

Biodiversity and ecosystem services

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CONSTITUENTS OF WELL-BEING



Source: Millennium Ecosystem Assessment

ARROW'S COLOR
Potential for mediation by socioeconomic factors

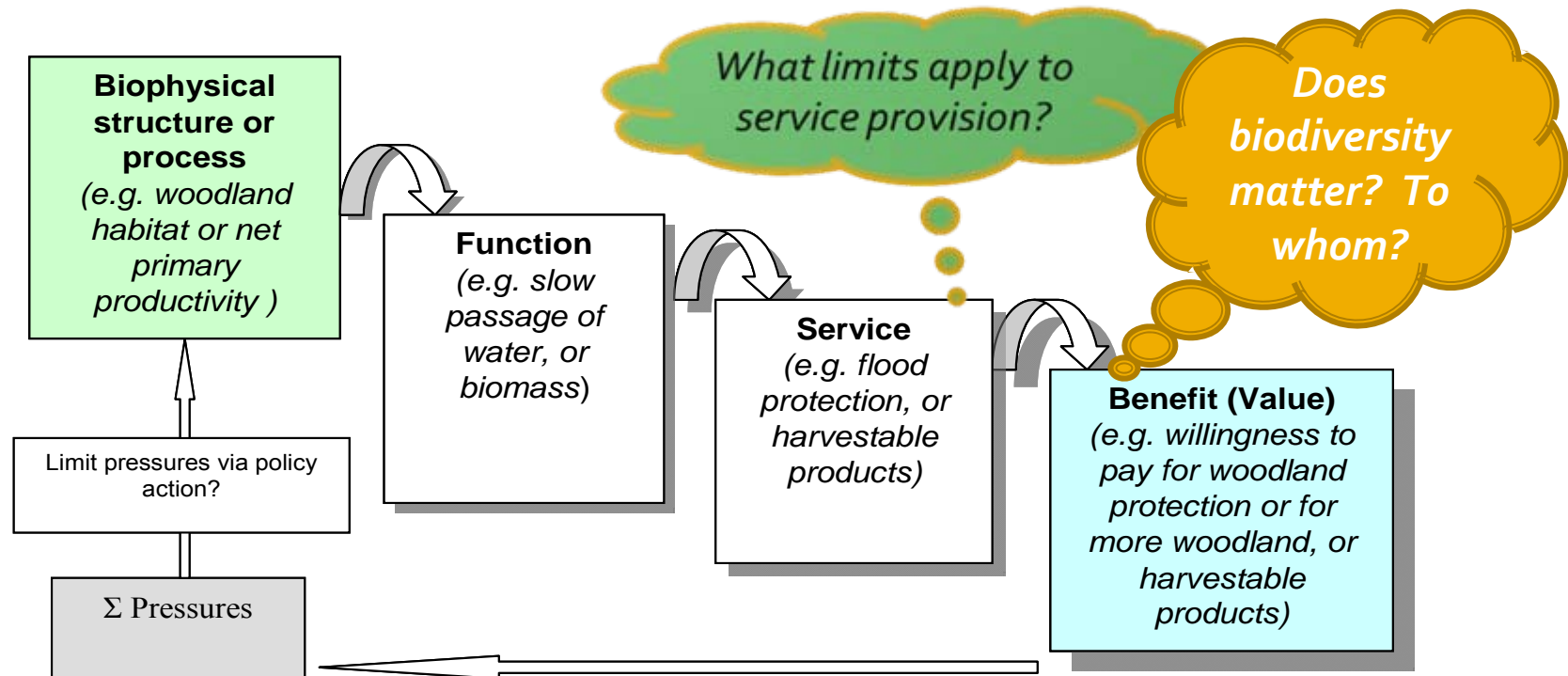
- Low
