

The challenge of addressing cumulative impacts

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Presentation Outline



1. What is a cumulative impact?
2. Problems of assessment
3. A conceptual framework
4. What to assess and include?
Example case studies (birds)
5. The future...



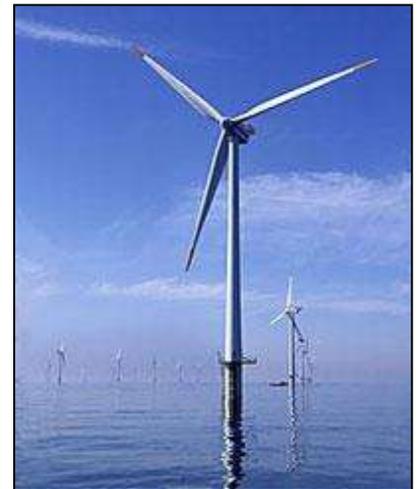
Cumulative impacts?

Many different opinions

What is the cumulative element?

- Projects/Developments
- Time
- Space
- Individuals
- Species...

Is there guidance from legislation or authorities?



Cumulative impacts?

Cumulative effects/impacts are...

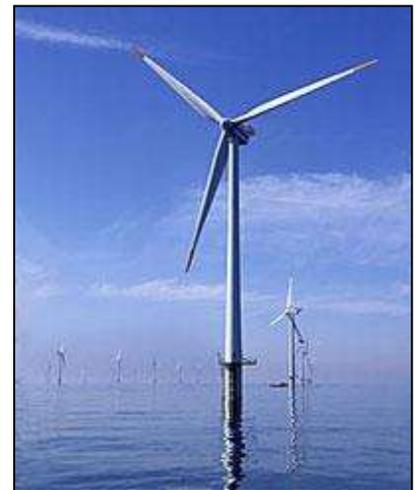
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Cumulative impacts?

Cumulative effects/impacts are...

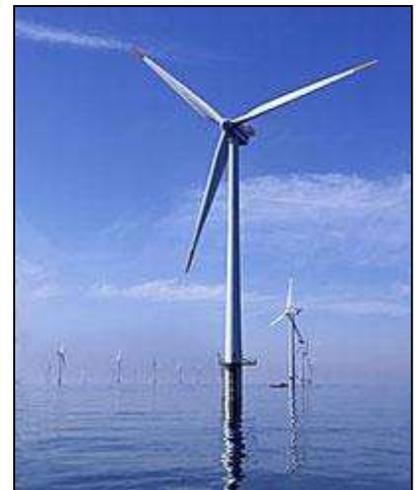
1. “Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project” (Hyder, 1999)
2. “The additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together” (Scottish Natural Heritage, 2009)



Cumulative impacts?

EC Directive (85/337/EEC) on EIA...

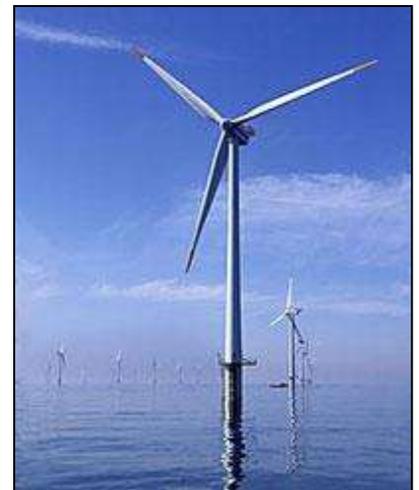
1. “the characteristics of development must be considered having regard, in particular, ...the cumulation with other developments”
(cumulative refers to developments)



Cumulative impacts?

EC Directive (85/337/EEC) on EIA...

1. “the characteristics of development must be considered having regard, in particular, ...the cumulation with other developments” (cumulative refers to developments)
2. “a description of the likely significant effects of the development on the environment, which should cover the cumulative effects of the development...” (cumulative refers to time?)



Problems with assessment



- Unclear what is cumulative
- No standard definition
- No standard method for assessment
- Increasing numbers of wind farms
- Agreement that cumulative impacts should be considered/assessed
- Should be comparable
- How?

