

The Monetary Value of Changes in Ecosystem Services Associated with River Restoration

Chris Mellor



Key thing to remember when trying to put a value on Ecosystem Services is that any value produced will be wrong but...

‘...measures need not be perfect to be useful, indeed the perfect may be the enemy of the good here.’

Realising nature's value: The Final Report of the Ecosystem Markets Task Force March 2013



What are ecosystem services?

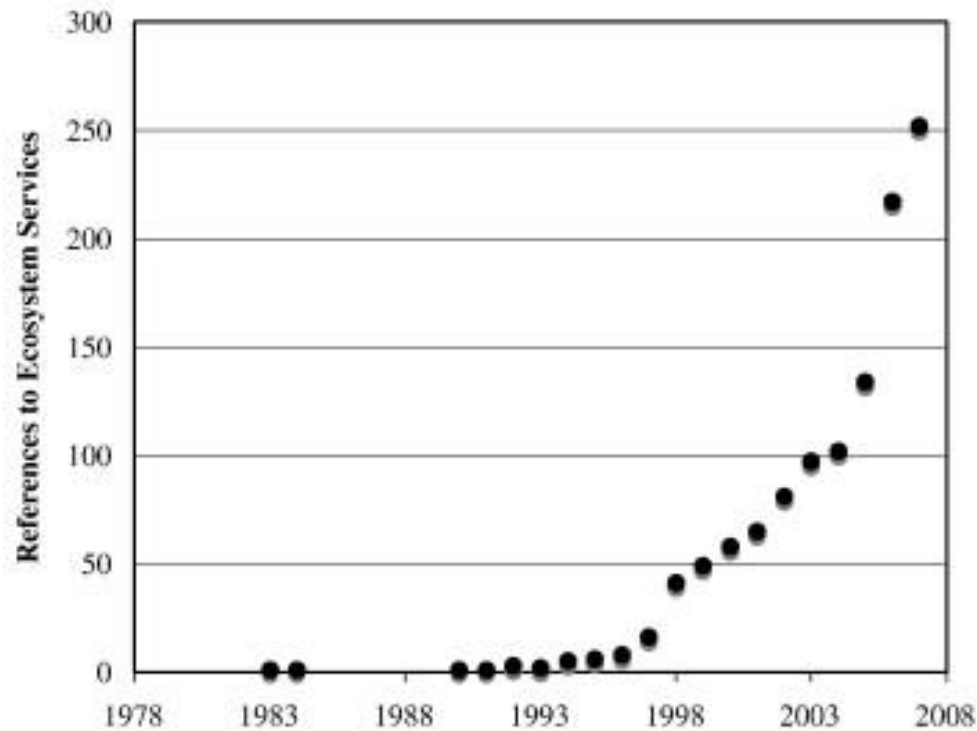
- ‘Ecosystem services are the direct and indirect contributions of ecosystems to human well-being.’ (*The Economics of Ecosystems and Biodiversity, 2010*)



Ecosystem Services a brief history

- Discussed in the scientific literature since the 1960s and talked around by Westman (1977) 'How much are nature's services worth?'
- 'Ecosystem services' first coined in 1981 by Ehrlich and Ehrlich.
- Costanza *et al.*, (1997) 'The value of the world ecosystem services and natural capital'
 - Overall global value of \$33 trillion
- Millennium Ecosystem assessment in 2005





Number of papers using the term “ecosystem services” or “ecological services” in an ISI Web of Science search in 2007. Fisher *et al.*, (2009)