- Medium
- High

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

- Weak
- Medium
- Strong

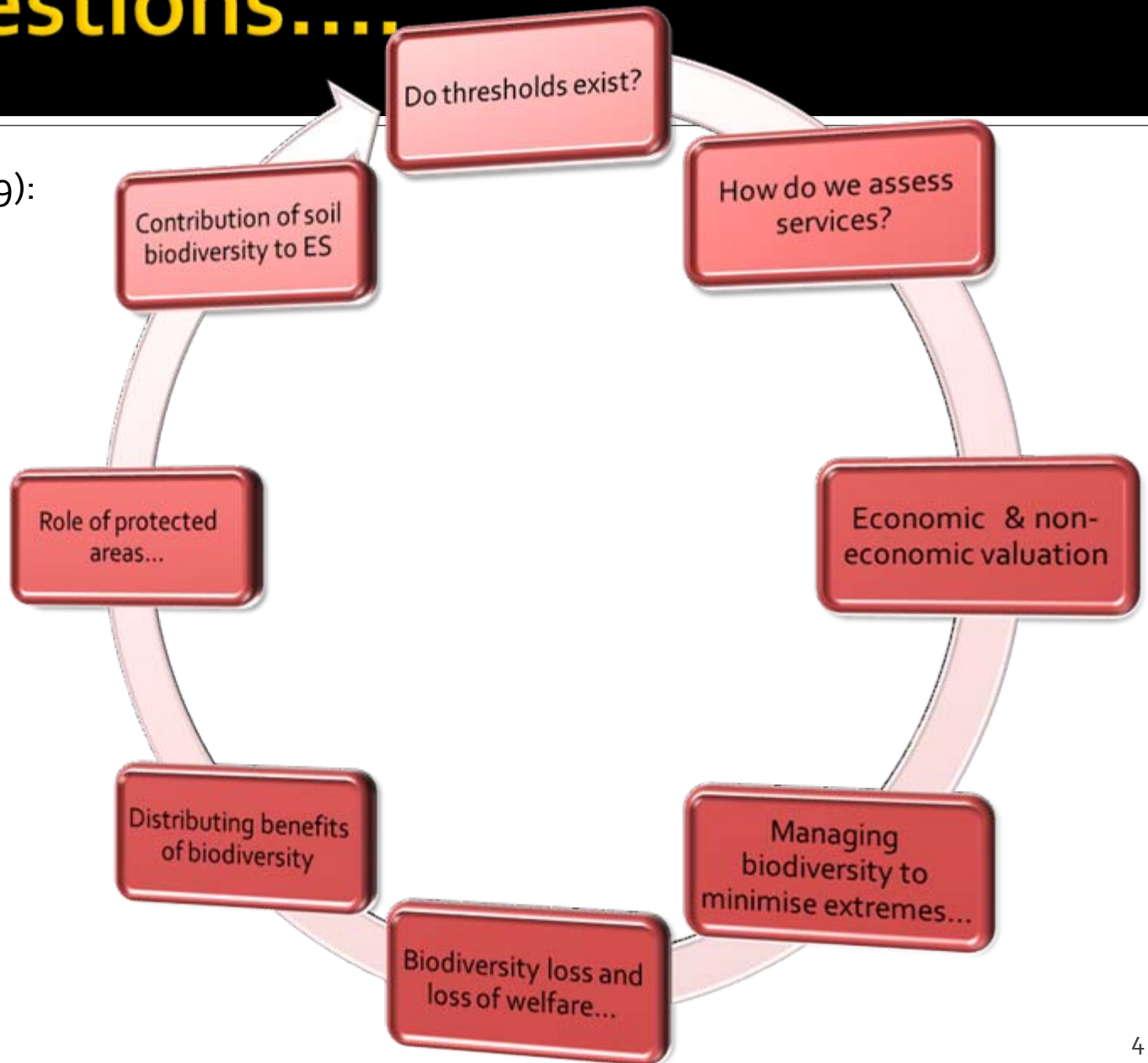
Ecosystem service cascade

- Ecosystem services are the outputs of ecosystem functioning that directly contribute to human well-being....