Conceptual Framework



Framework for planning and assessment

All possible cumulative elements

At simplest = checklist

Promotes transparency of practice

Conceptual Framework



Framework for planning and assessment

All possible cumulative elements

At simplest = checklist

Promotes transparency of practice

$$CI = \sum_{i \in A} \sum_{j \in R} \int_{\mathbf{x} \in \Omega} \left(\int_{t_0}^0 I(A_i, R_j, \mathbf{x}, t) dt + \int_0^{t_1} I(A_i, R_j, \mathbf{x}, t) dt \right) d\mathbf{x}$$

Masden, E.A., Fox, A.D., Furness, R.W., Bullman, R., & Haydon, D.T. 2010 Cumulative impact assessments and bird/wind farm interactions: developing a conceptual framework.

Environmental Impact Assessment Review. *Environmental Impact Assessment Review*. **30**:1-7

Conceptual Framework



Impact – single or cumulative (*CI*)

Actions – developments

Receptors – individuals/species/processes...

x space – spatial scale

time – temporal scale

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What to assess and include?

$$CI = \sum_{i \in A} \sum_{j \in R} \int_{\mathbf{x} \in \Omega} \left(\int_{t_0}^t I(A_i, R_j, \mathbf{x}, t) dt + \int_t^{t_1} I(A_i, R_j, \mathbf{x}, t) dt \right) d\mathbf{x}$$

Impact – single or cumulative (CI)

What is assessed?

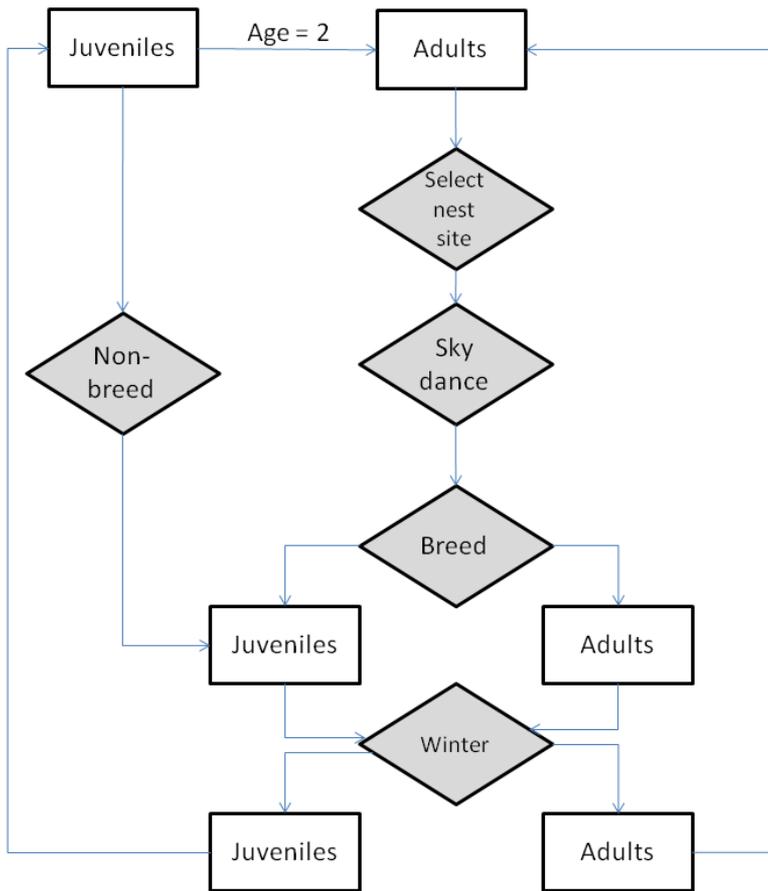
Units of CI (cumulative impact)?

Apples and oranges!

Individuals or area or energy or ...

