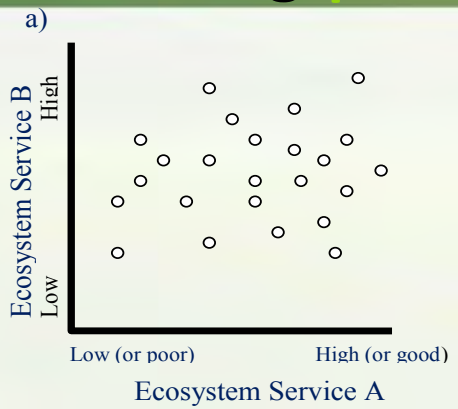
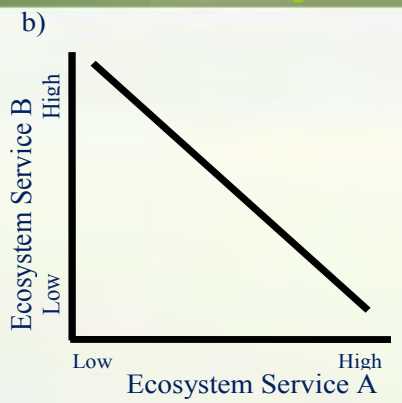
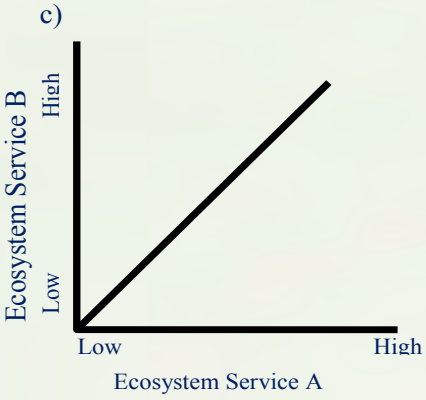
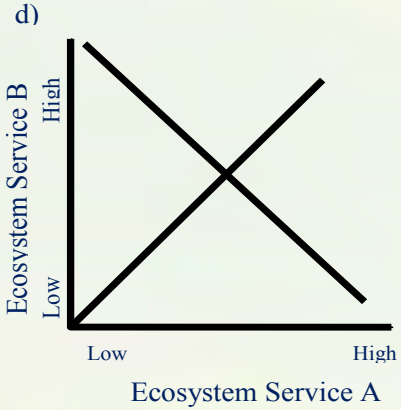
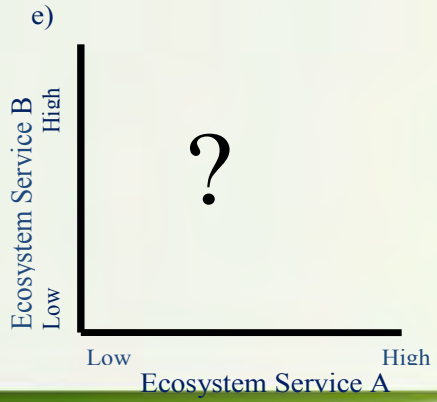
Farm scale ecosystem services Pilgrim, Macleod *et al.* 2010











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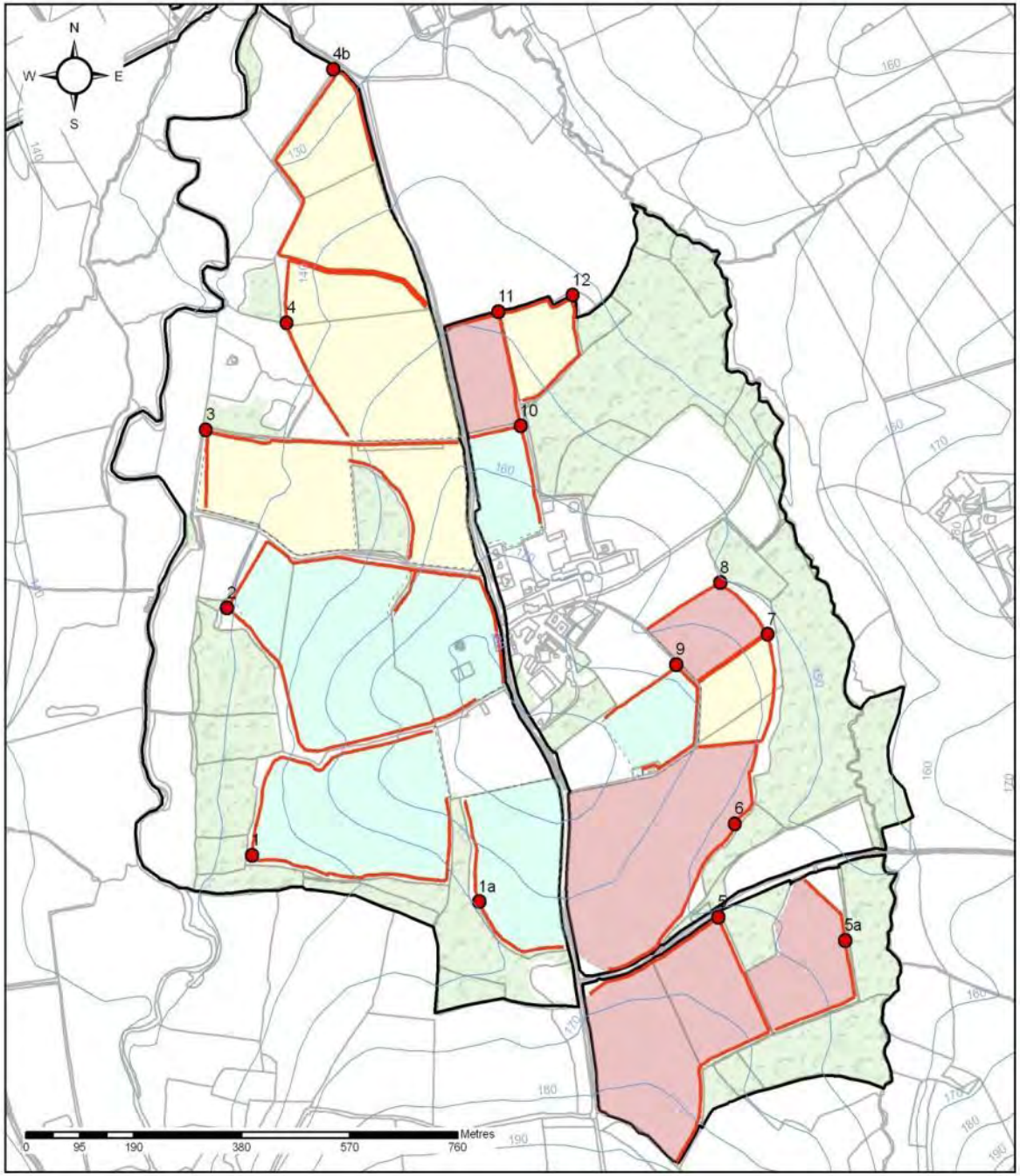
Service	Description
Agricultural Production	Provisioning ES from MEA: food, water, fuel, fibre etc
Climate Regulation	GHG key in regulating climate. Different land uses affect GHG emission & C sequestration
Air Quality	Agricultural grasslands act as sources & sinks for atmospheric compounds e.g. NH_3, O_3, aerosols & dust which affect air quality
Water Quality	Grassland systems this is affected by nutrient loss e.g. N, P, sediment & pathogenic organisms from field to surface water
Hydrological Regulation	Changes in land use affect surface flow rates & water storage potential of the soils, plants etc which can affect flooding.
Erosion Regulation	Soil erosion influenced by soil structure, landscape, vegetation cover, water runoff, wind and rainfall
Nutrient Cycling	The movement of essential nutrients (N, P, K etc) within & between the biotic & abiotic entities in which nutrients occur in the environment
Biodiversity Conservation	Nearly all research is at level of whole organism/assemblage though diversity of genes, populations & sp underlies all grassland ecosystem processes
Landscape Quality	Landscape affected by natural and/or human factors.Importance of landscape quality to people