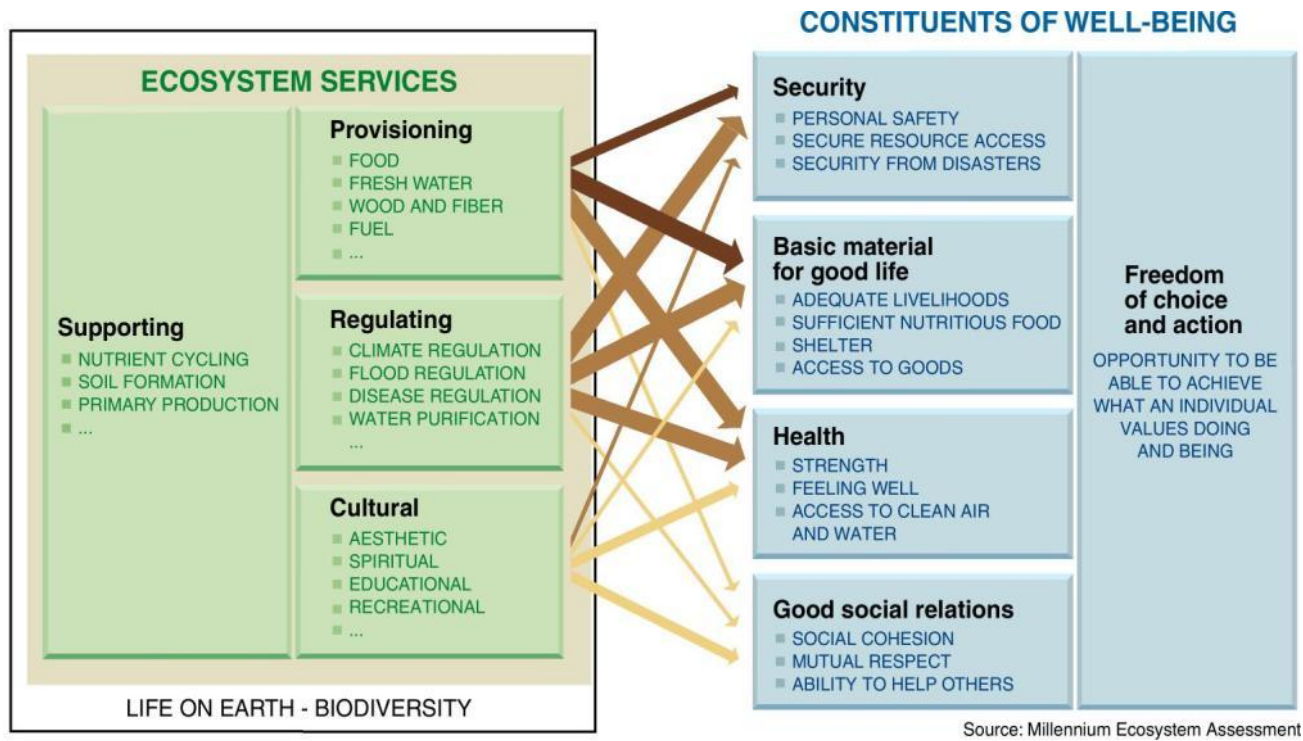


Key publications:

- Millennium Ecosystem Assessment (MA)
- The Economics of Ecosystems and Biodiversity (TEEB)
- UK National Ecosystem Assessment (UK NEA)
- Common International Classification for Ecosystem services (CICES)



