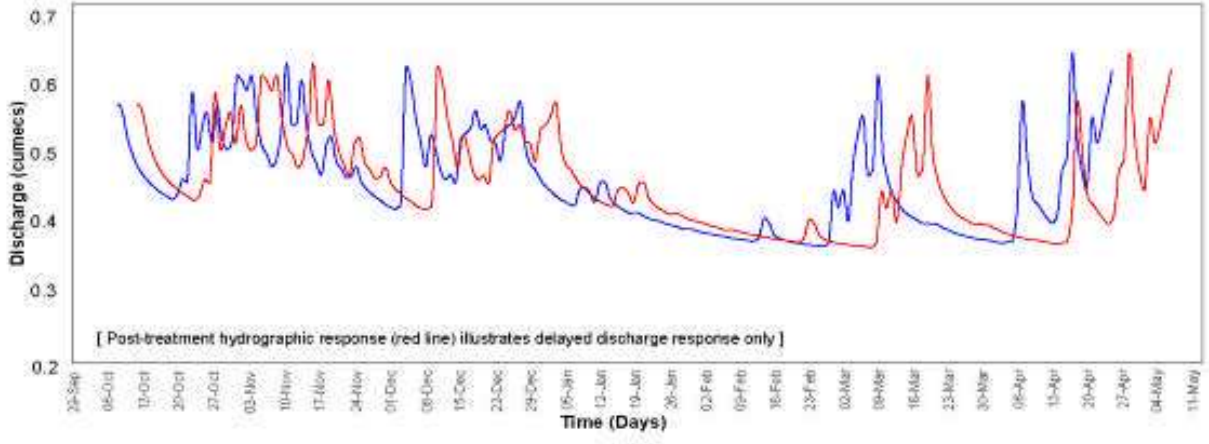
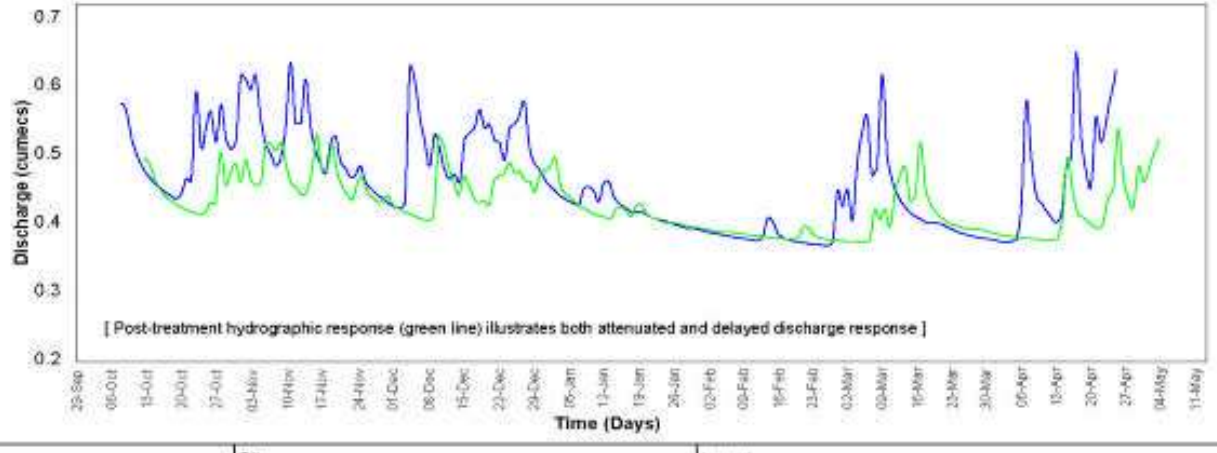
29-Sep







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Title:

Hypothetical catchment discharge hydrographs for pre and post treatment moorland grip blocking sites

Legend:

- Discharge hydrograph – pre-treatment
- Discharge hydrograph – post-treatment (grip blocking)
- Discharge hydrograph – post-treatment (grip blocking) and *Sphagnum* habitat regeneration

Vegetation Dynamics and River Restoration

Angela Gurnell

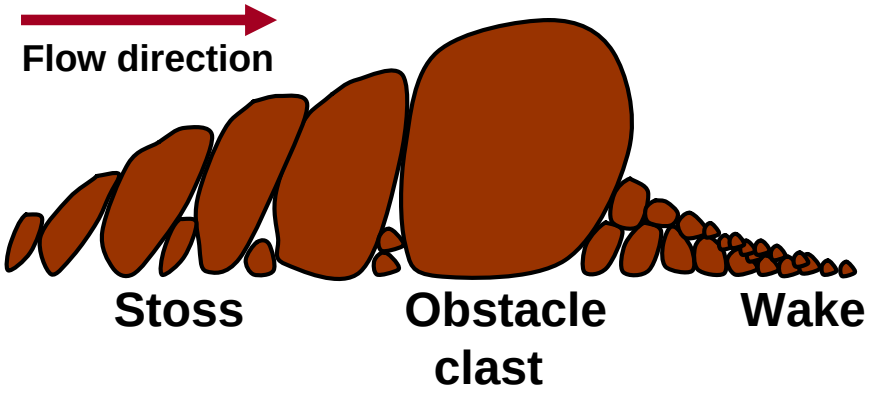
KING'S College LONDON

University of London

Centre for Environmental Assessment Management and Policy
and
Department of Geography

Vegetation Obstacles:

Force – Resistance – Climate Change?



Learning from Semi-Natural Reference Systems 1

River Tagliamento, Italy

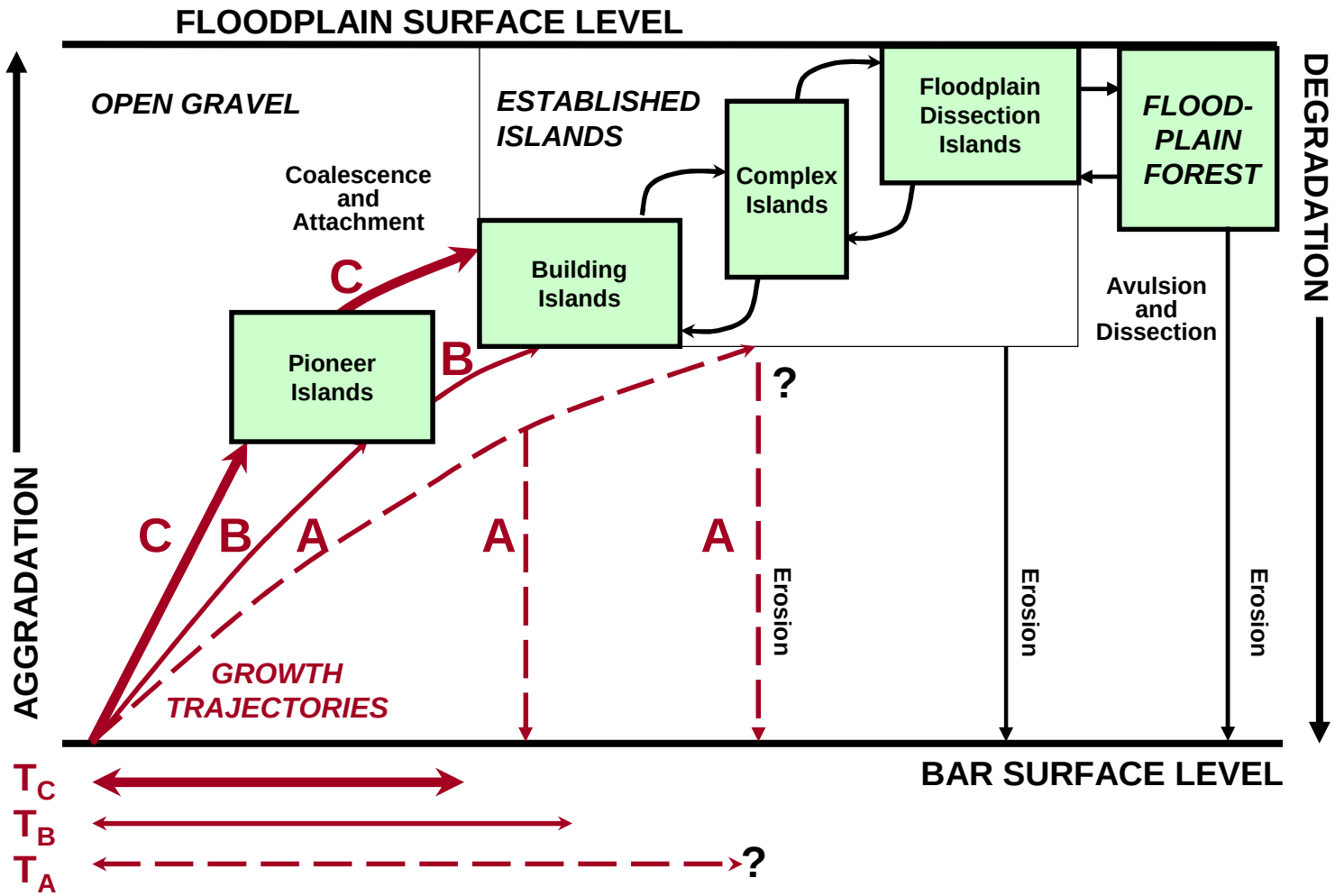
Geomorphology and Biocomplexity driven by:

RIPARIAN TREES

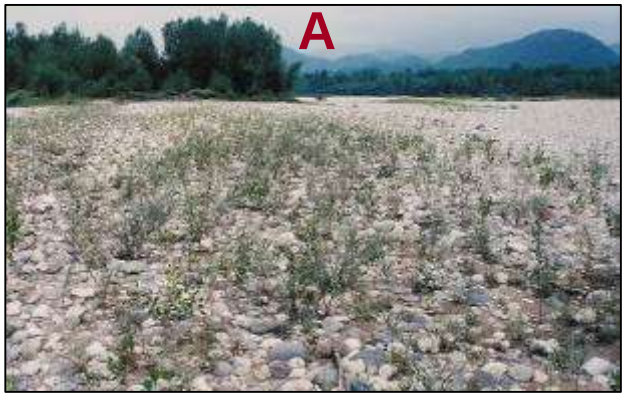
(Black Poplar)