	Agricultural production	Climate Regulation	Air quality	Water quality	Hydrological regulation	Human health	Erosion regulation	Nutrient cycling	Biodiversity conservation	Landscape quality
Agricultural production		↕ ***	↓ ***	↓ ***	↕ **	↓ **	↓ **	↓ ***	↓ ***	↓ ***
Climate Regulation	↕ **		↑***	↑***	↑ **	↑ *	↑ **	↕ **	↕ **	↕ **
Air quality	↕ **	↕ **		↑ ***	↑ *	↑ ***	0	↑ **	↑ ***	↑ ***
Water quality	↔	↕ **	↕ **		↕ **	↑ ***	0	0	↑ **	↑ **
Hydrological regulation	↕ **	↕ **	↔	↑ **		↕ **	0	↑ ***	↕ **	↕ **
Human health	↕ *	↕ **	↕ **	↕ **	↕ **		0	0	↑ **	↑ **
Erosion regulation	↑ **	↕ **	↑ **	↑ ***	↑ *	0		↕ **	↑ **	↔
Nutrient cycling	↑ ***	↑ **	↑ *	↑ ***	↑ **	↑ **	↑ *		↑ **	↑ **
Biodiversity conservation	↕ **	↕ **	↔	↑ **	↑ **	↕ **	↑ **	↑ *		↑ ***
Landscape quality	↕ *	↕ *	↕ *	↑ *	↑ *	↑ **	↑ **	↕ **	↑ ***	



North Wyke Farm Platform

Provisional Farming Systems

Legend

- Conventional Beef and Sheep Production
- Inovation Farming System
- Legume Based Beef and Sheep Production
- Flumes
- French drains
- NW Boundary
- Woodland
- 10m Contour

NORTH WYKE RESEARCH

23rd April 2010

Development of the Farm Platform

Macleod and Ferrier in press

Examples of the broad scale service provision by different temperate grassland types.

*Service provision as judged by the authors. Weak positive = +, medium positive = ++, strong positive = +++, Weak negative = -, medium negative = --, strong negative = ---, no clear service provision = o, +/- = mixed relationships.

Service	Semi- natural grassland				
	Acid grassland*	Neutral Grassland	Calcareous grassland	Intensive Grassland	Flood meadow
Provisioning					
• Food					
○ Meat	+	+	++	+++	++
○ Milk	O	+	+	+++	++
• Fibre	+	+	++	+++	+
Regulating					
• Water quality	+	+	+	- - -	++
• Soil infiltration	+	+	+	+/-	+
• Groundwater recharge	O	O	+	++	+++
• Flood attenuation	+/-	+	+	+	+++
Supporting					
• C Sequestration	++	+	+	+	++
• GHG emissions	+/-	+/-		- - -	--
• Biodiversity	+/-	+/-	+++	--	+++
• Pollination	+/-	+/-	++	-	++
Cultural					
• Traditional practices	+/-	+/-	+++	- - -	+++
• Recreation	+	+	++	-	+/-

BBSRC SuperGRaSS

Linking the biology and physics of temperate multifunctional forage grasses and soil hydrological function

C.J.A.(Kit) Macleod[1], A. Binley[2], L. J. Clark[3], S. O'Donovan[4], A. Gregory[3], S. L. Hawkins[4],M. Humphreys[4], A. Joynes[1], A. Papadopoulos[2], L. Skøt[4], A. Stone[1], L. B. Turner[4], C. Watts[3], C. Webster[3], W. R. Whalley[3] and P. M. Haygarth[1,2]

(1) North Wyke Research, North Wyke, Devon, UK
(2) Lancaster University, Lancaster, UK
(3) Rothamsted Research, Hertfordshire, UK
(4) IBERS, Aberystwyth, UK

Complementary traits in ryegrass (*Lolium*) and fescue (*Festuca*)

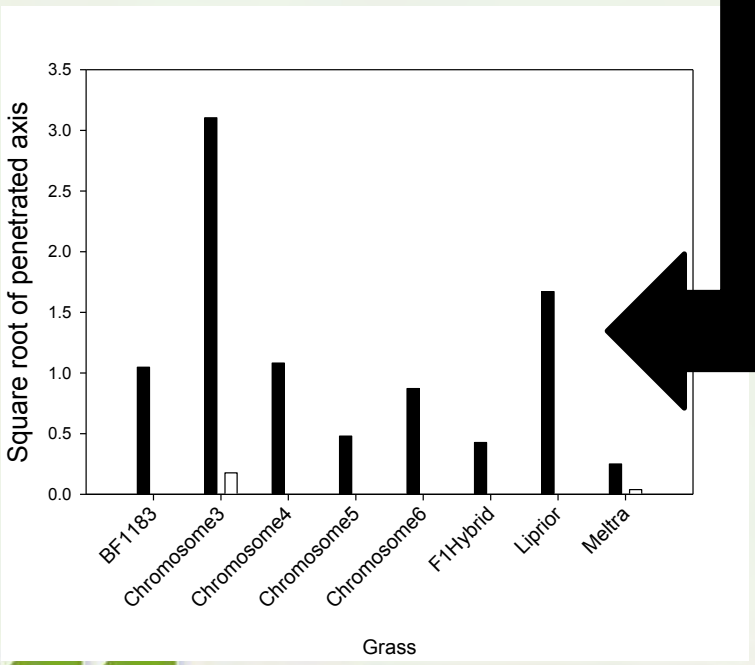
Trait	*Lolium Multiflorum* (Italian ryegrass)	*Festuca Arundinacea* (Tall Fescue)
Establishment	+++++	+++
Spring growth	+++++	+++
Summer growth	++++	++++
Digestibility	+++++	+++
Winter hardiness	+	++++
Drought resistance	+	++++
Water-use-efficiency	+	++++
Root development	+	+++++
Persistency	+	+++++