ES as viewed by MA



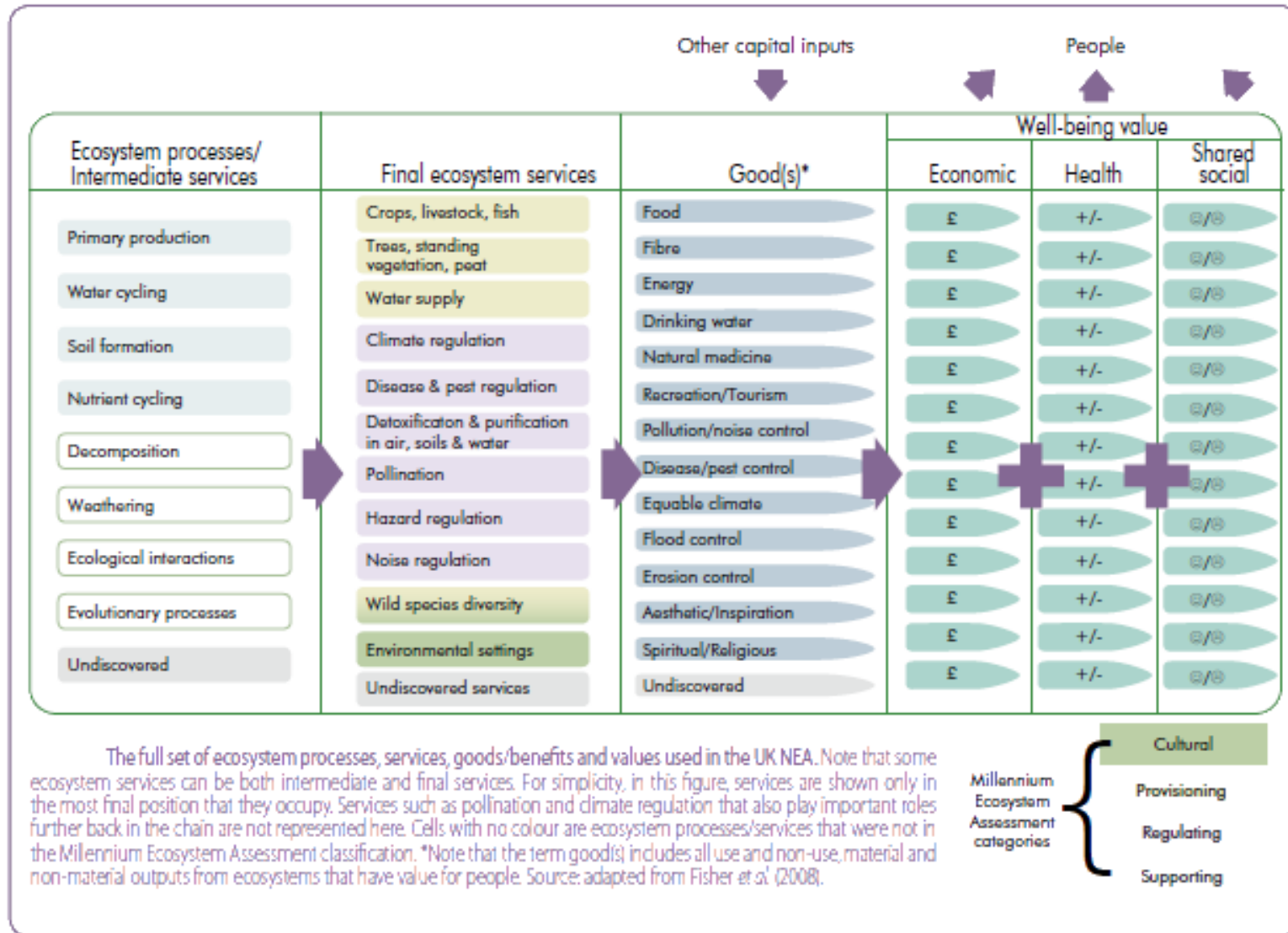
ARROW'S COLOR
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