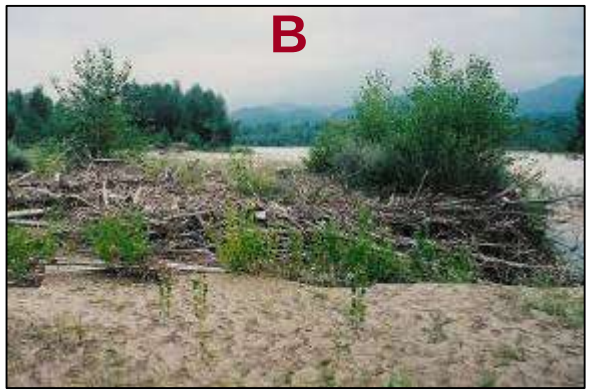
Research funding: Natural Environment Research Council

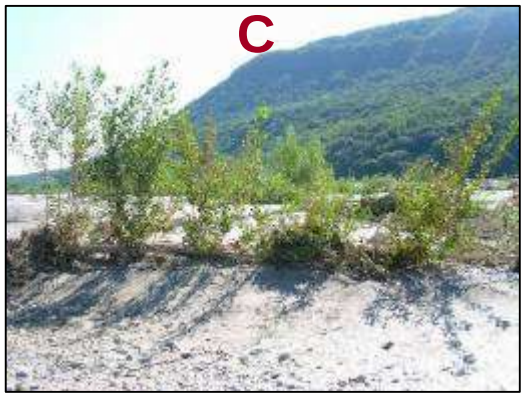
TREE GROWTH RATES ARE CRITICAL

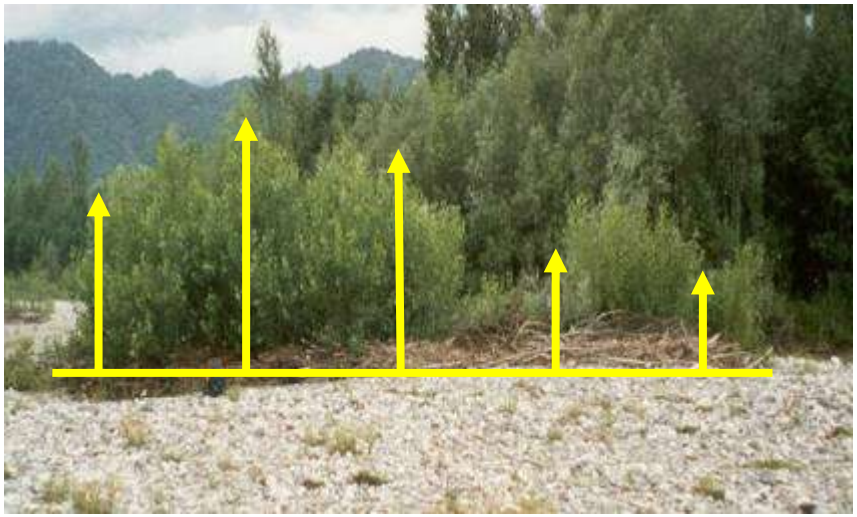


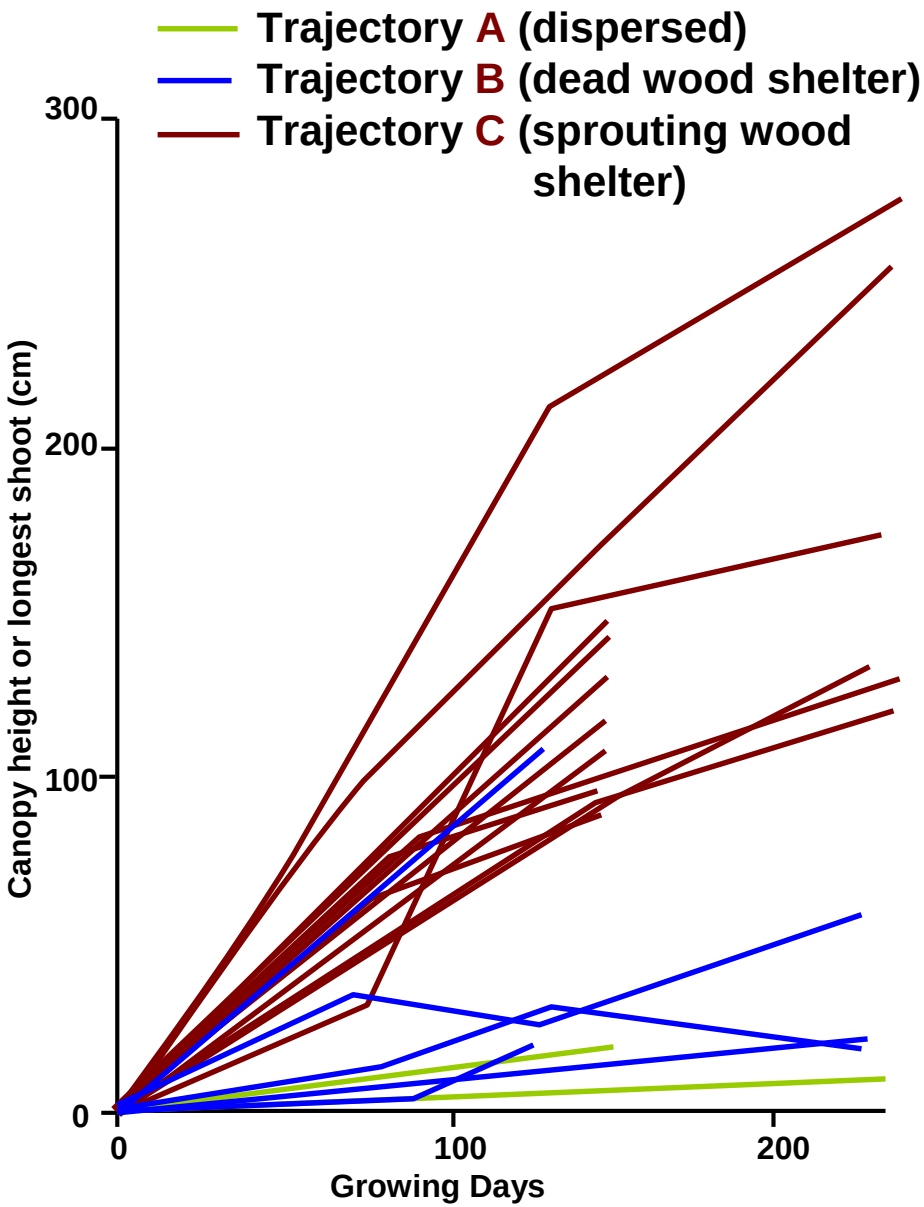
A.M. Gurnell et al (2001) Riparian vegetation and island formation along the gravel-bed Fiume Tagliamento, Italy. *Earth Surface Processes and Landforms*, 26, 31-62





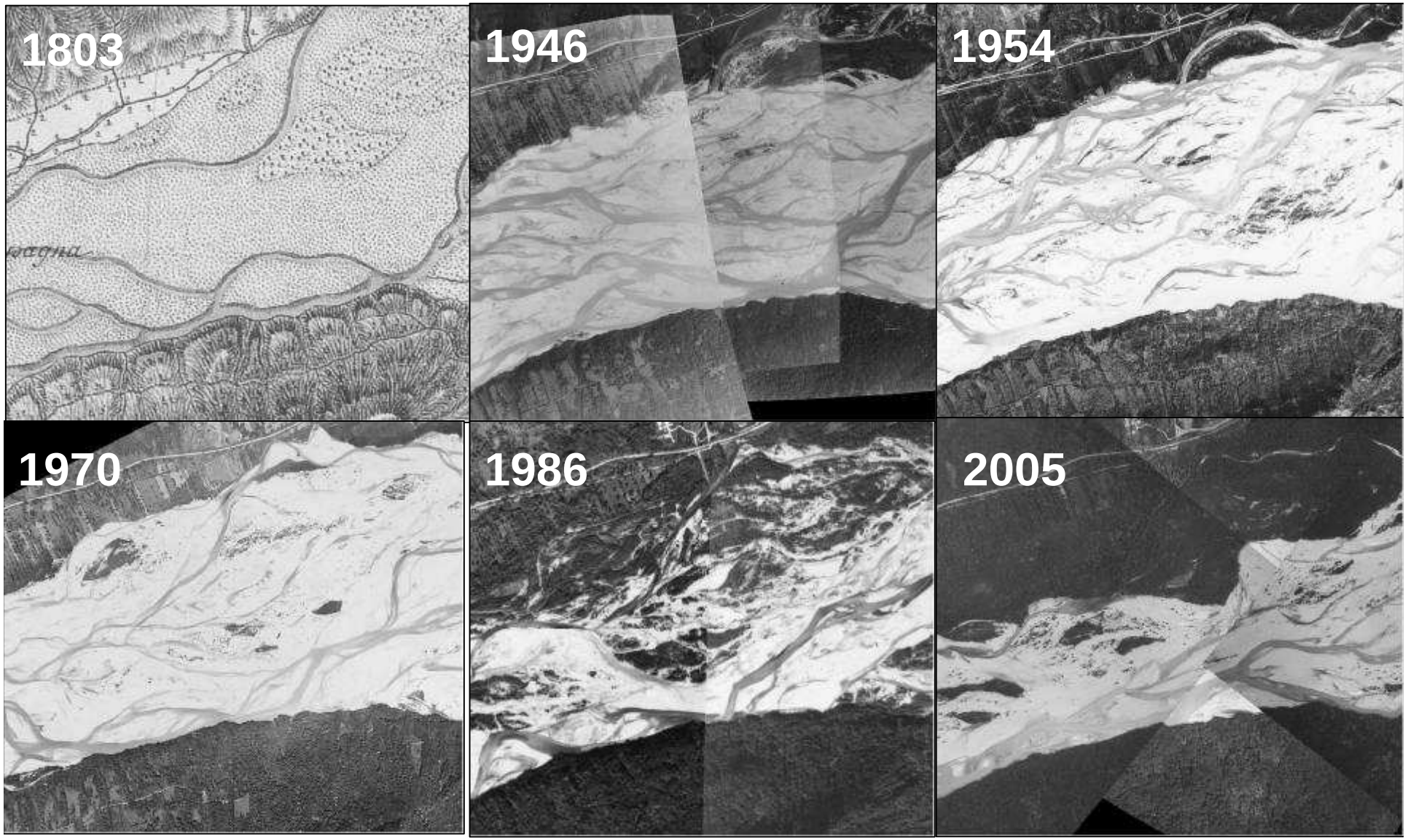






Francis, R.A., Gurnell, A.M., Petts, G.E. and Edwards, P.J. (2006) Riparian tree establishment on gravel bars: interactions between plant growth strategy and the physical environment. International Association of Sedimentologists Special Publication 36, 361-380.