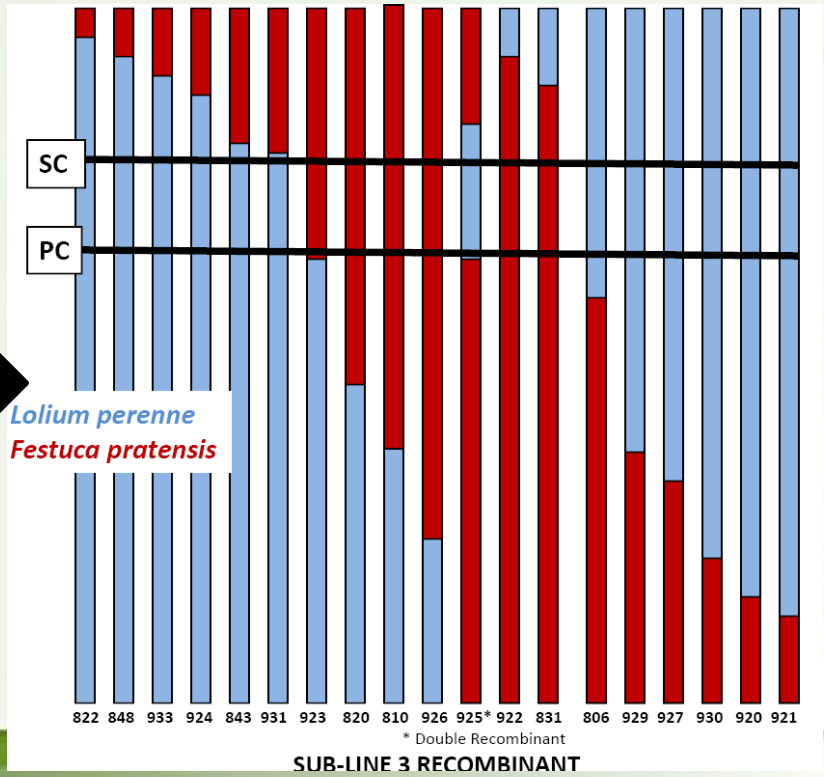
Plant material

Aberstar
-Perennial ryegrass

Prior
-Festulolium hybrid

BF993
-Meadow fescue





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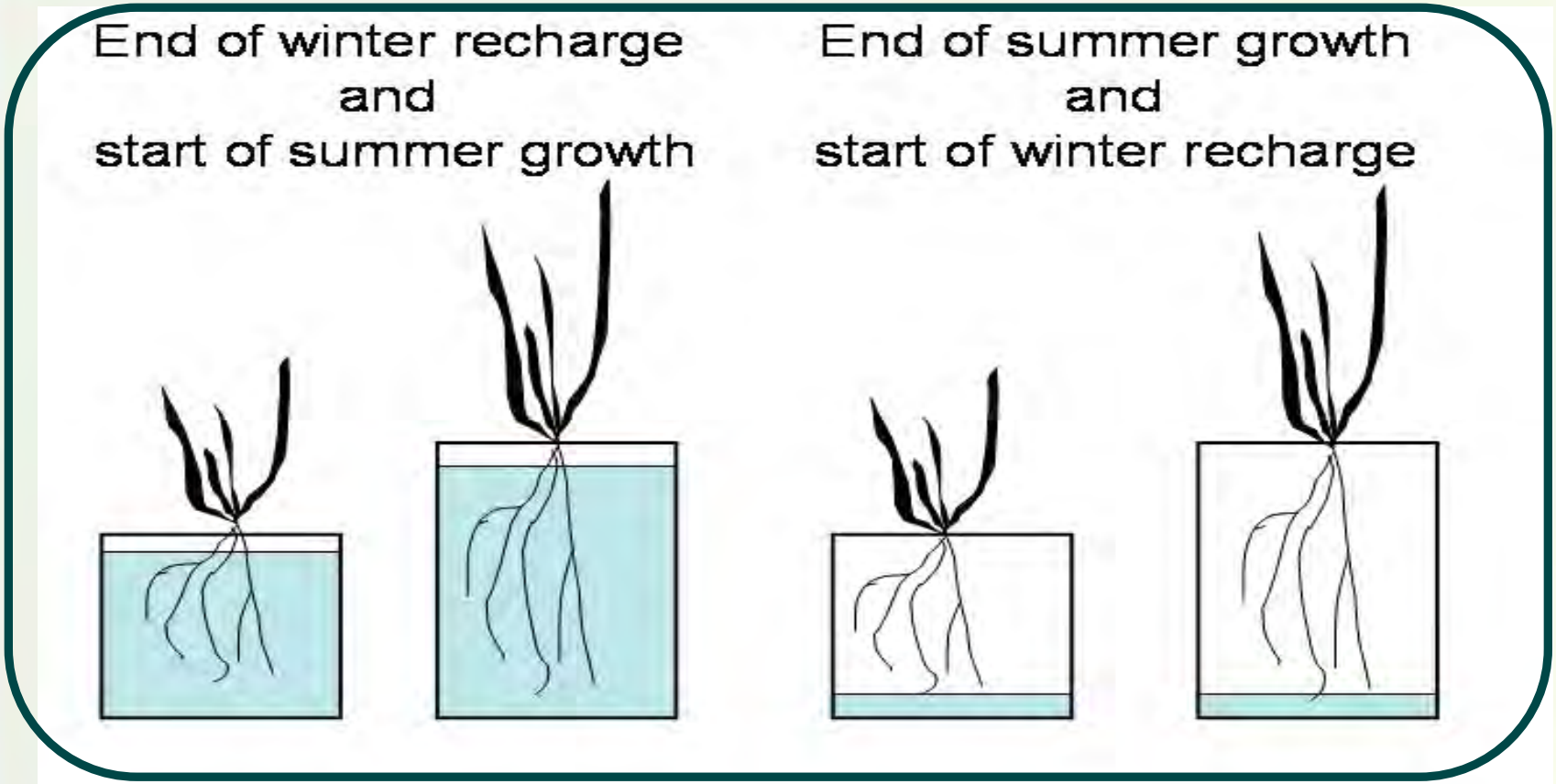
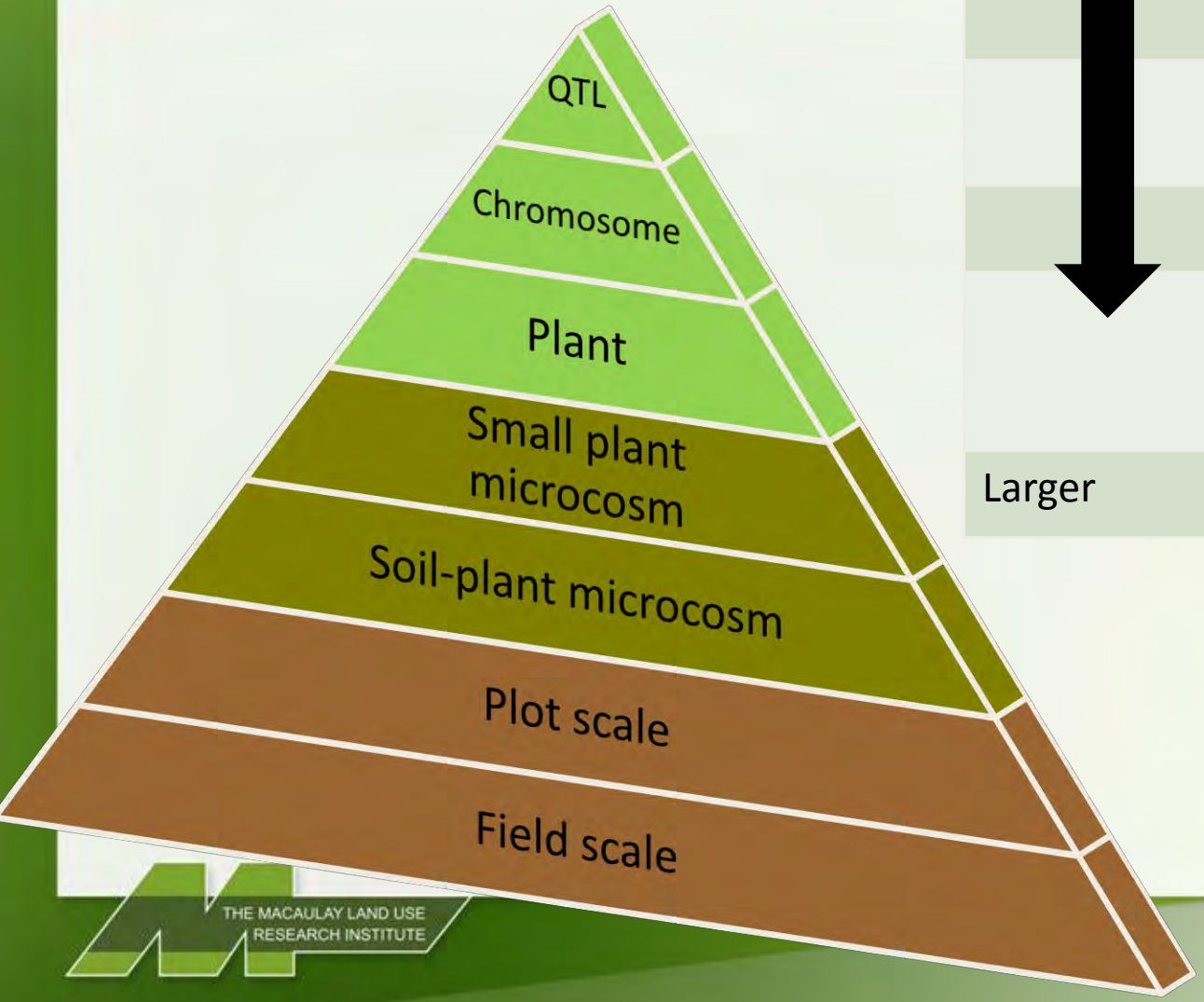
To test the hypothesis that grasses with genes derived from *Festuca*-species have lower surface runoff during periods of water excess than *Lolium* species.