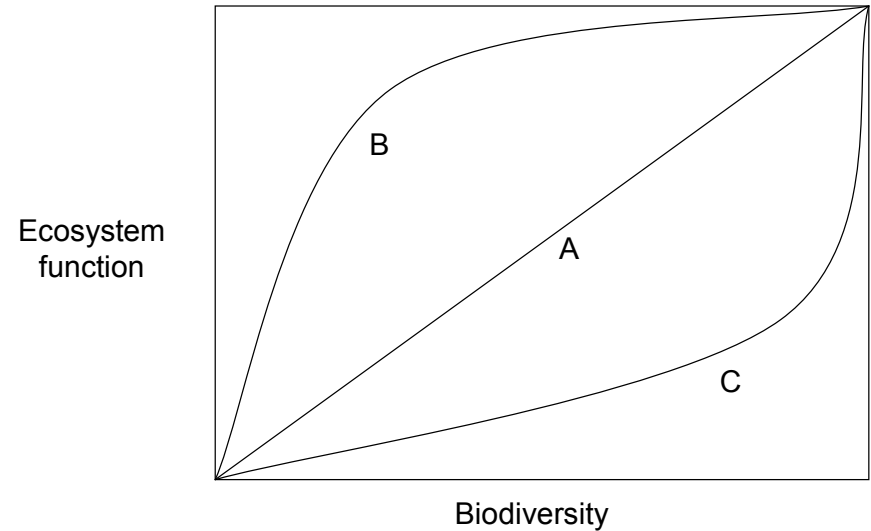
Key questions....

Sutherland et al. (2009):