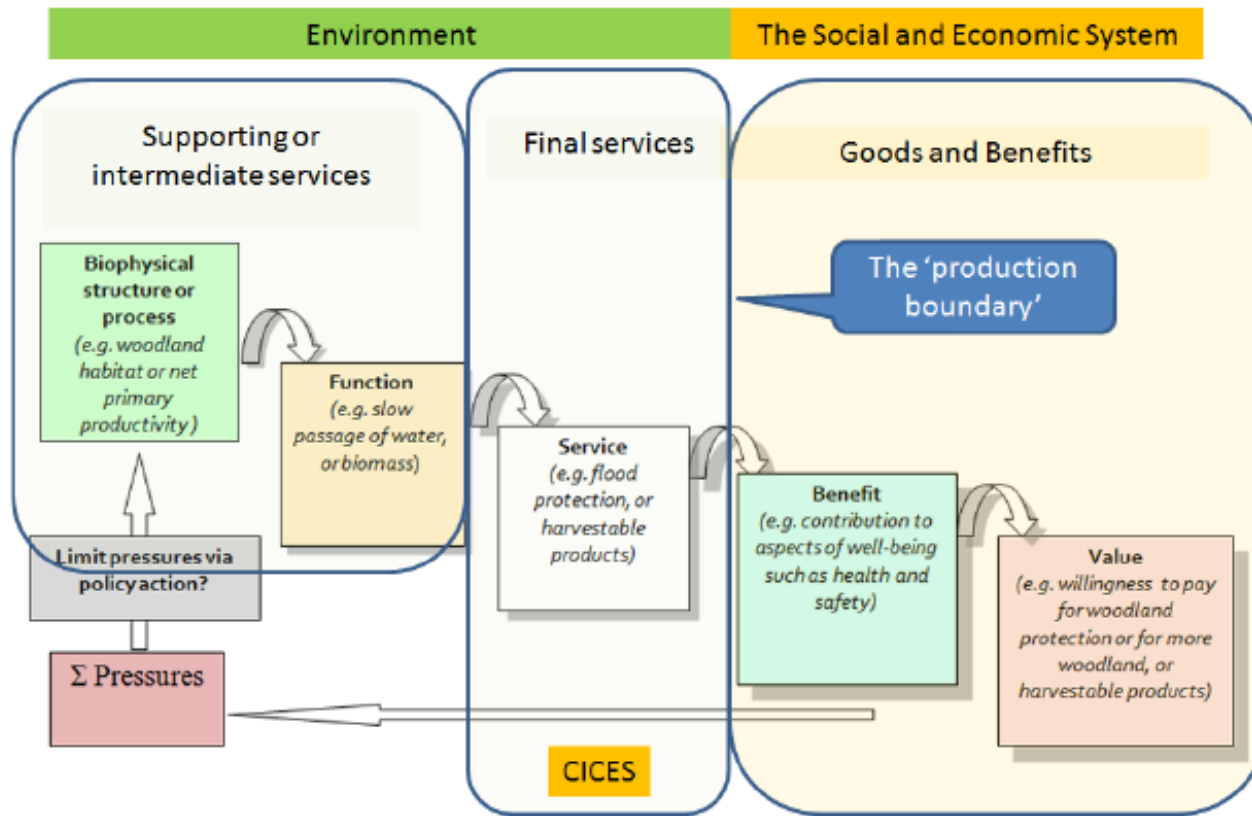
ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong





ES as viewed by CICES



CICES Ecosystem Services Classification

Section	Division	Group	
Provisioning	Nutrition	Biomass	
		Water	
	Materials	Biomass, Fibre	
		Water	
	Energy	Biomass-based energy sources	
		Mechanical energy	
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	
		Mediation by ecosystems	
	Mediation of flows	Mass flows	
		Liquid flows	
		Gaseous / air flows	
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	
		Pest and disease control	
		Soil formation and composition	
		Water conditions	
		Atmospheric composition and climate regulation	
	Cultural	Physical and intellectual interactions with ecosystems and land-/seascapes	Physical and experiential interactions
			Intellectual and representative interactions
Spiritual, symbolic and other interactions with ecosystems and land-/seascapes		Spiritual and/or emblematic	
		Other cultural outputs	



Methodology

- Discussion with stakeholders to identify ES
- Estimate monetary value of identified developments in ES
- Apply a 3.5% discount rate (HM Treasury, 2011) to get 25 year 'lifetime' Following Everard (2009) and annual marginal value for the restoration