IMPACT OF RIPARIAN TREE MANAGEMENT?



L. Zanoni, A.M. Gurnell, N. Drake, N. Surian (in press) Island dynamics in a braided river from analysis of historical maps and air photographs . *River research and Applications*.

Learning from Semi-Natural Reference Systems 2

Rivers Frome & Tern England

Geomorphology and Biocomplexity driven by:

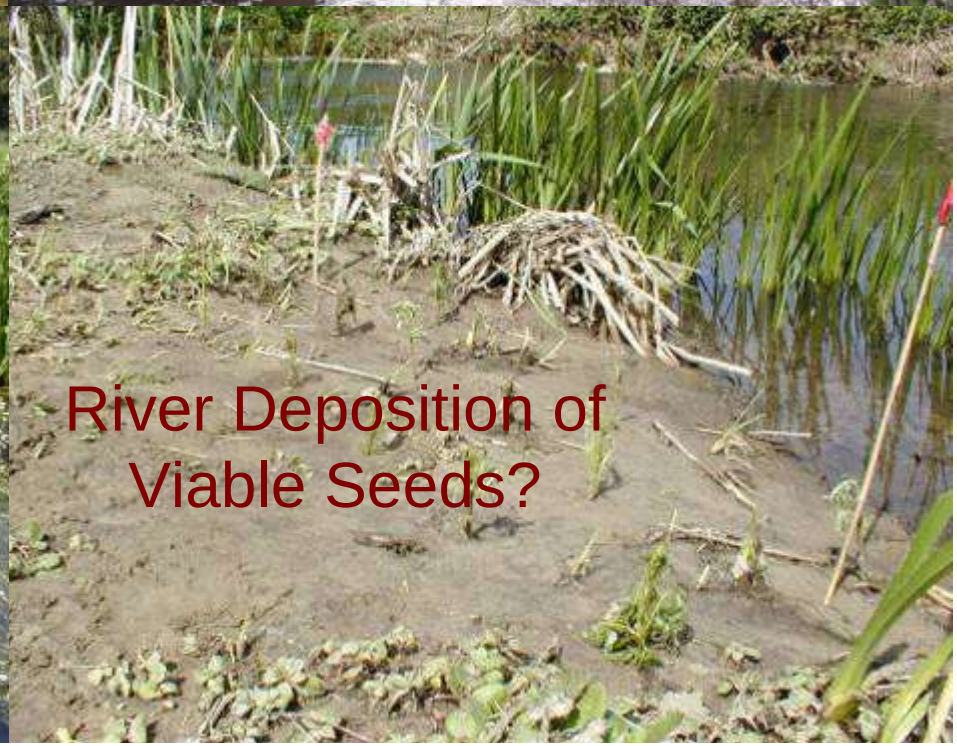
EMERGENT MACROPHYTES

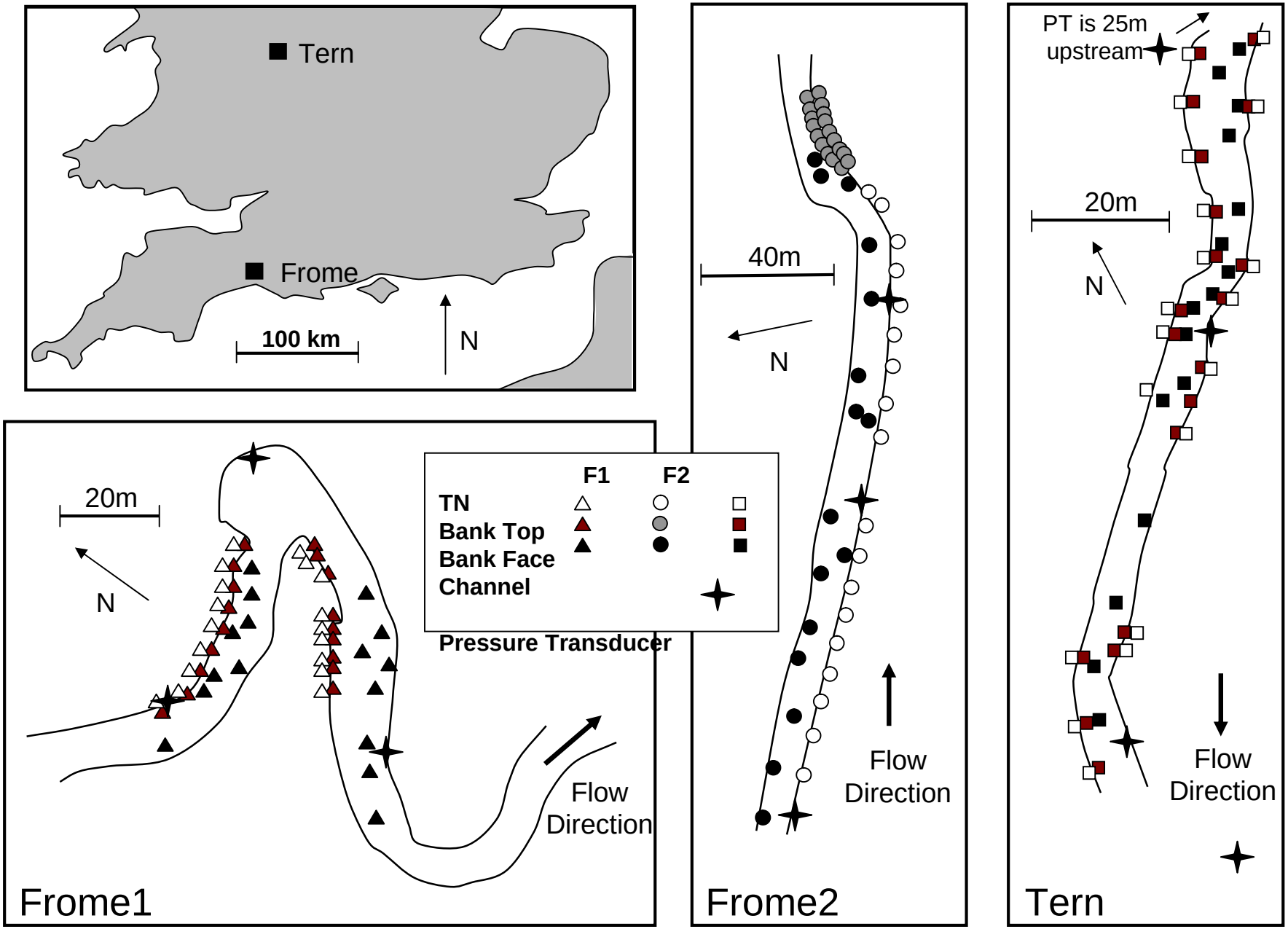
Research funding: Natural Environment Research Council


Frome 1


Tern


Frome 2


River Deposition of
Viable Seeds?



Gurnell, A.M., Thompson, K., Goodson, J., Moggridge, H. 2008. Propagule deposition along river margins: linking hydrology and ecology. *Journal of Ecology*, published on line.