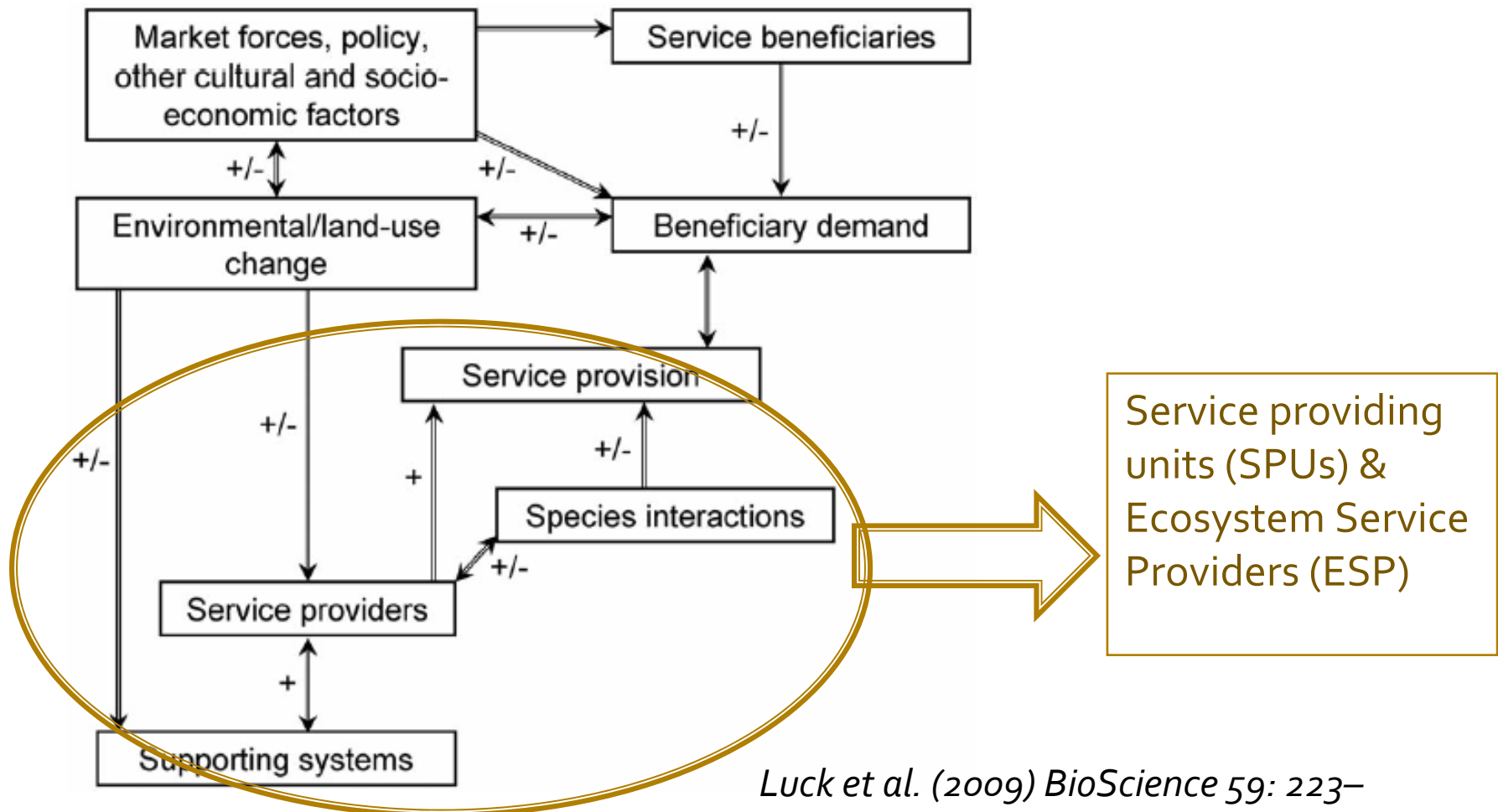
Biodiversity and service output

- Is there a simple direct relationship between biodiversity and service output?
- What in fact do we mean by biodiversity?
- Can the results of manipulative experiments be scaled up?



- Schwartz et al. (2000)
- Balvanera et al. (2006)
- EASA (2009)
- ...and others