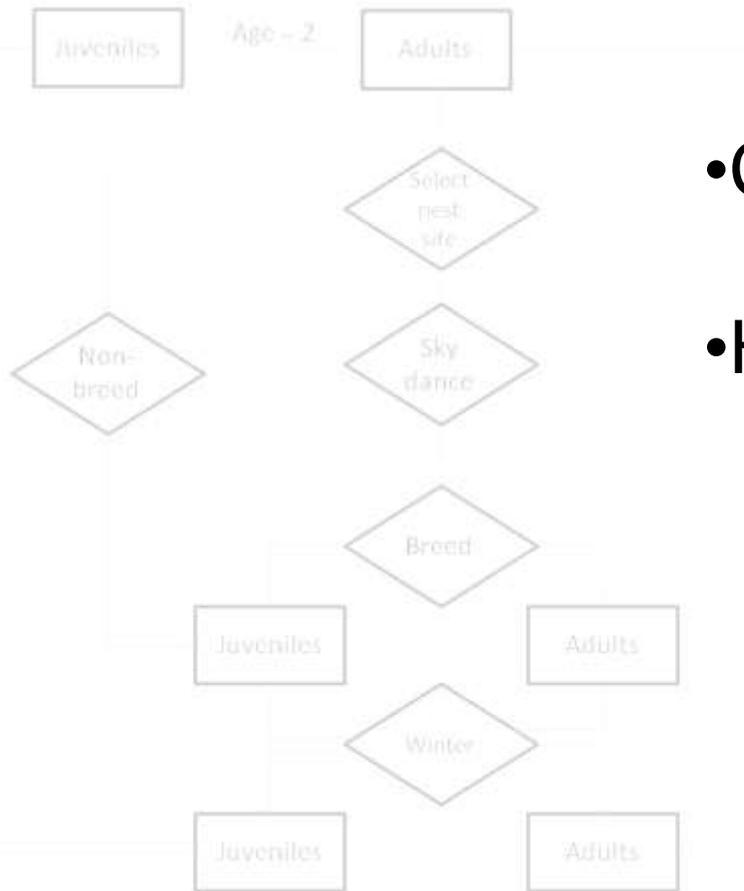
Cumulative Impact (CI)

Hen Harriers in Scotland



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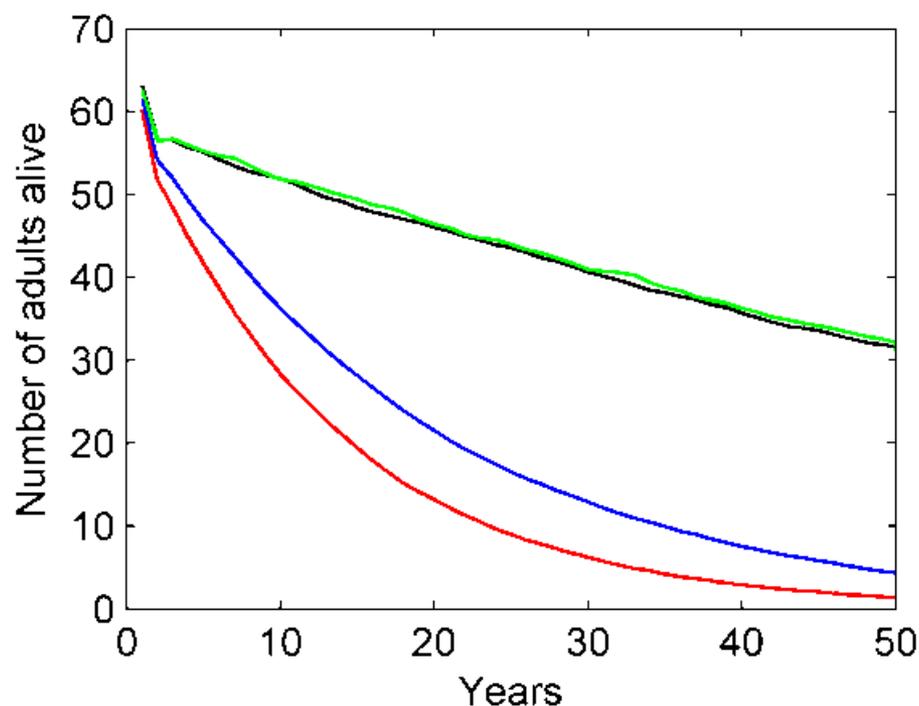