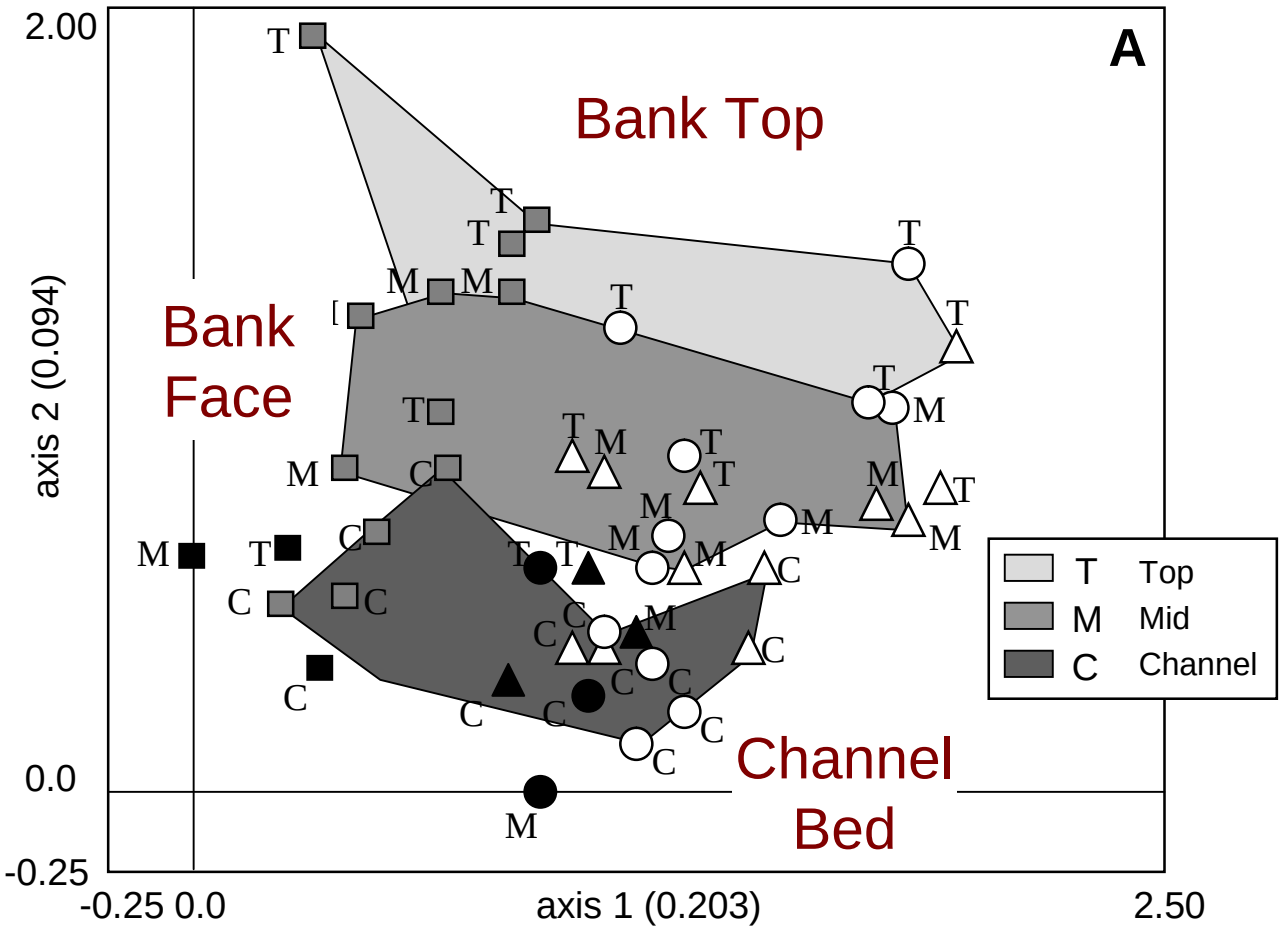

Emergence Trials


Emergence Trials

104,818 viable propagules
172 species

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

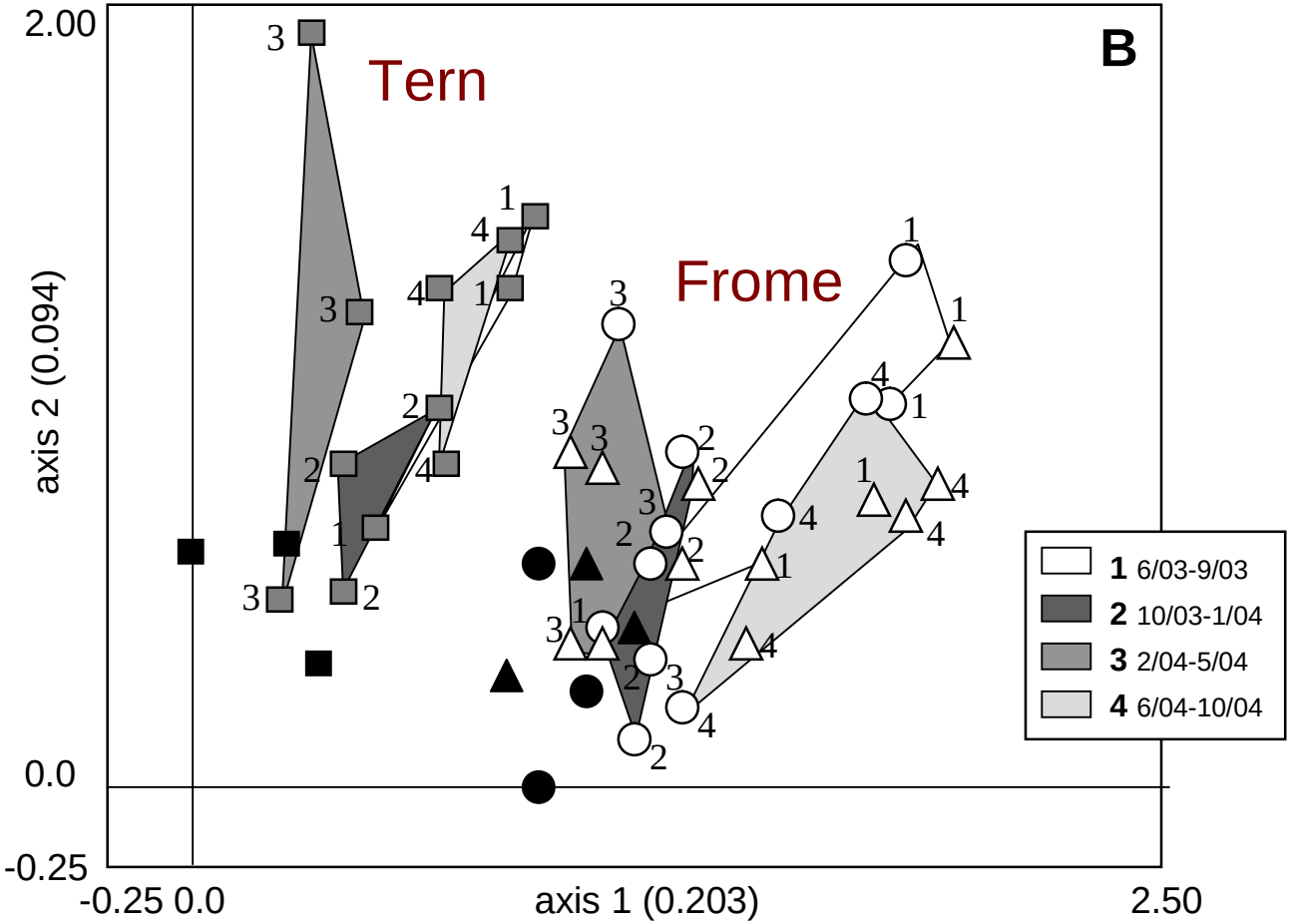
Differences in species composition from channel to bank top