Macleod *et al*. 2007 Hydro. Proc.



Scale	Observations
Smaller	Gene/QTL
	Plant-above
	Plant-root
	Soil-X-ray Computed Tomography
	Soil-Tension Infiltration
	Plot-Electrical Resistivity Tomography -soil-water status
Larger	Plot-Run off

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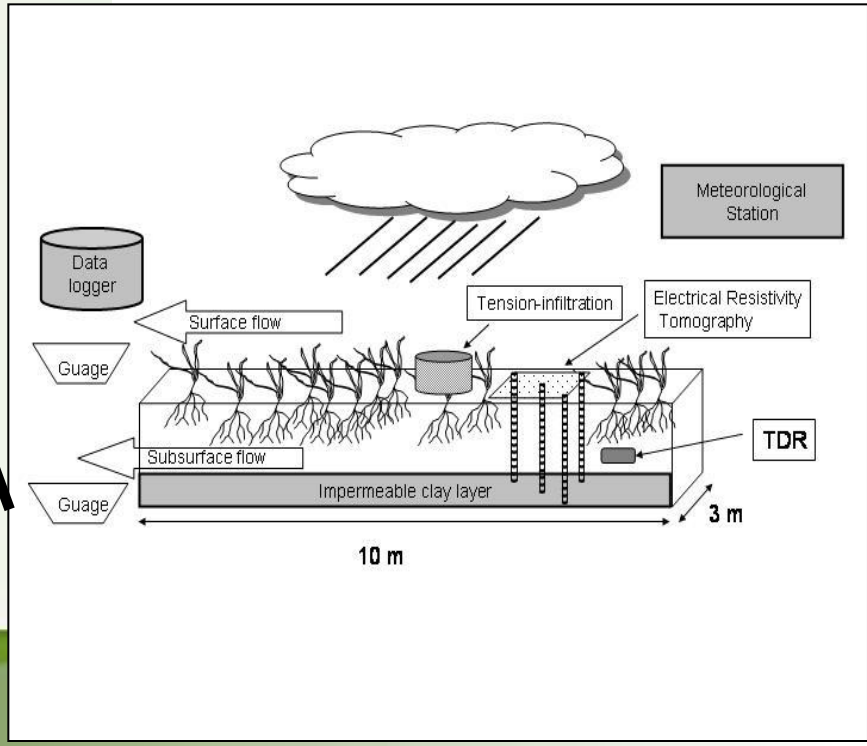
Haldrup

Established June 2006 on Typic Haplaquept (USDA-NRCS, 1975) clayey non-calcareous pelostagnogley (Avery, 1980) of the Hallsworth Series.



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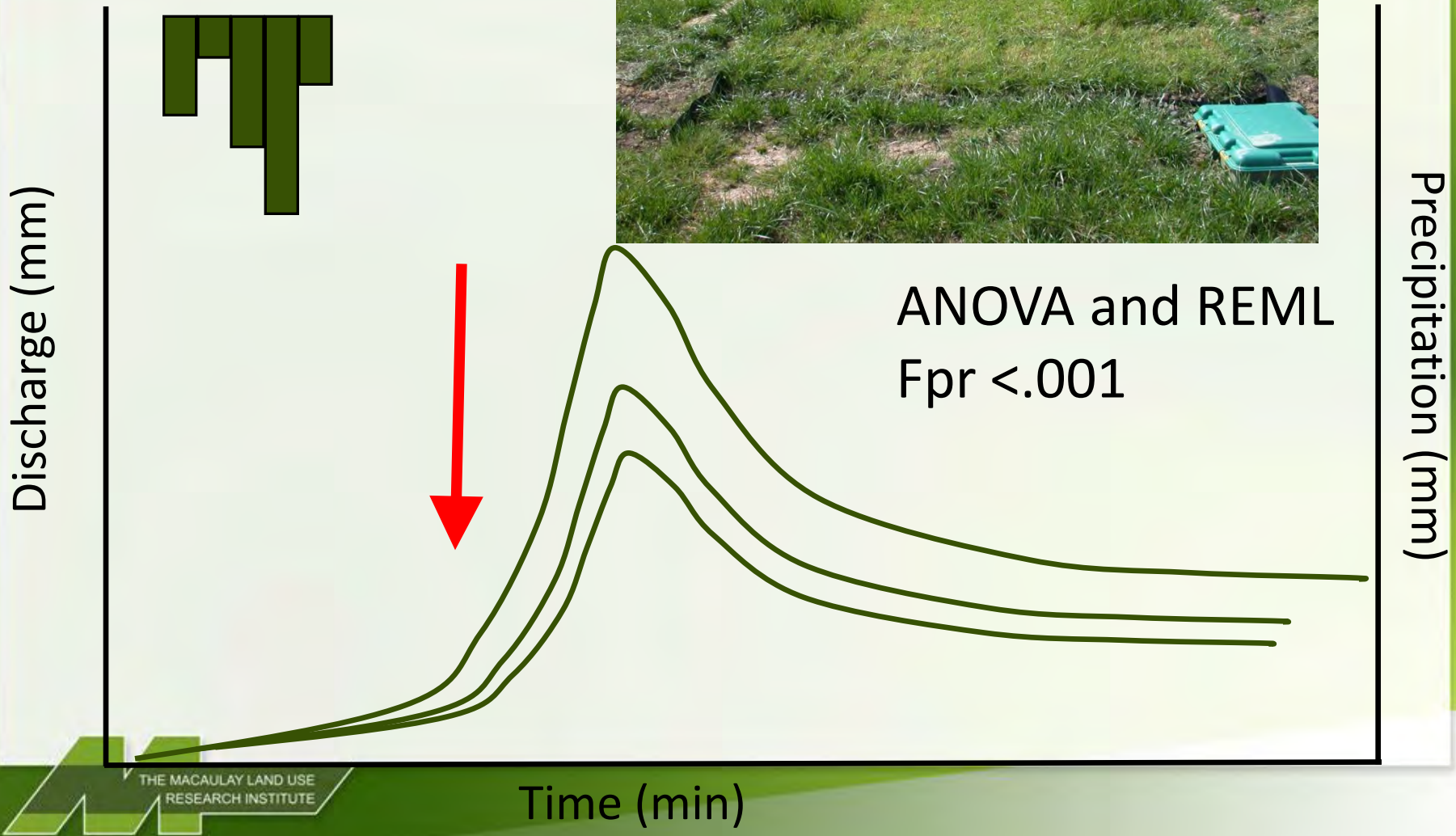
Runoff coefficient (% rainfall as runoff)



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Student-Newman-Keuls test

Latin name/origin	Common name (abbreviation)	Cultivar name (representative)	Runoff as % of rainfall
Lolium perenne	Perennial rye grass (PRG)	Aber Star	66.94
Festuca pratensis	Meadow fescue	BF993	50.48
L. perenne xF.pratensis	Hybrid of the ~two above	Prior	34.22

s.e.d. 2.53

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Macleod *et al*. 2007

Integrated catchment managing (ICM) requires:

1)the legislation and policies that aim to achieve ICM, must be combined with existing and future legislation and policies,
2) the science that is required to support ICM and provide the evidence base also needs to be integrated across natural and social science disciplines,
3) the management of catchments should be based on integrating land management with a wide range of stakeholder requirements, policies and scientific evidence base.