Where the biophysical meets the social....



Luck et al. (2009) *BioScience* 59: 223–235

SPUs and ESPs

Can service providers be characterised in terms of functional groups on the basis of their response traits and their effects traits?

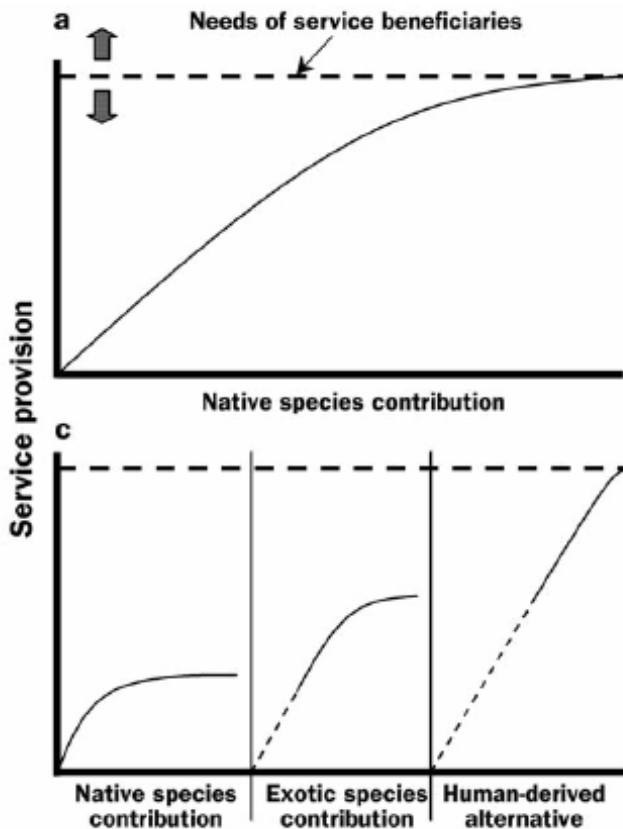
Service-providing unit (SPU) (adapted from Luck et al. 2003).