Different in species composition between rivers

….. and between seasons

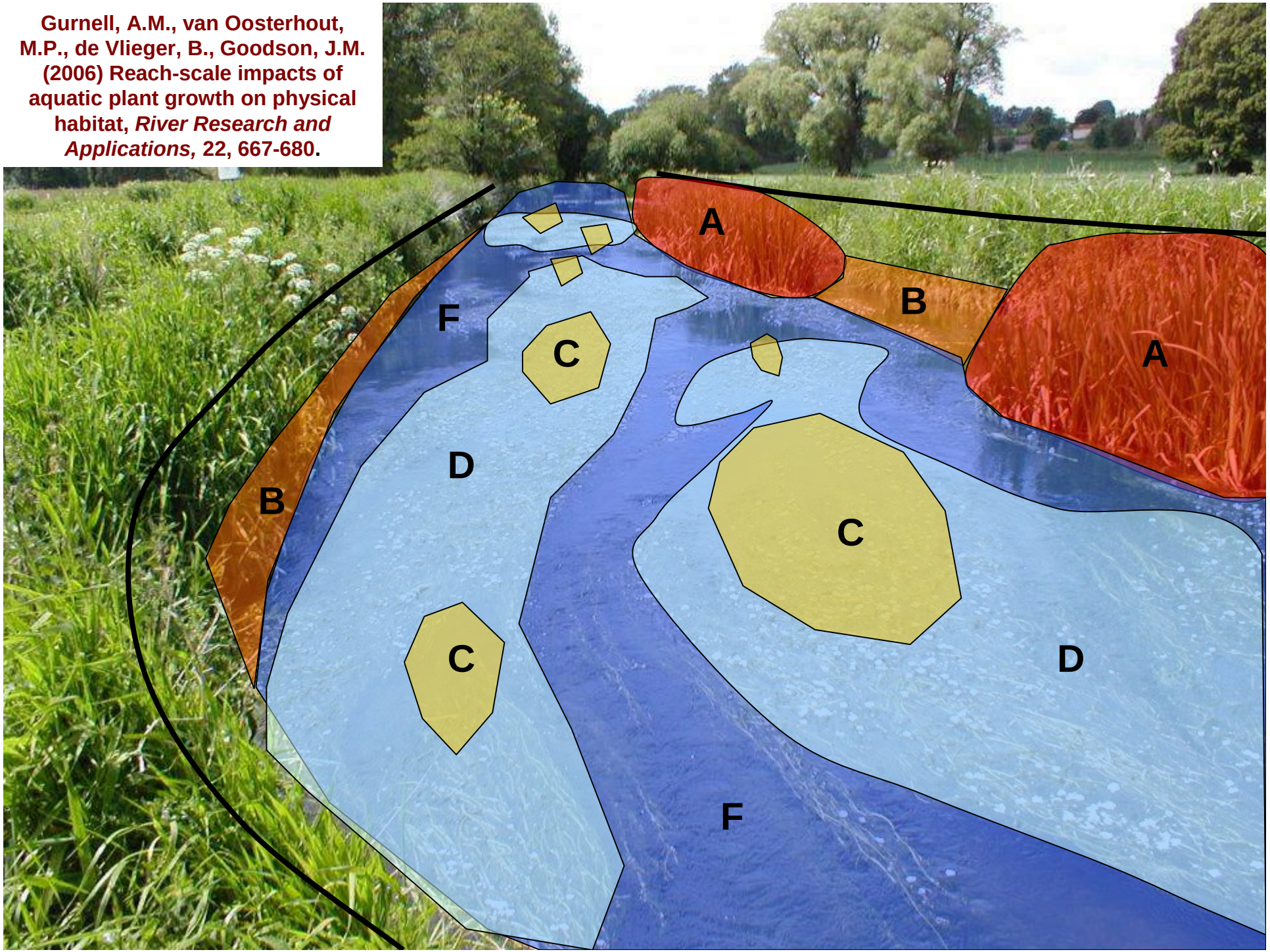
…… most species deposited in winter



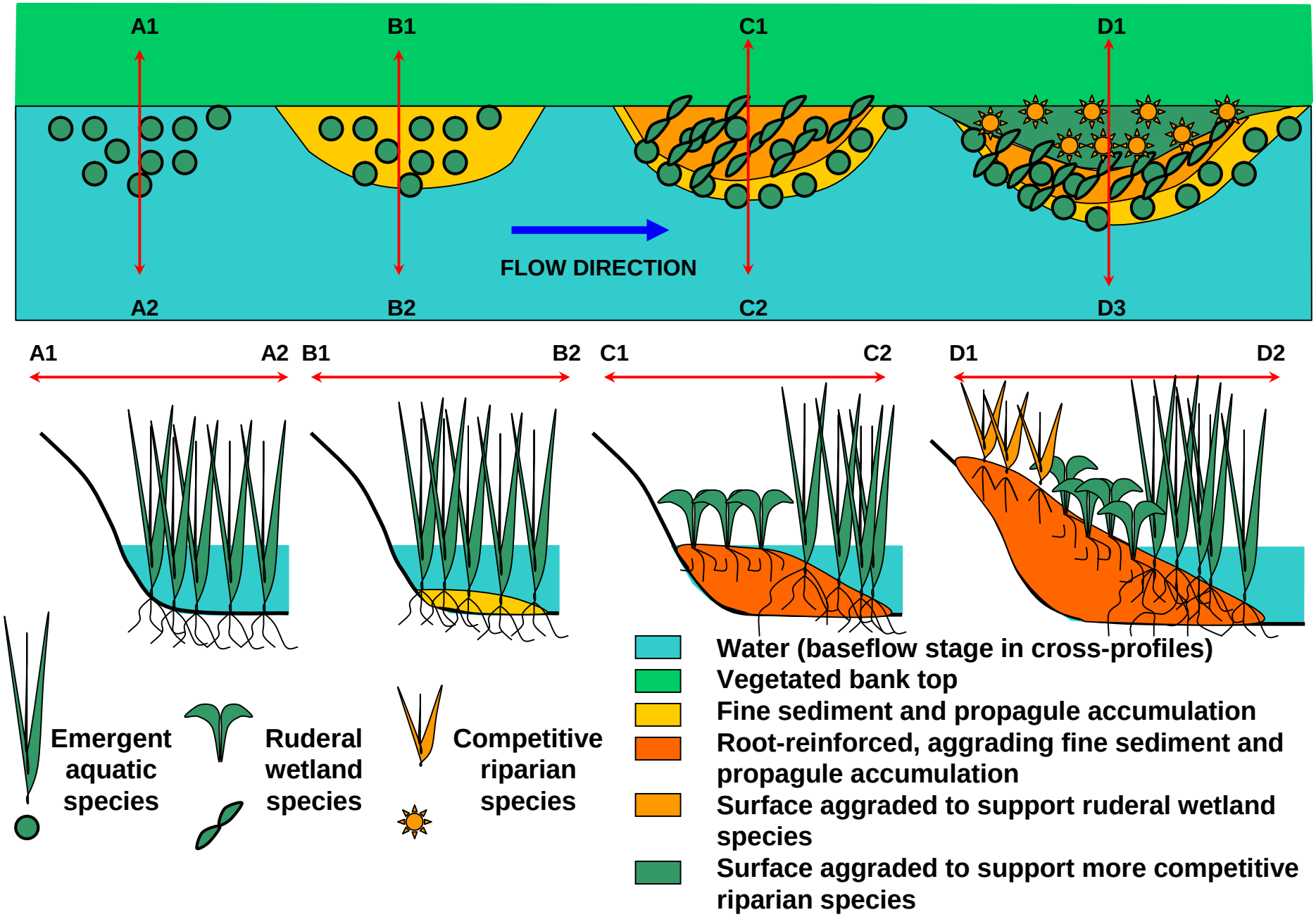
Where on the river bed are the propagules stored?

Class	A	B	C	D	E	F
Bed Sediment Calibre	silt	sand	gravel	sand /gravel	silt /sand	gravel
Surface Sediment Calibre	silt	sand	sand /gravel	sand /gravel	silt /sand	gravel
Nearest vegetation	emergents	trees/ riparian herbs	aquatics	aquatics	none	none
Position w.r.t. vegetation	Within <1m DS	<1m DS	within /edge	edge /between	no veg	no veg
Nearest macrophytes	*Sparganium erectum*	*Phalaris arundacea* *Ranunculus. Penicillatus*	*Ranunculus penicillatus*	*Ranunculus penicillatus* *Myriophyllum spicatum*	no macrophytes	no macrophytes
Location w.r.t. macrophytes	within /between	none /upstream of macrophytes	within /between	between /upstream	no macrophytes	no macrophytes
Number of species	11	10	8	6	8	4
Propagules/m2	660	320	360	167	300	65

Gurnell, A.M., van Oosterhout, M.P., de Vlieger, B., Goodson, J.M. (2006) Reach-scale impacts of aquatic plant growth on physical habitat, *River Research and Applications*, 22, 667-680.



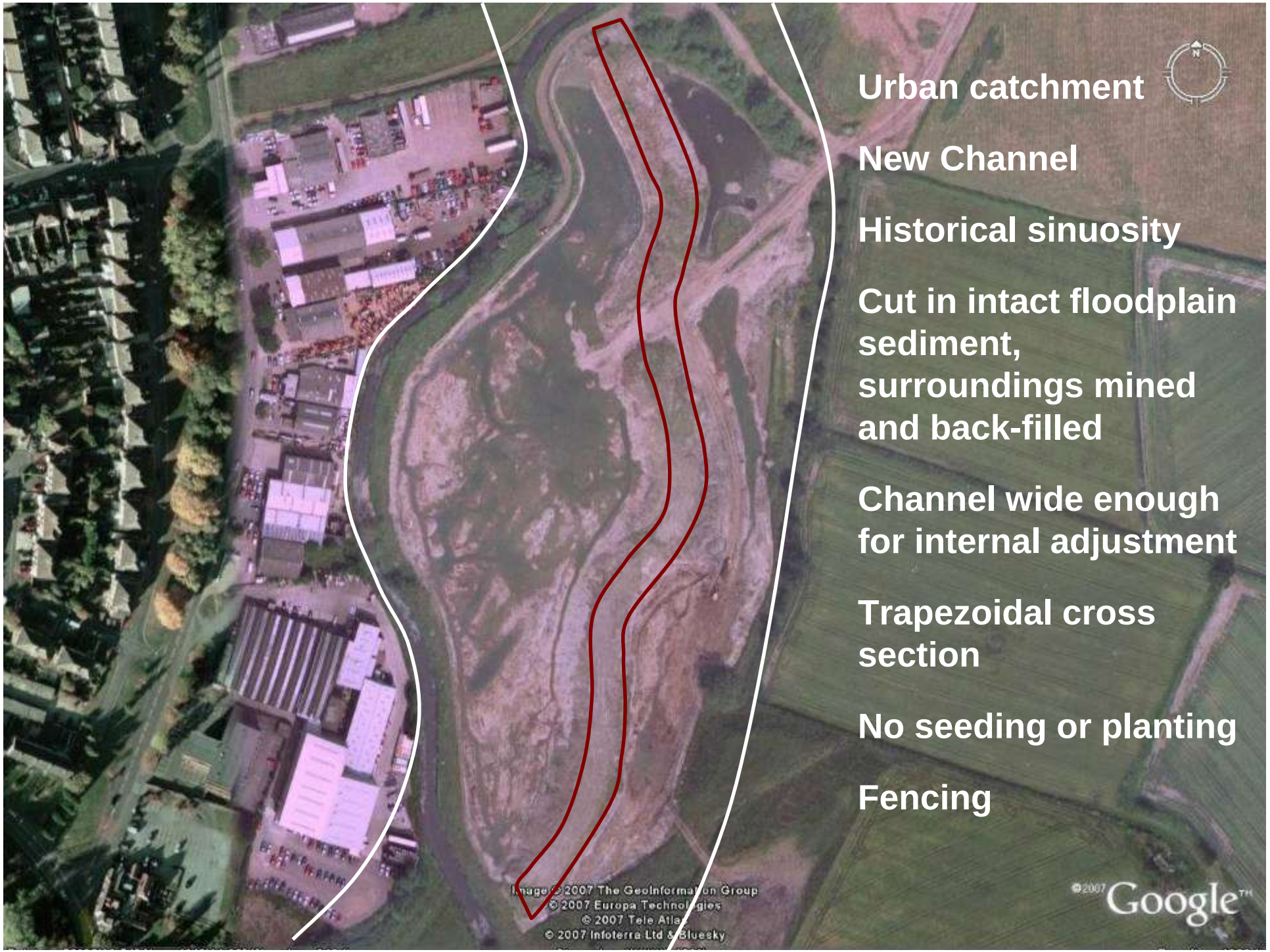
4-stage biogeomorphological sequence: bank aggradation / migration