Common set of qualities are required to achieve integration, these include: **curiosity, confidence, credibility, capacity, communication, collaboration and connections**.

MLURI Interdisciplinary workshop v2
Monday 8th November

Participants: Kit Macleod, Simon Langan, Julian Dawson, Bex Holmes, Katrin Prager, Kerry Waylen, Mike Rivington, Jose Munoz-Rojas, Keith Marshall, Andy Vinten, Julia Martin-Ortega

Aims:

1) To provide an opportunity to share experiences of interdisciplinary research (from the gene to earth system scale).
2) Highlight the challenges, benefits and lessons learnt of interdisciplinary research.
3) To learn as a group how we can be more effective in interdisciplinary research activities.
4) To feed into the ACES workshop on Enhancing environmental sustainability through inter-disciplinary action. ACES Workshop for early career researchers interested in working in interdisciplinary research.

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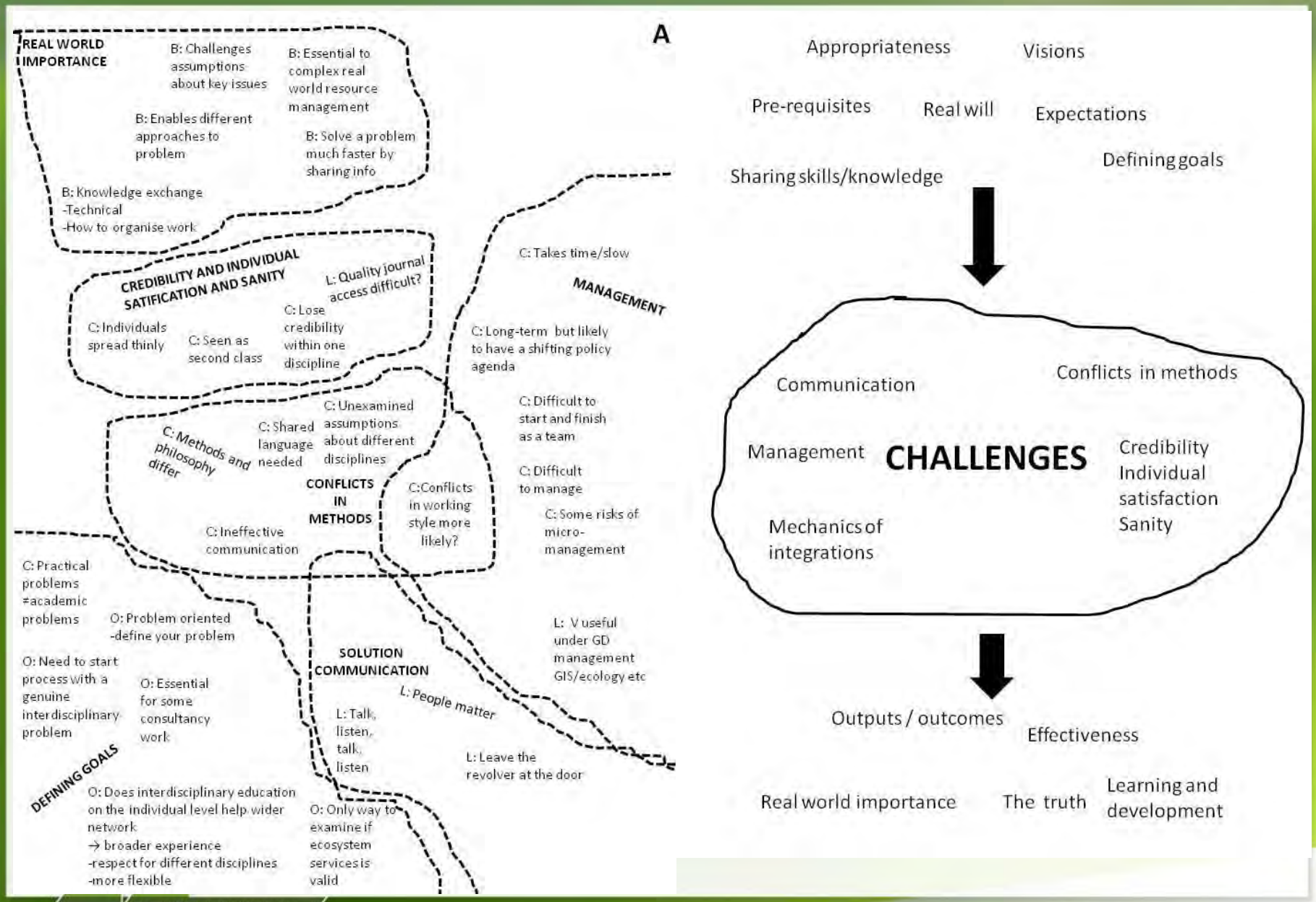
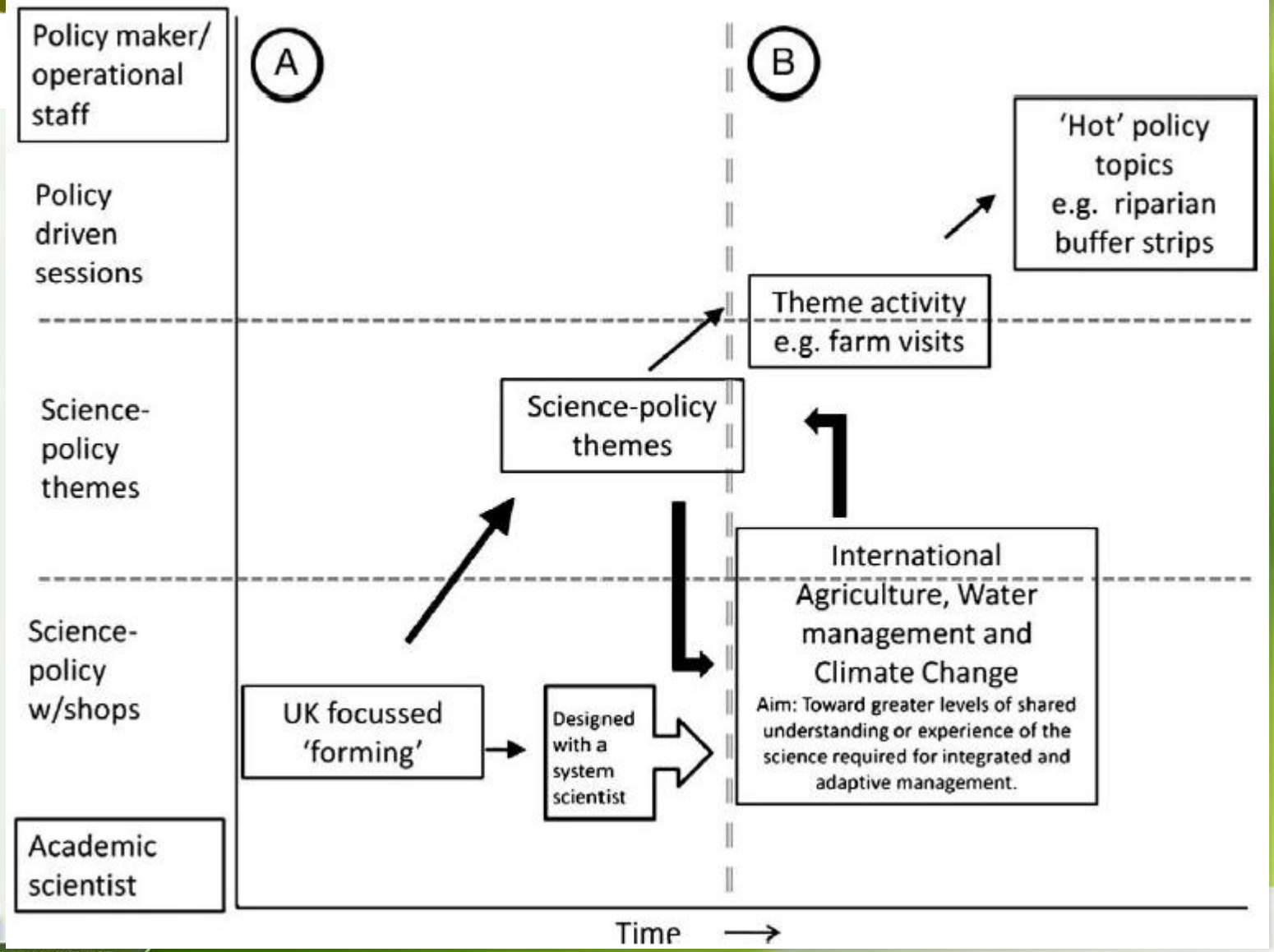