The collection of individuals from a given species and their characteristics necessary to deliver an ecosystem service at the desired level

Ecosystem service provider (ESP) (adapted from Kremen 2005).

The component populations, communities, functional groups, interaction networks, or habitat types that provide ecosystem services

Understanding supply and demand...



E.g. Eurasian jays (*Garrulus glandarius*) in oak forest in the National Urban Park of Stockholm, Sweden

E.g. Pest control....and some regulation services?

Applying the Ecosystem Service Paradigm

- *There are different ways of applying the ecosystem service approach...*
 - *Using a habitats perspective*
 - *From a systems perspective*
 - *... and from a place-based perspective*

Taking a habitats perspective

- Review suggested that different habitats had different services associated with them... *multi-functionality*
- It was apparent that habitats had benefits and liabilities... *ecosystem accounting*
- Most of the direct drivers of change related to land management... *maintenance costs*

Taking a habitats perspective

- There was very little information to link ideas about the conservation status of these habitats to their ability to deliver ecosystem services....*we need something like 'favourable delivery status'*
- It is still very difficult to make some judgement about the status of services as a whole, because we simply do not know how habitats contribute to service output....*who assigns the importances?*
- In most cases it proved very difficult to move from an assessment made on a habitat-by-habitat basis to an overall assessment of a particular service *What approach will the national ecosystem assessment take?*

Taking a systems perspective

- It may be easier in one sense to track back from some kind of 'service delivery profile' to the mechanisms that underpinned it...
 - *Bayesian Networks (BN) are a good way of constructing narratives and of combining different kinds of knowledge*
 - *They can help build up this rich picture of the problem from the stakeholder/client perspective*
 - *E.g. by modelling Service Providing Units (SPUs), etc.*

- Ecological Structure or Process
- Ecological Function or Capacity
- Service
- Benefit
- Driver (direct and indirect)

L: Diffuse pollution load	
Increasing	20.0
Stable	40.0
Declining	40.0
0.2 ± 0.75	

G: Temperature increase (+ baseline)	
0 to 0.5	30.0
0.5 to 1	40.0
1 to 2	20.0
2 to 2.5	9.00
2.5 to 3	1.0
0.905 ± 0.66	

C: Summer drought	
likely	60.0
unlikely	40.0
1.2 ± 0.98	

F: Rainfall amount	
Increase	30.0
Stable	60.0
Decrease	10.0
0.2 ± 0.6	

D: Peat formation	
Active	92.2
Inactive	7.81
4.72 ± 3.8	

B: Carbon balance for peat (t/ha/yr)	
Increasing	41.1
Stable	41.6
Decreasing	17.4
0.119 ± 0.36	

A: Peat decomposition	
high	65.1
moderate	11.6
low	23.3
3.5 ± 3.6	

V: Carbon Offset Value (£/ha/yr)	
Value	10.8811

M: Liming	
Done	0
Not done	100
-1	

J: Grazing	
Heavy	20.0
Light	60.0
None	20.0
0.5 ± 0.77	

H: Burning	
None	50.0
Managed	50.0
Wildfire	0
0.25 ± 0.25	

K: Drainage management	
New drainage	0
No change	50.0
Restoration	50.0
1.25 ± 0.75	

R: Water table	
Rising	24.0
Stable	41.0
Dropping	35.0
0.147 ± 1.8	

E: Habitat type	
Heathland	0
Mire	100
Acid grassland	0
Woodland	0
Improved grassland	0
Arable	0
2	

Q: Decomposition Type	
Newly aerobic	0
Typically anaerobic	29.8
Anaerobic	70.2
0.298 ± 0.46	