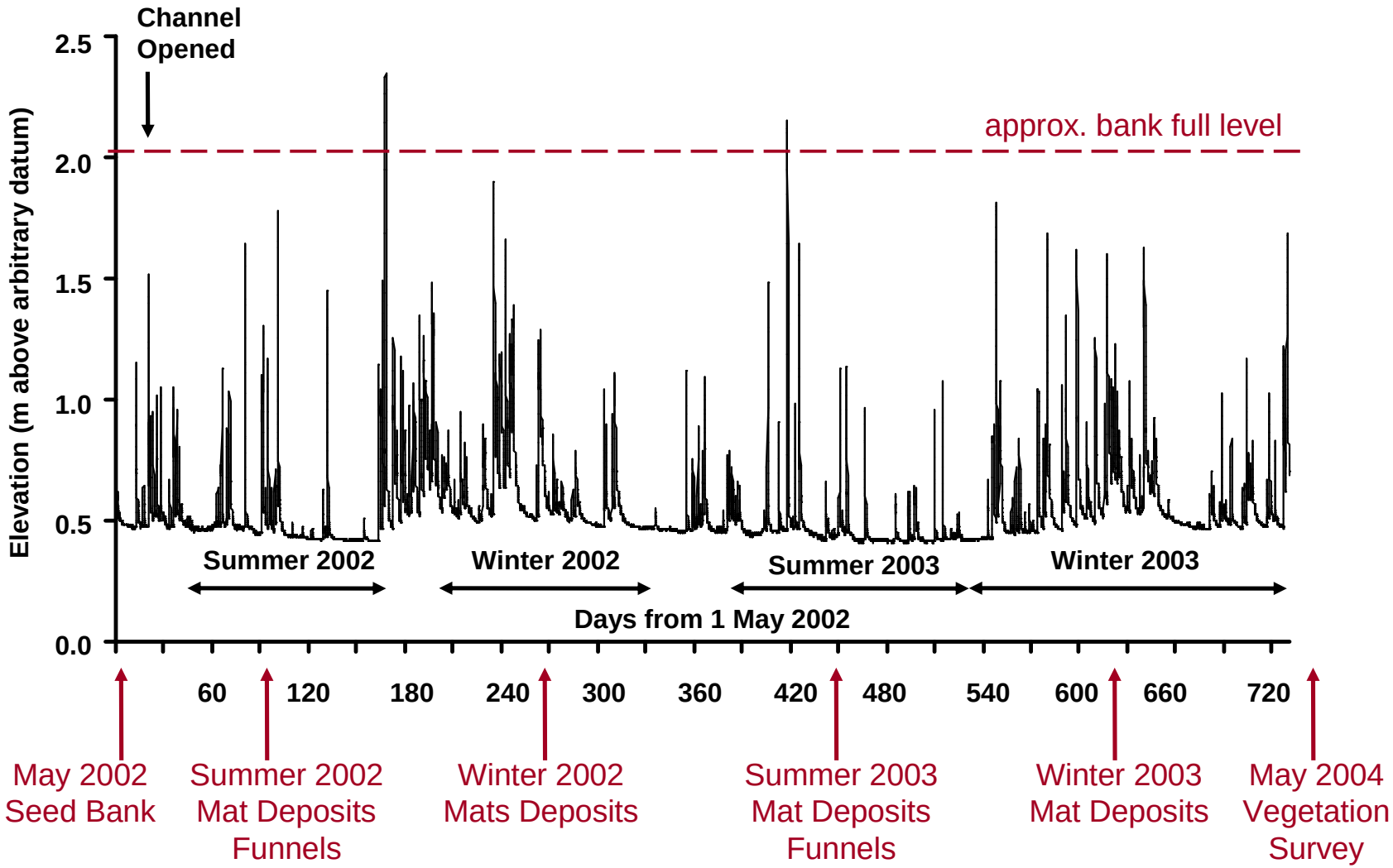


Plant Engineering in River Restoration

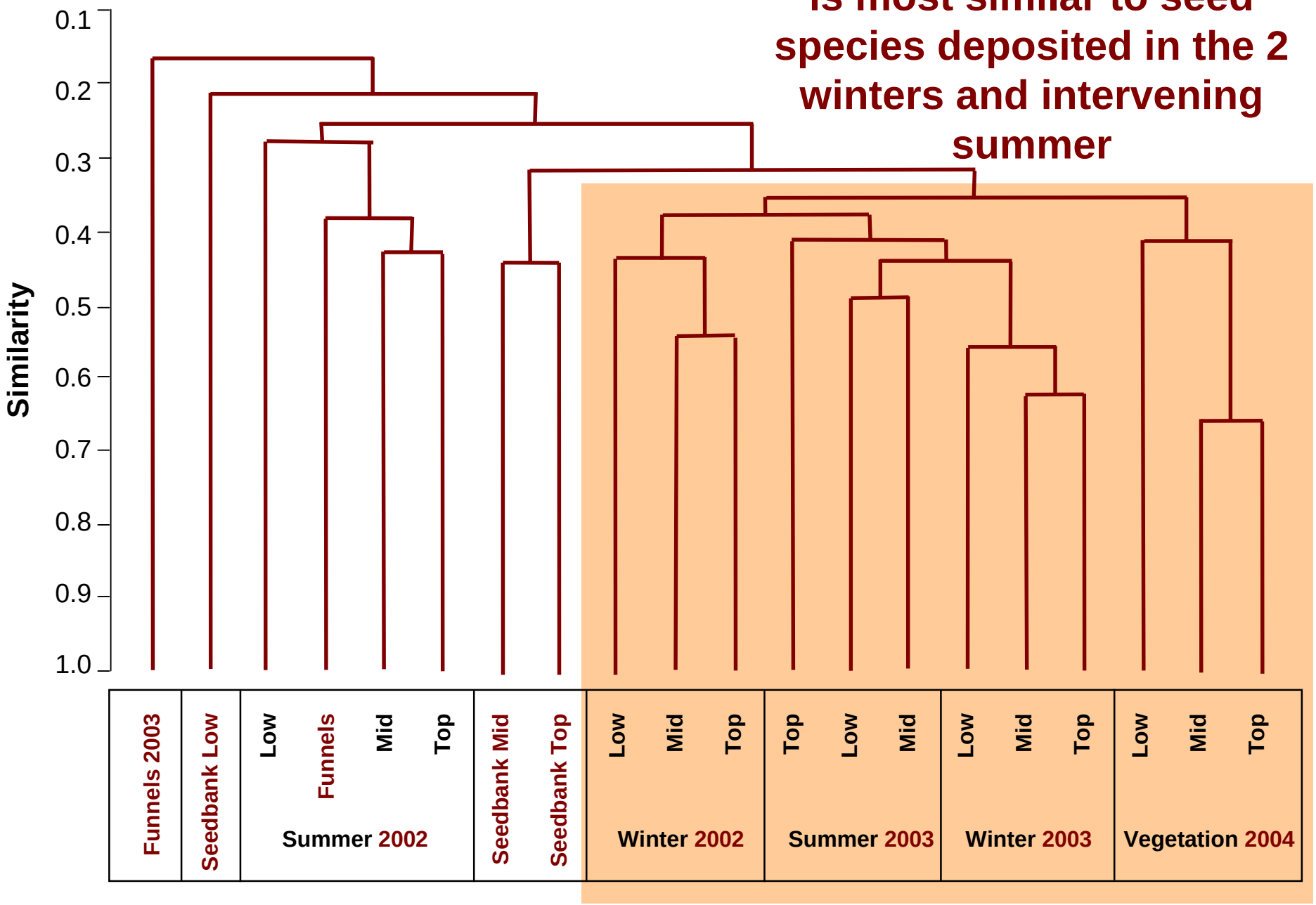
River Cole, West Midlands, UK

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
Image © 2007 The GeoInformation Group
© 2007 Europa Technologies
© 2007 Tele Atlas
© 2007 Infoterra Ltd & Bluesky
©2007 Google


Channel Opened
approx. bank full level
Elevation (m above arbitrary datum)
2.5
2.0
1.5
1.0
0.5
0.0
Summer 2002
Winter 2002
Summer 2003
Winter 2003
Days from 1 May 2002
60
120
180
240
300
360
420
480
540
600
660
720
May 2002 Seed Bank
Summer 2002 Mat Deposits Funnels
Winter 2002 Mats Deposits
Summer 2003 Mat Deposits Funnels
Winter 2003 Mat Deposits
May 2004 Vegetation Survey

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 MACROPHYTES

& 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**


Complex bank vegetation


'Self-sown' willow trees


Lots of Himalayan balsam upstream

Research Collaborators:

Atkins:	**Ian Morrissey**
CEH:	**Patrick Armitage, Owen Mountford**
Entec UK Ltd:	**Jo Goodson**
ETH Zurich:	**Peter Edwards**
IGB Berlin:	**Klement Tockner**
Jacobs UK Ltd:	**Angela Boitsidis**
King's College London:	**Rob Francis, Helen Moggridge**
University of Nottingham:	**Nick Clifford**
University of Sheffield:	**Ken Thompson**
University of Trento:	**Luca Zanoni**
University of Westminster:	**Geoff Petts**

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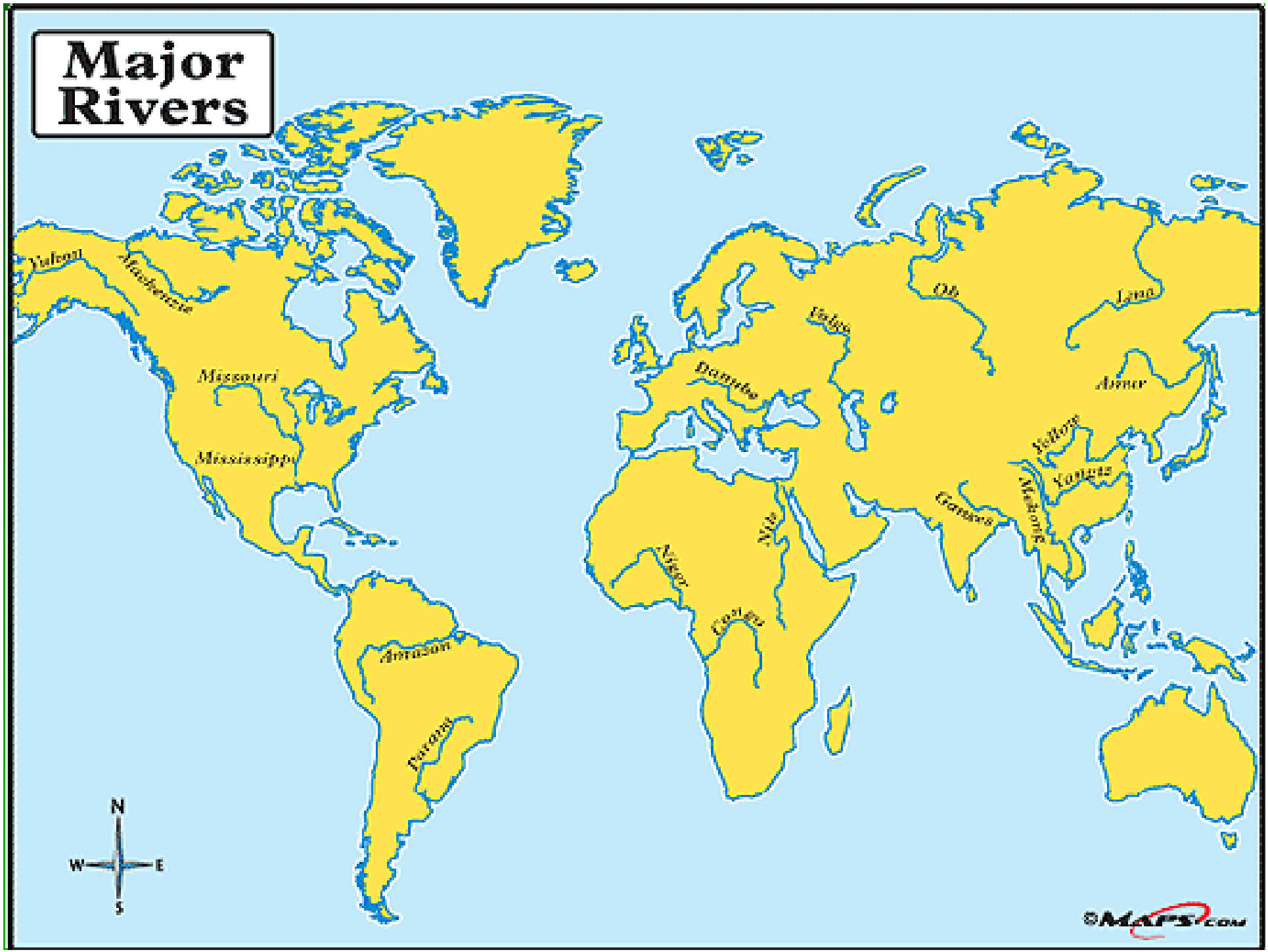
River Restoration in a Global Context
- how do we compare?