- Collision Mortality
- Habitat loss



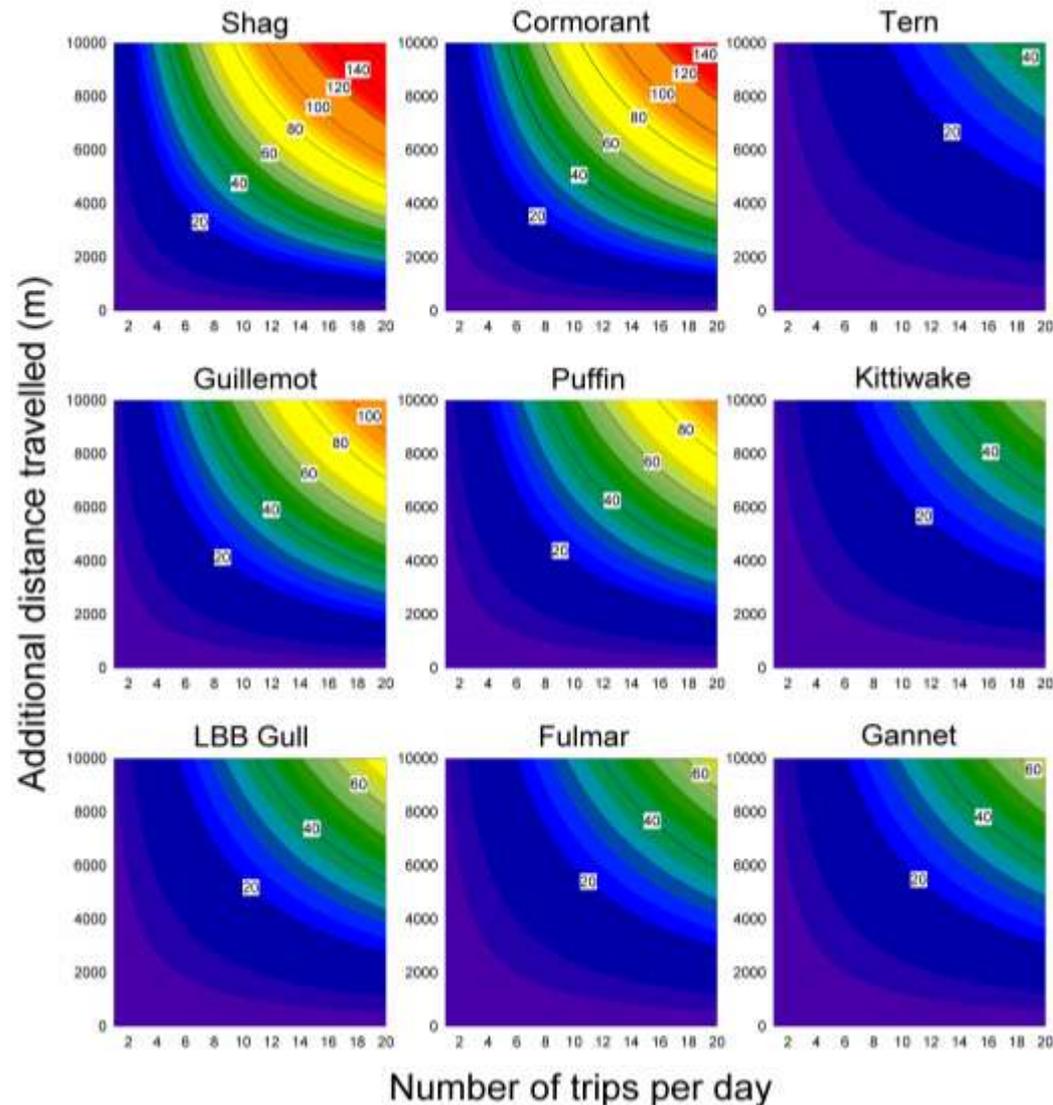
Cumulative Impact (CI)