S: NO2-Emissions

N: CH4-Emissions

Bayesian Belief Network

- Ecological Structure or Process
- Ecological Function or Capacity
- Service
- Benefit
- Driver (direct and indirect)

L: Diffuse pollution load	
Increasing	20.0
Stable	40.0
Declining	40.0
0.2 ± 0.75	

G: Temperature increase (+ baseline)	
0 to 0.5	30.0
0.5 to 1	40.0
1 to 2	20.0
2 to 2.5	9.00
2.5 to 3	1.0
0.905 ± 0.66	

C: Summer drought	
likely	60.0
unlikely	40.0
1.2 ± 0.98	

F: Rainfall amount	
Increase	30.0
Stable	60.0
Decrease	10.0
0.2 ± 0.6	

D: Peat formation	
Active	58.4
Inactive	41.6
1.34 ± 5.7	

B: Carbon balance for peat (t/ha/yr)	
Increasing	28.3
Stable	35.6
Decreasing	36.1
-0.0392 ± 0.4	

A: Peat decomposition	
high	75.8
moderate	12.1
low	12.1
4.28 ± 3.2	

V: Carbon Offset Value (£/ha/yr)	
Value	-3.5990

M: Liming	
Done	0
Not done	100
-1	

J: Grazing	
Heavy	20.0
Light	60.0
None	20.0
0.5 ± 0.77	

H: Burning	
None	50.0
Managed	50.0
Wildfire	0
0.25 ± 0.25	

K: Drainage management	
New drainage	0
No change	50.0
Restoration	50.0
1.25 ± 0.75	

R: Water table	
Rising	24.0
Stable	41.0
Dropping	35.0
0.147 ± 1.8	

E: Habitat type	
Heathland	0
Mire	0
Acid grassland	100
Woodland	0
Improved grassland	0
Arable	0
1	

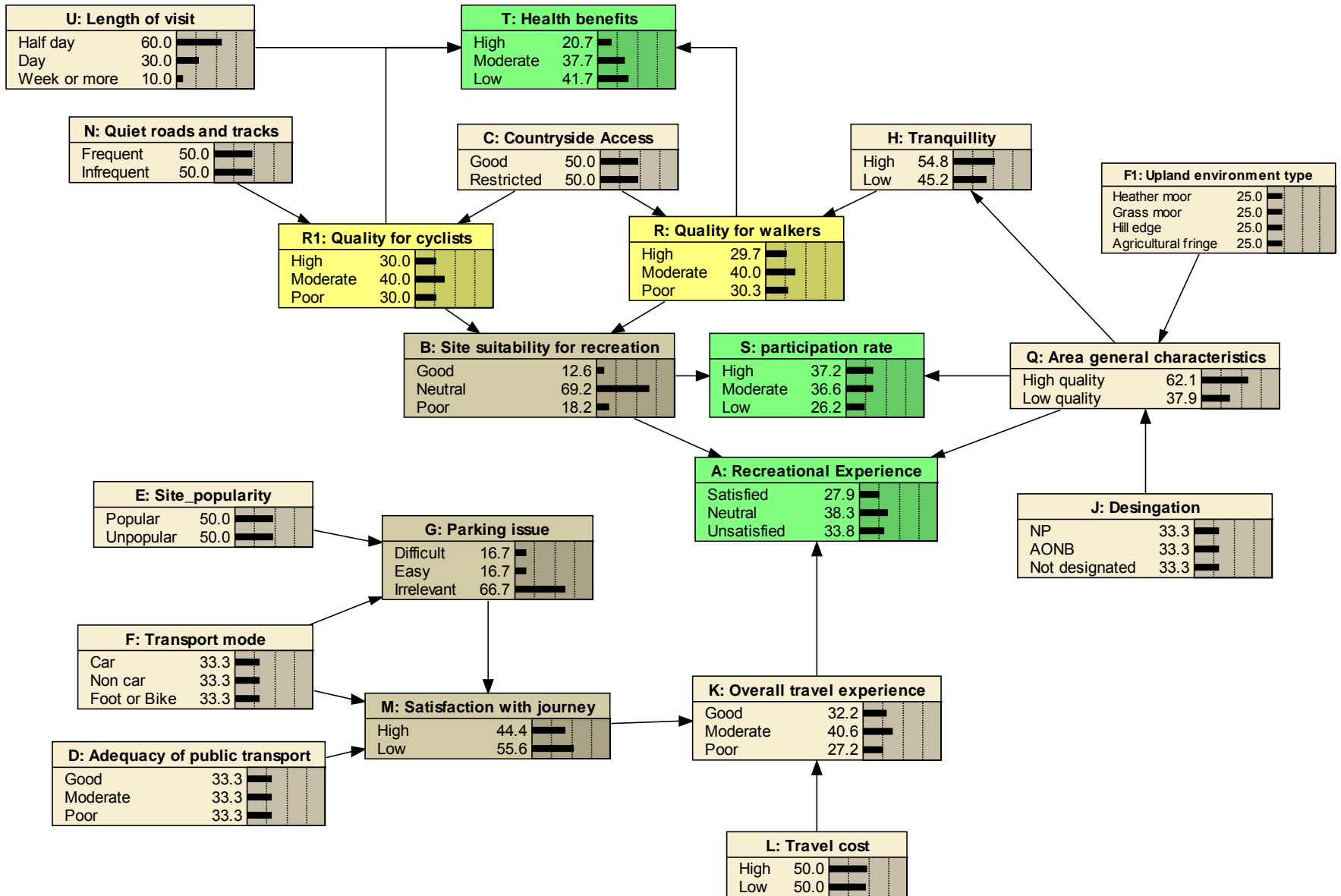
Q: Decomposition Type	
Newly aerobic	36.0
Typically anerobic	31.4
Anerobic	32.7
1.03 ± 0.83	