A
REAL WORLD IMPORTANCE
B: Challenges assumptions about key issues
B: Essential to complex real world resource management
B: Enables different approaches to problem
B: Solve a problem much faster by sharing info
B: Knowledge exchange
-Technical
-How to organise work
CREDIBILITY AND INDIVIDUAL SATIFICATION AND SANITY
L: Quality journal access difficult?
C: Individuals spread thinly
C: Seen as second class
C: Lose credibility within one discipline
C: Takes time/slow
MANAGEMENT
C: Long-term but likely to have a shifting policy agenda
C: Difficult to start and finish as a team
C: Difficult to manage
C: Some risks of micro-management
C: Unexamined assumptions about different disciplines
C: Shared language needed
C: Methods and philosophy differ
CONFLICTS IN METHODS
C:Conflicts in working style more likely?
C: Ineffective communication
C: Practical problems ≠academic problems
O: Problem oriented
-define your problem
O: Need to start process with a genuine interdisciplinary problem
O: Essential for some consultancy work
SOLUTION COMMUNICATION
L: People matter
L: Talk, listen, talk, listen
L: Leave the revolver at the door
L: V useful under GD management GIS/ecology etc
DEFINING GOALS
O: Does interdisciplinary education on the individual level help wider network
→ broader experience
-respect for different disciplines
-more flexible
O: Only way to examine if ecosystem services is valid
Appropriateness
Visions
Pre-requisites
Real will
Expectations
Defining goals
Sharing skills/knowledge
Communication
Conflicts in methods
Management
CHALLENGES
Credibility
Individual satisfaction
Sanity
Mechanics of integrations
Outputs / outcomes
Effectiveness
Real world importance
The truth
Learning and development

Integrating Water and Agricultural Management (IWAM)



(A) Macleod *et al*. 2008
(B) Macleod and Haygarth 2010

defra
Department for Environment Food and Rural Affairs

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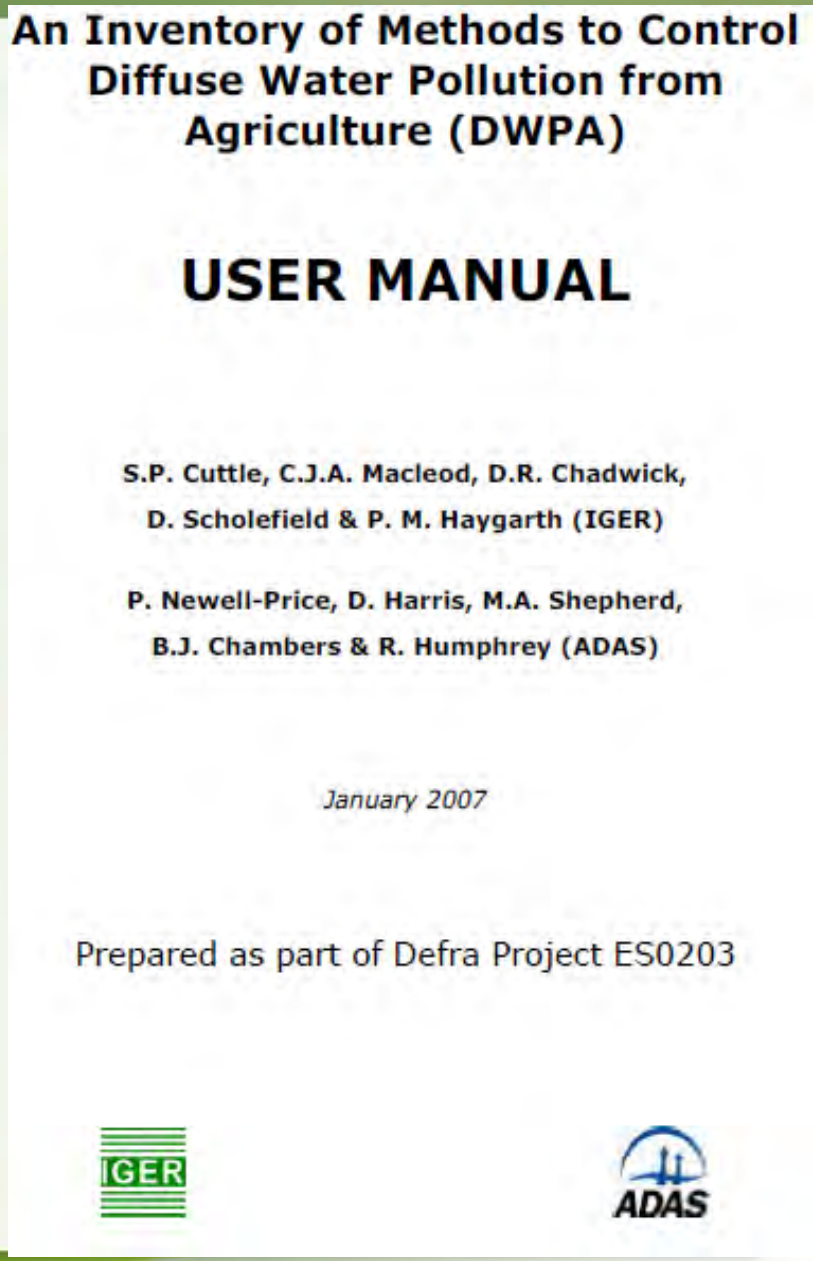
Macleod *et al*. 2008

Mechanisms to Improve Integrative Research at the Science-Policy Interface for Sustainable Catchment Management

Integrative research, as defined by Winder (2003), covers both interdisciplinary and transdisciplinary research projects.