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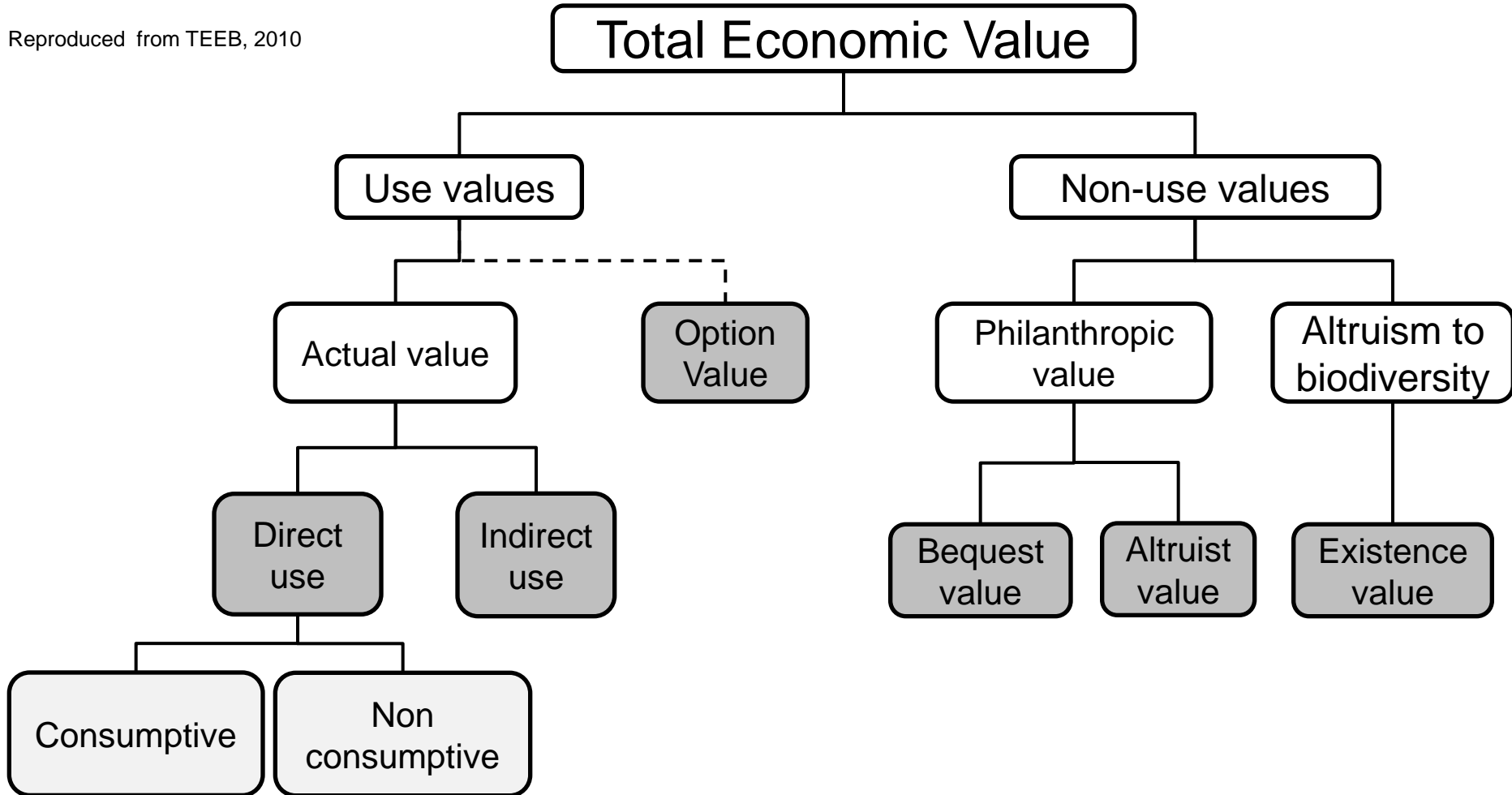


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Reproduced from TEEB, 2010



Case studies



Case study 1 – Rottal burn

- Tributary of the River South Esk (SAC)
- Rural
- Canalised and dredged
- Good quality salmon spawning grounds

Aims of restoration:

- Enhance habitats for SAC designated species
- Re-instate natural channel processes
- Act as a demonstration site



Case study 2 – Water of Leith

- Flows through North West Edinburgh
- Industrial heritage
- Heavily modified
- Steady improvement in water quality since 1900s
- Enhanced through work by the Water of Leith Conservation Trust and the Volunteer bailiffs



Rottal Burn

Water of Leith

Ecosystem Service		Impact	
Provisioning	Cultivated crops	0	
	Reared animals and there outputs	-	
	Wild plants, algae and there outputs	+	
	Wild animals and there outputs	+	
	Aquaculture	0	
	Surface/ ground water for drinking	0/-	
	Fibres (+ other materials) for direct use or processing	0	
	Materials from animals and plants for agricultural use	-	
	Genetic materials from all biota	+	
	Water for non-drinking purposes	0/-	
	Plant based fuel resources	0	
	Animal based fuel resources	0	
	Animal based mechanical energy	0	
	Bio-remediation by biota	+	
	Remediation by ecosystems	+	
	Dilution by atmosphere, freshwater and marine ecosystems	+	
	Mediation of smell/ noise/ visual impacts	+	
Regulation and maintenance	Mass stabilisation and control of erosion rates	+	
	Buffering of mass flows	+	
	Maintenance of baseline flows	+	
	Flood protection	+	
	Storm protection	+	
	Ventilation and transpiration	+	
	Pollination and seed dispersal	+	
	Maintaining nursery populations and habitats	+	
	Pest control	+	
	Disease control	0	
	Maintenance of soil fertility through biogeochemical processes	+	
	Maintenance of chemical conditions of freshwaters	+	
	Maintenance of chemical conditions of saltwater	0	
	Global climate regulation	+	
	Local climate regulation by control of micro climate	+	
	Cultural	Experiential use of environment and biota (in-situ)	+
		Physical use of environment and biota (e.g. fishing)	+
Scientific		+	
Educational		+	
Heritage		0	
Entertainment		0	
Aesthetic		+	
Symbolic		+	
Sacred and/ or religious		0	
Existence		+	
Bequest	+		

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Sacred and/ or religious		0	
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Bequest	+		



Key marginal gains associated with the restoration of the Rottal Burn:

- Salmon productivity £ 198,351
- Climate regulation £ 19,319
- Biodiversity £ 125,959
- Flood mitigation £ 83,313
- Education £ 28,146

Total = £455, 088



Values associated with **Salmon production**

Angling – *benefit transfer*

- Maximum smolt production from site estimated at 6/100m² using data from Baum *et al.*, (2012)
- Pre restoration smolt estimate = 5
- Post restoration smolt estimate = 363
- Marginal gain is £148, 492 based on value transfer from Butler *et al.*, (2009)

Capital value – *market values*

- Marine survival constant at ~ 5.3% (WGNAS, 2013) each fish adds £6000 (CKD Galbraith)
- Fishery sold after 25 years
- Marginal gain is £49, 859



Values associated with **Climate regulation**

- Development of 10.5 ha of riparian woodland
- Carbon stored in different land uses pre and post restoration estimated and run through the InVEST carbon model
- Social value of carbon estimated at £29.2 per tonne following Everard (2009)
- Total marginal value over 25 years = £19, 319



Values associated with **Biodiversity**

- Grants for managing the land – *market value*
= **£39, 164**
- Non use value of habitat – *benefit transfer*
= **£62, 229** based on values from Bateman *et al.*,
(2011)
- Non use value associated with iconic species (salmon
and otter) – *benefit transfer*
= **£24, 566** based on values from Lawrence &
Spurgeon (2007) and White *et al.*,(1997)



Values associated with **Flood Mitigation**

- Value of the 12 ha of riparian woodland for flood defence
– *benefit transfer*

= **£83, 313** based on a value of is £407/ ha/ yr from
Bateman *et al.*,(2011)



Values associated with **Education**

- Value of 5 trips of 20 individuals to the restoration site
– *projected Willingness to pay*

= **£28, 146** based on values charged for field visits by the water of Leith and the cost of coach hire.