S: NO2-Emissions

N: CH4-Emissions

Taking a service perspective

- People don't usually see the world in terms of ecosystem services, and it's not just a matter of advocacy on our part...
 - we need to show what kinds of role natural capital plays alongside the *other* kinds of capital (social, manufactured, intellectual, financial....)
 - where does biodiversity fit in?
- Are ecosystem services essentially about ecological processes?



Taking a place-based perspective

- A habitat perspective is ok but it has its limitations...
- A service perspective is exciting but significantly expands the problem...
 - It doesn't (easily) fix the issue of multi-functionality
 - ... and we often have to look at ecosystem services in along side the benefits produced by cultural and social capital etc..
- What about a place-based view of the world?

Taking a place-based perspective

- If we want to influence the way people make decisions (the choices they make) then we need to make sure we are working at the right scales with the right units...
- People make decisions about places
 - Places set the context in which people frame problems...
 - Their values are often context dependent
- What is a place?
 - An area with a common bundle of problems...

Taking a place-based perspective

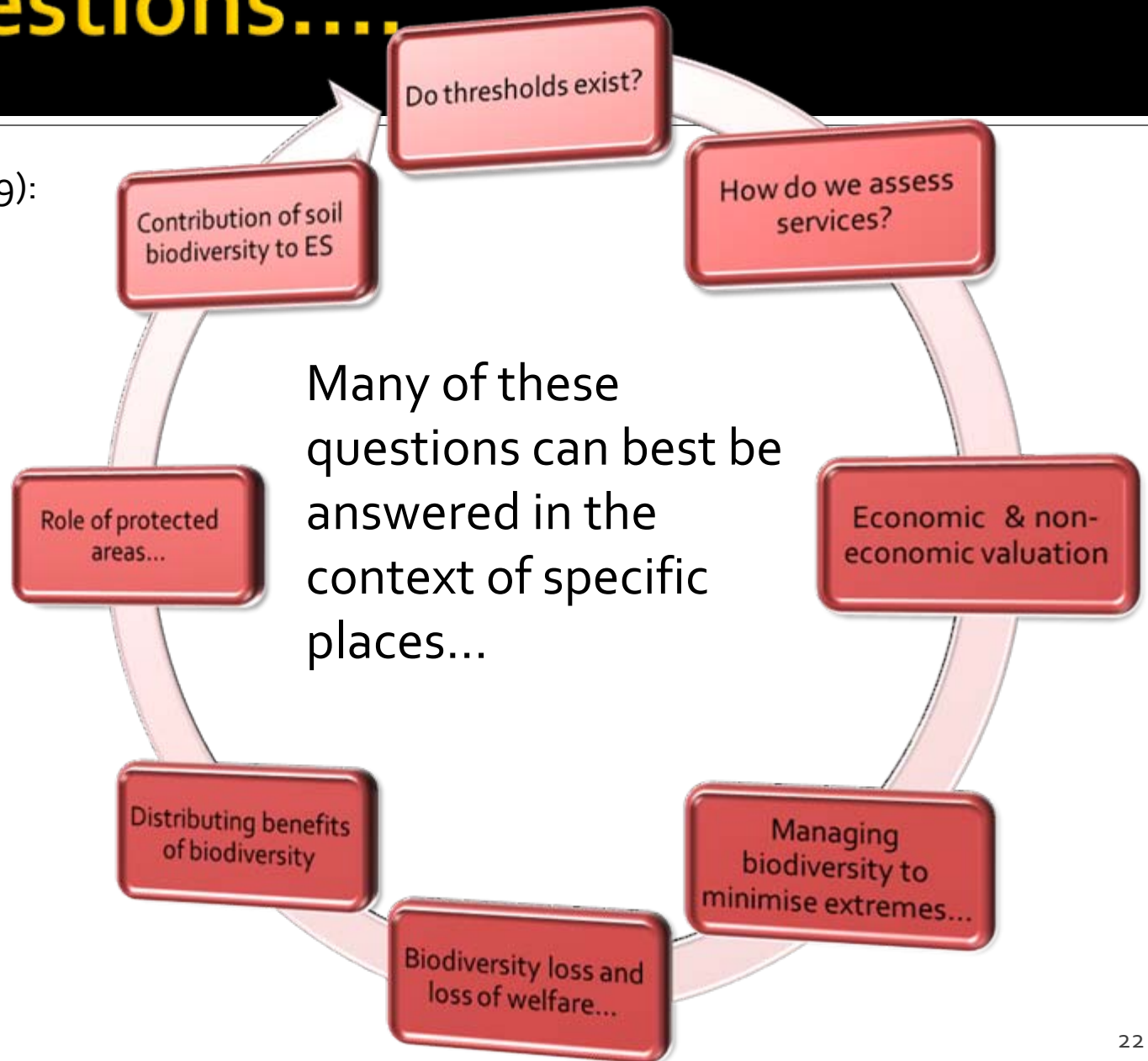
- What are the ecosystem services associated with this place that matter to people's well-being?
- How are these services generated? Do they arise locally or are they generated outside the place or area being considered?
- How important is each of these services, to which individuals or groups, and for what reasons? Do people outside the area also depend on these services?
- How can the importance of these services be prioritised or valued?

Taking a place-based perspective

- Do we expect to have enough of each of these services either here or elsewhere in the future?
- What, if anything, could replace or substitute for each of the benefits obtained from these services, either here or elsewhere?
- What kinds of management or policy actions are needed to protect or enhance these services and in particular how might actions directed towards one service impact or enhance another?

Key questions....

Sutherland et al. (2009):



Concluions

- The ecosystem service paradigm significantly expands the range of arguments that those interested in biodiversity and conservation can use....
- We need, however, to better understand the links between biodiversity and service outputs...
- *And increasingly the values people assign to them...*