Martin Janes and Jenny Mant
River Restoration Centre

Annual Network Conference 2008


Major Rivers
Yukon
Mackenzie
Missouri
Mississippi
Amazon
Paraná
Niger
Congo
Nile
Danube
Volga
Ob
Lena
Amur
Ganges
Mekong
Yangtze
Huang
N
W
E
S
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Europe

- Dominated by WFD work.
  - Better integration between countries (trans-boundary. Shared experiences. Common goal.
  - 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

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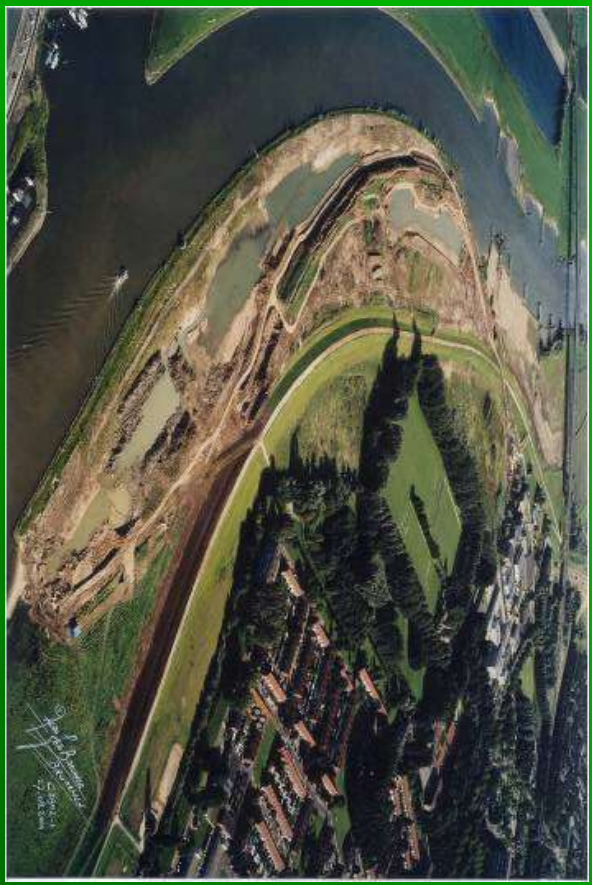

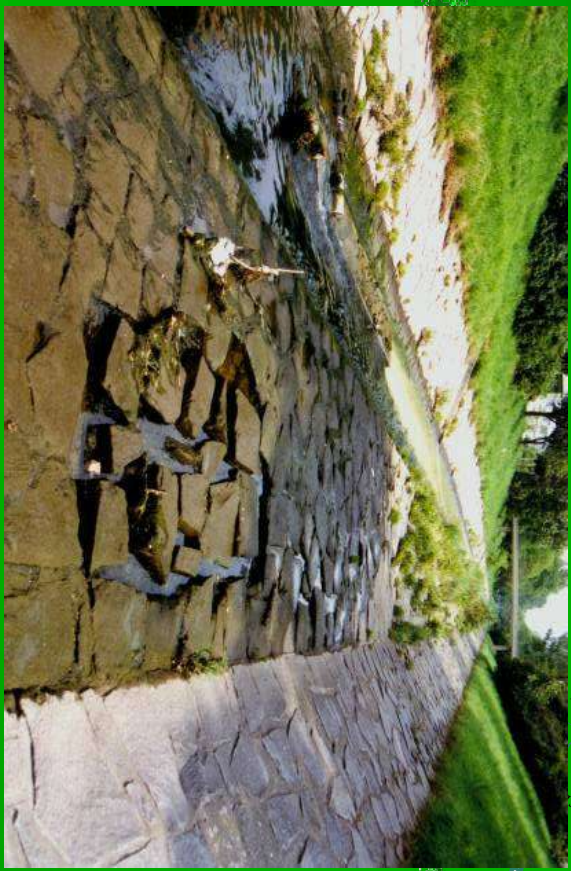

RIVER RESTORATION CENTRE

Special thanks to Alice Jones

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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.

ASIA

- 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 km^2 river-lake reconnection
- Climate change/water quality

Options for connections – 3 years

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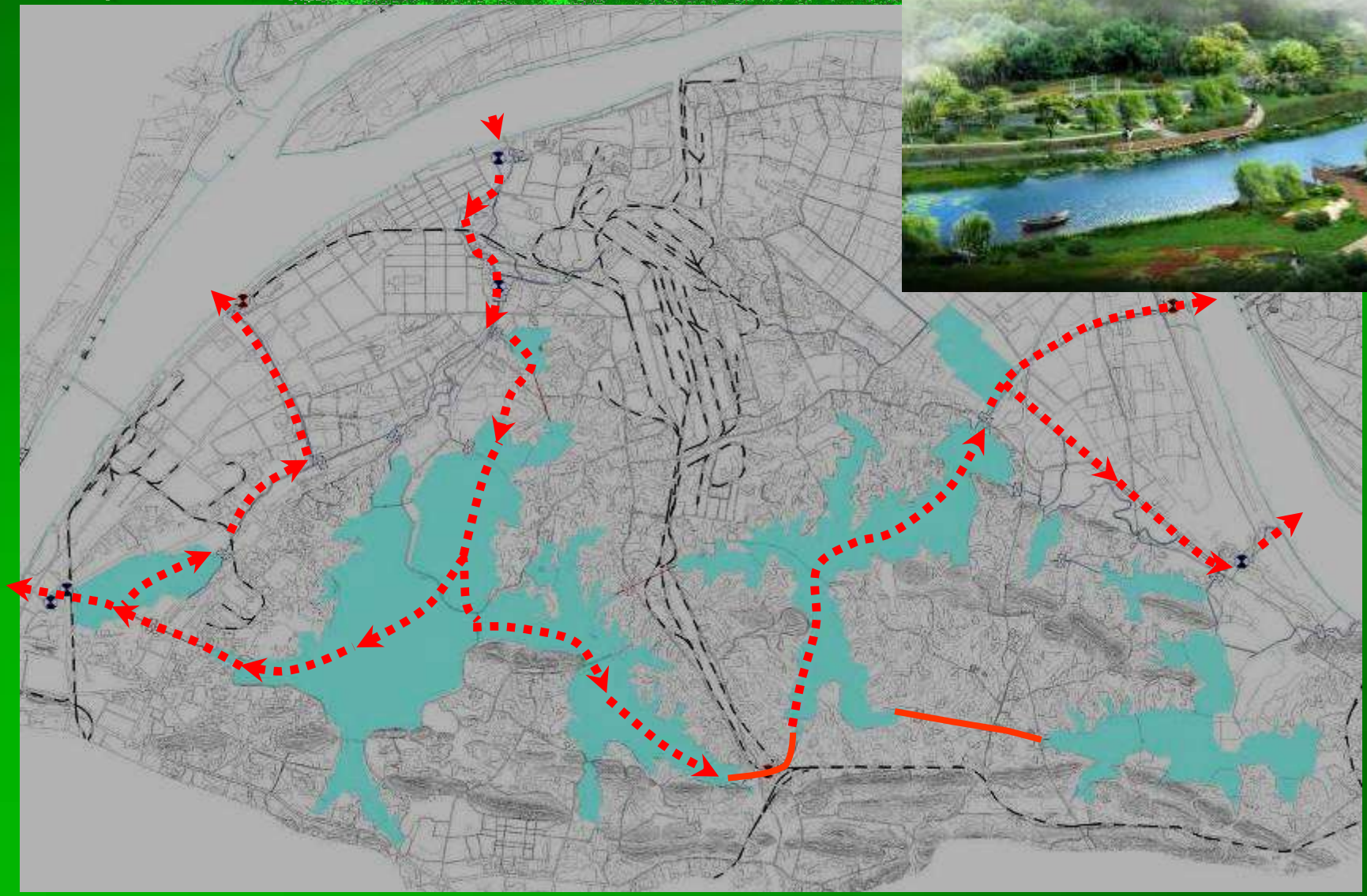