Key marginal gains associated with work by the Water of Leith Conservation Trust and Bailiffs:

- Habitat improvement £ 16, 977
- Engaging the community £ 45, 542
- Education £ 9, 071
- Recreational fishing £ 28, 590

Annual Total = £ 100, 180

Potential value over 25 years (assuming similar actions continue) = £1, 708, 907



Annual value associated with **Habitat improvement**

- Value of the 3302 volunteer hours – *replacement cost*

= **£16, 977** based on hourly rates for labourers and apprentices



Annual value associated with **Engaging the community**

- Value of the 3302 volunteer hours – *replacement cost and Willingness to Pay*
- Value of Health benefits from using the Water of Leith walkway – *benefit transfer* from Rabl and De Nazelle (2012)
- Value of CO₂ emissions avoided – *benefit transfer* from Walsh *et al.*, (2008)

= £45, 542



Annual Value associated with **Education**

- Value of school / education visits – *market value*
- Value of youth volunteers – *replacement cost*
- Value of podcasts – *market value* estimated from Rosemarin (2006).

= £9, 071



Annual value associated with **Recreational Fishing**

- Value of permits from volunteer run fishery – *Willingness to pay transferred from similar fishery*

= **£28, 590** based on cost of an annual trout fishing permit on the River Tweed



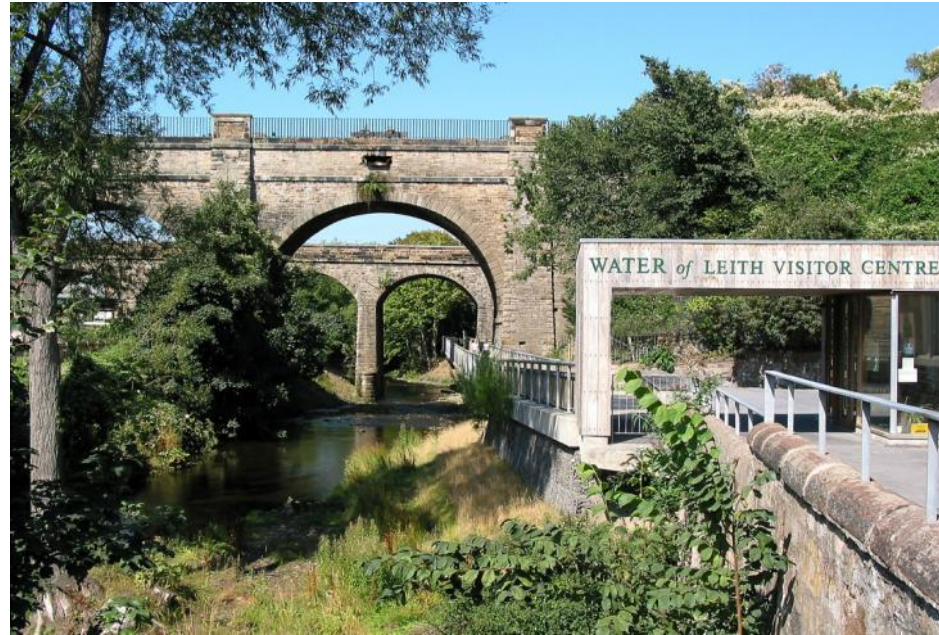
Rottal Burn



Cumulative value over 25 years
= £455,088



Water of Leith



Cumulative value over 25 years
= £1, 708, 907

Remarks on the process

- CICES excellent for identifying ES and associated benefits
- Big gap between identification and monetary valuation
- Anthropocentric nature of ES definitions still controversial
- Despite inherent assumptions valuation is a useful tool to aid decision makers



Disclaimer: Although funded through SNH the findings of this project are my own and do not necessarily reflect the thoughts or stance of the organisation as a whole on this subject.

Acknowledgements

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