CLOSING-DOWN MECHANISM: ***DIFFUSE POLLUTION USER MANUAL***



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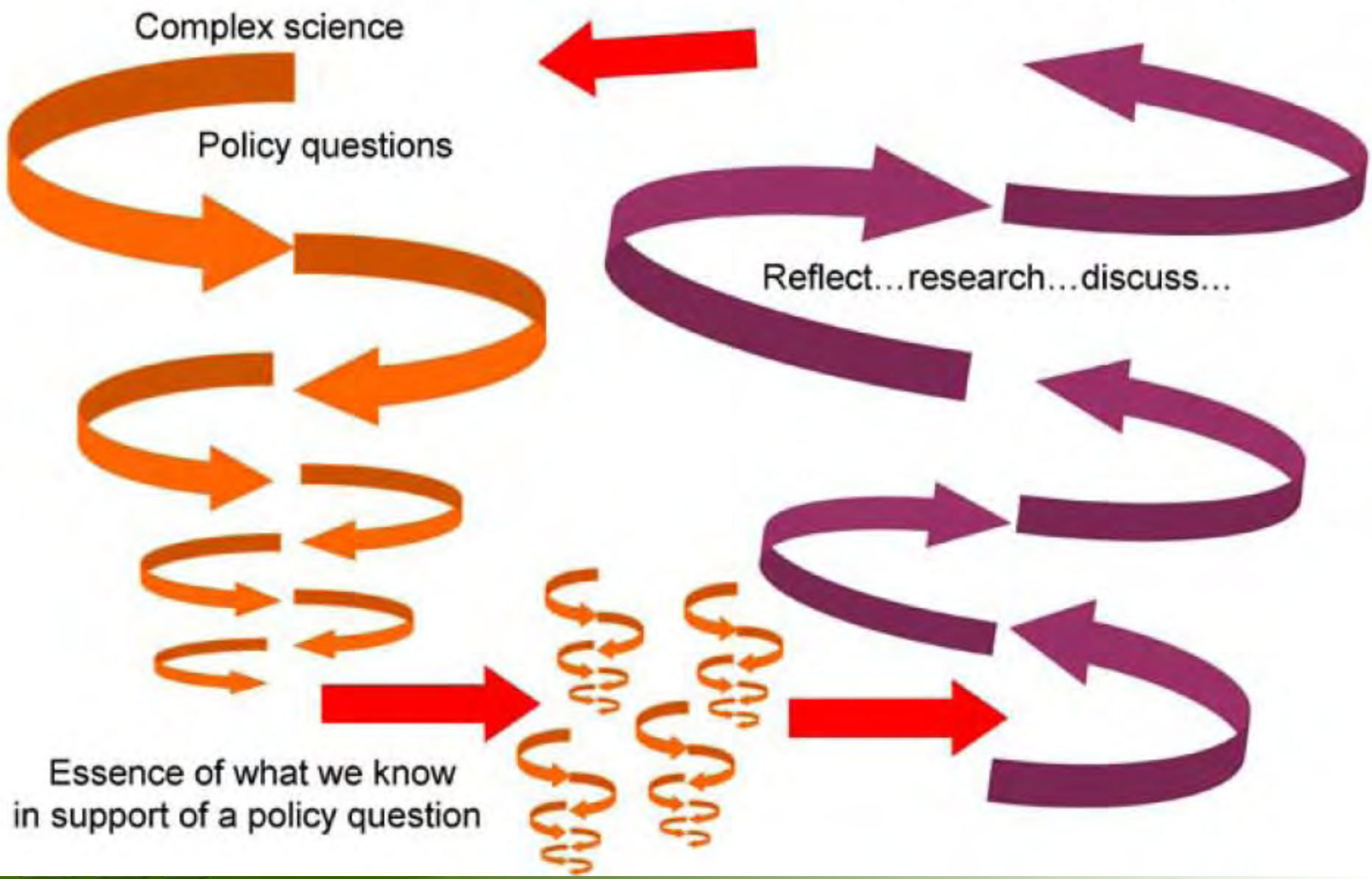
‘Closing down’ ↔ ‘Opening up’



(1) The PQR Formula

Do P By Q

In order to contribute to achieving R

provides a shape for

(2) Root definition

enriches

(3) Mnemonic

CATWOE

Customers Actors Owners Env const Transformation World View

may be

(4)

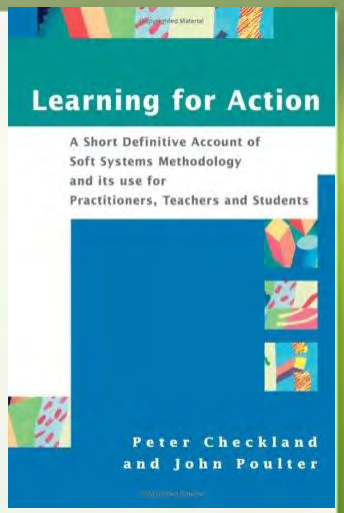
Primary Task

Issue-based

leads to

monitored by criteria for

(5) Purposeful Activity Model



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Agriculture, Water Management and Climate Change

IGER

4-6th March 2008
Bath, UK.

defra

Purpose of the workshop:

Toward greater levels of shared understanding or experience of the science required for integrated and adaptive management

Understanding the situation

Summary of Gaps

-Policy integration / drivers (especially market)/ objectives

-Understanding socio-ecological system characteristics, interactions, functioning and responses

-Data-information-knowledge-evidence

-Cost of change and adaptation: reorganization and loss of skills, increased breadth required for interdisciplinary science

-Education / understanding of scientists and stake holders

-Role of science re: right questions / research directions (funding)

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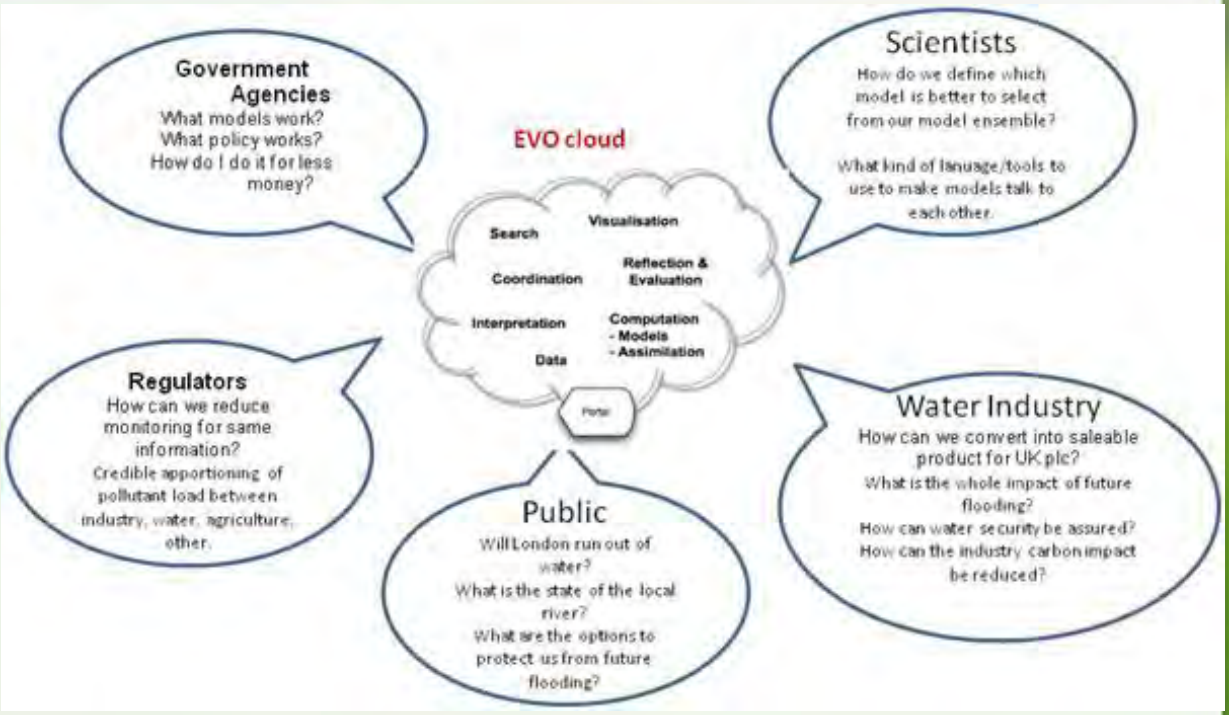
NERC Environmental Virtual Observatory