A time for reflection! – 3 Gorges Dam

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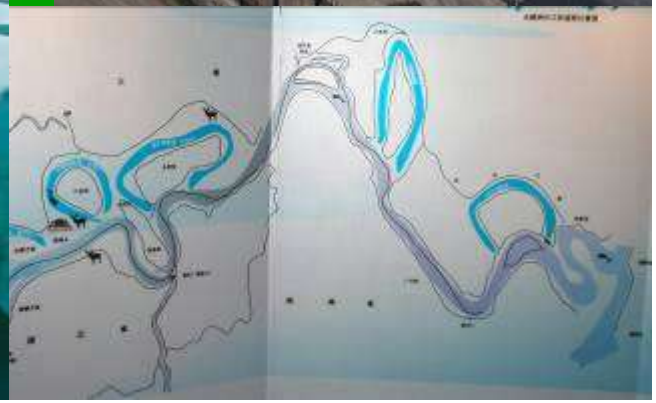
Facts:

- 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 (10years+)

Woody debris - Portland, Oregon

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Now you see it, now you don't (Mackay Creek)

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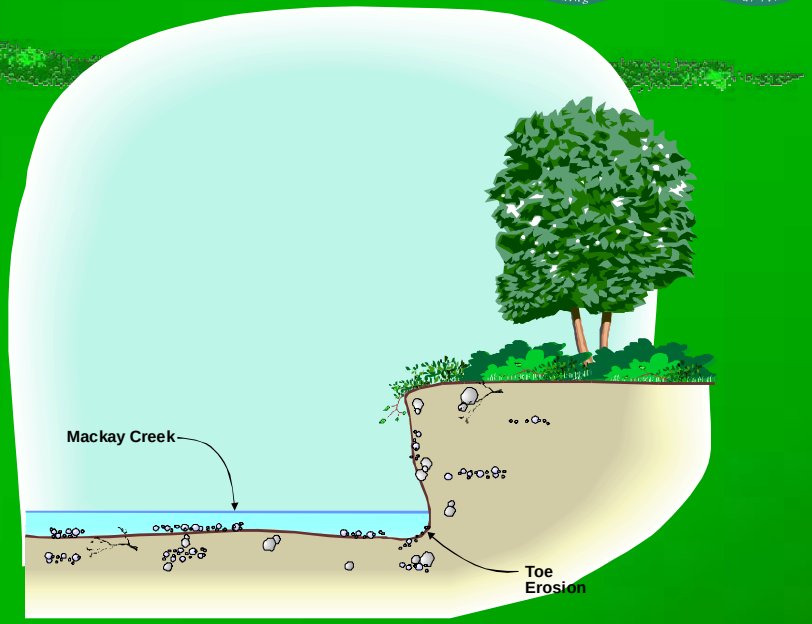
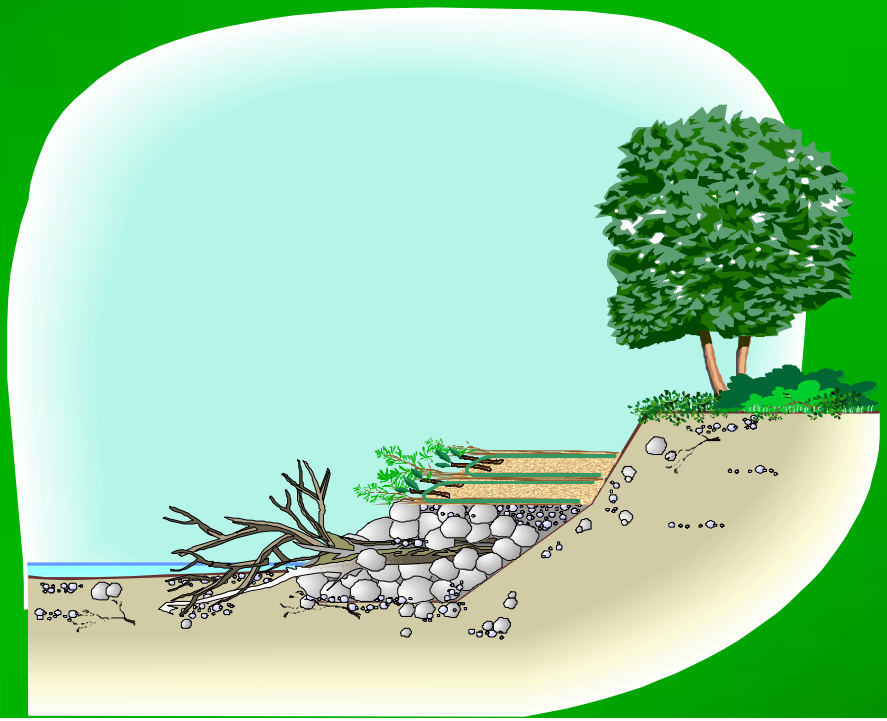
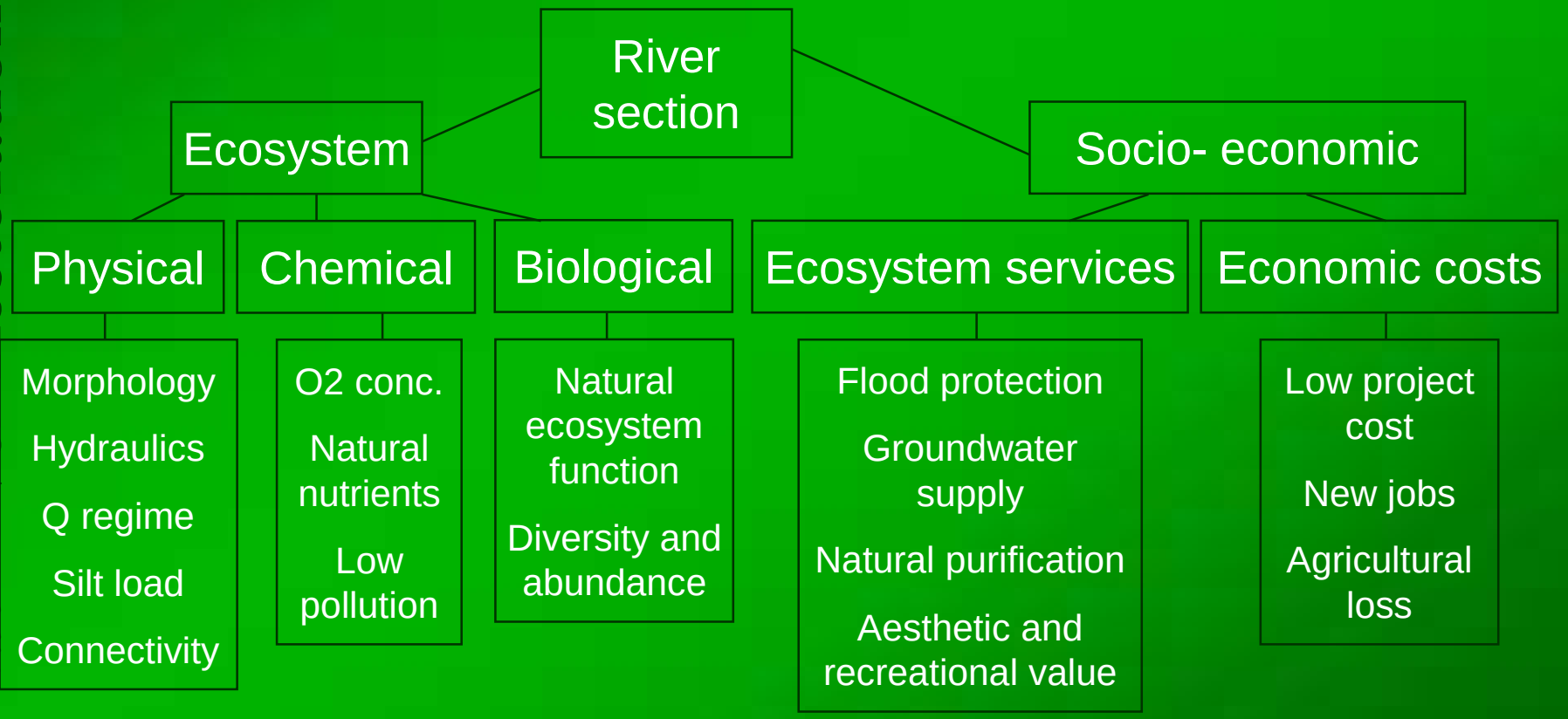




Inception, completion and beyond

- 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

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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*

A National River Restoration Resource

- UK restoration ‘network’ well developed…….

River Restoration NEWS

Issue 27
July 2007

NEWSLETTER of the RIVER RESTORATION CENTRE

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Learning from Post-Project Appraisals of California Urban Stream Restoration Projects

Shannah Anderson, University of California, demonstrates new cost effective measures for addressing post-project appraisal.

In the United States, the number of restoration projects continues to grow annually. The Pacific coast has the largest number of projects and greatest investment overall[1]. Yet despite the vast number of river restoration projects implemented in California since 1980 (over 4,000)[2], the effectiveness of the restoration investment has been largely unevaluated[3,4].

Currently, there are few means for interested scientists and practitioners to gain insights from existing river restoration projects and to improve understanding of science and field practice issues that need to be considered within the design. Furthermore, access to relevant new scientific information as it emerges remains fragmented. The University of California at Berkeley is conducting 40 post-project appraisals of river restoration projects (PPAs) as part of the National River Restoration Science Synthesis (NRRSS). NRRSS is a national collaboration that aims to analyse the scientific basis and success of stream river restoration projects to date, and disseminate lessons learned from the data to the greater restoration community.

A post-project appraisal is an evaluation of the effectiveness of restoration projects based on systematic data collection that responds to the following questions[4]:

1) Was the project built as designed?
2) Did it achieve its objectives?
3) Should steps be taken to address unanticipated effects?
4) How can we improve future restoration design?

Ideally, baseline surveys, design rationale, design drawings and post-project monitoring surveys are required to carry out PPA and analyse success criteria.

Lower Codornices Creek in urbanised Berkeley, California - a 300m reach restored from a concrete-lined ditch in 2004.
(Photograph taken from a site by Cris Dentoni)

Continued on Page 2

Inside this issue

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……..

the River Restoration Centre

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