Vision:

- Make environmental data more visible and accessible to a wide range of potential users and free to use for public good applications;
- Provide tools to facilitate the integrated analysis of data, greater access to added knowledge and expert analysis, and visualisation of the results;
- Develop new, added-value knowledge from public and private sector data assets to help tackle environmental challenges.

http://www.environmentalvirtualobservatory.org/

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Likens *et al.* 2009

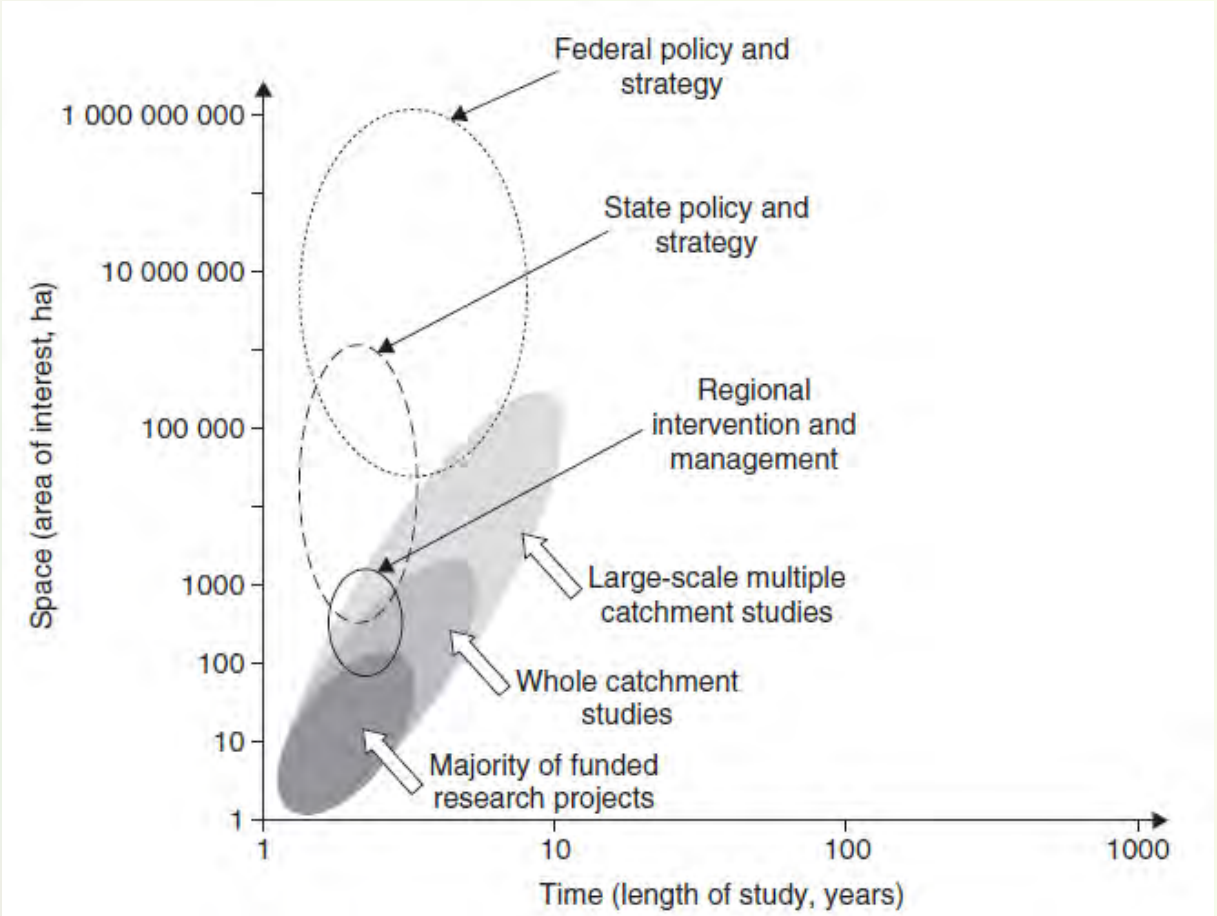

Fig. 1. Diagrammatic representation of the current temporal and spatial scales of research (shaded ellipses), showing the disconnection in the scales at which federal, state and regional policy and management (open ellipses) operate.

Knight *et al.* 2008 Knowing but not doing

1. Acknowledge the research–implementation gap is real.
2. Source research questions from practitioners.
3. Situate research within a broader conservation planning operational model.
4. Expand the social dimension of conservation assessments.
5. Support conservation plans with transdisciplinary social learning institutions.
6. Reward academics for societal engagement and implementation.
7. Train students in skills for doing conservation.

Norgaard 2010

Ecosystem services: From eye-opening metaphor to complexity blinder

1) **The richness of the ecological sciences**
2) **ES and sustainability in a general equilibrium framework**
3) **Become serious about env governance**

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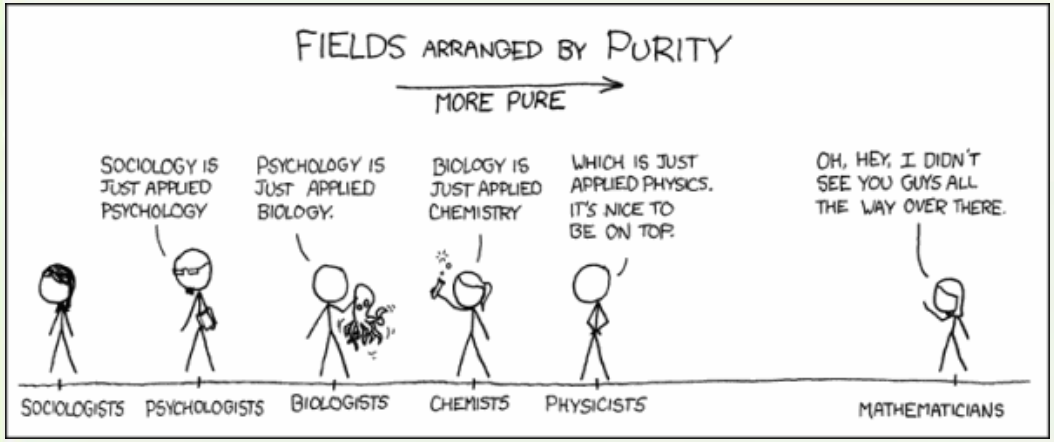
Thank you



Robert Cartaino
http://blog.stackoverflow.com/2010/09/good-subjective-bad-subjective/

Phil Haygarth, Rich Brazier, Tobi Krueger, Gary Billota, Steve Granger, Keith Goulding, Richard Whalley, Alice Milne, Murray Lark, Emma Pilgrim, Kirsty Blackstock, Bob Ferrier, Alan Lilly, Keith Mathews, Pete Falloon, Bob Evans, Kevin Collins, Simon Pollard, David Scholefield, Allan Puttock, Kim Mack... Funders...

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