Hen Harriers in Scotland



Number of hen
harriers alive

Examples Cumulative Impact (CI)



Energy Expenditure

Graded colours show energy requirement as the percentage daily energy expenditure

Migrating Seaducks



Windfarm Factor	Kilometres Travelled	Fat burnt (kJ)	Bird Mass (kg)
0	1200	12700	2.06
0	1400	14400	2.00
2	1401	14400	2.00
10	1405	14400	2.00
100	1450	14800	1.98
1000	1900	18500	1.85
4000	3400	28700	1.50
5000	3900	31600	1.50

Masden, E. A., Haydon, D. T., Fox, A. D., Furness, R. W., Bullman, R., and Desholm, M. 2009. Barriers to movement: impacts of wind farms on migrating birds. *ICES Journal of Marine Science*, **66**

What to assess and include?



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Actions (A)

Any event that effects the environment

Homotypic or heterotypic

Should it be exhaustive?

May (not) have specific consenting process

Include climate change?

Examples



Actions (A)

“The additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together” (SNH, 2009)

Examples



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Wind farm impacts and seabirds:

Wind farm developments...

Examples



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Wind farm impacts and seabirds:

Wind farm developments...

plus wave/tidal developments?

Examples



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plus fisheries?

Examples



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Wind farm impacts and seabirds:

Wind farm developments...

plus wave/tidal developments?

plus fisheries?

plus climate?

Examples



Actions (A)

“The additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together” (SNH, 2009)

Climate change:

Can we include climate change in assessments?

Should we include climate change in assessments?

Benefits of renewable energy

What to assess and include?



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Receptors (R)

Guilds or functional groups

Species

Individuals or stages

Processes i.e. foraging behaviour

Examples

Receptors (R) – What to include?

Exhaustive

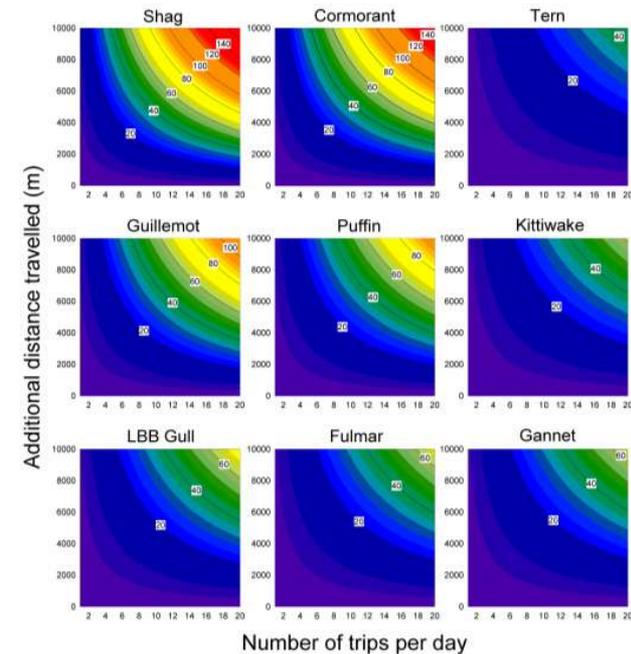
Representative coverage

Species of conservation importance

Sensitivity and/or risk analysis

Garthe, S., & Hüppop, O. (2004). Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. *Journal of Applied Ecology*, 41(4), 724-734.

King, S., Maclean, I., Norman, T., & Prior, A. (2009). Developing guidance on ornithological cumulative impact assessment for offshore wind farm developers. COWRIE CIBIRD Stage 2.



What to assess and include?

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Space (x)

Spatial extent of cumulative impact assessment?

Extent of strategic development area (COWRIE book in welcome pack)

Will depend on receptor and location

North Sea? Global range of population?

Examples

Migrating Seaducks



- Increase distance with avoidance of wind farm
- What other actions along eider migration route?
- Smøla eagle location data is another example

What to assess and include?

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Time (t)

Impact over increasing lengths of time

Temporal scale of development

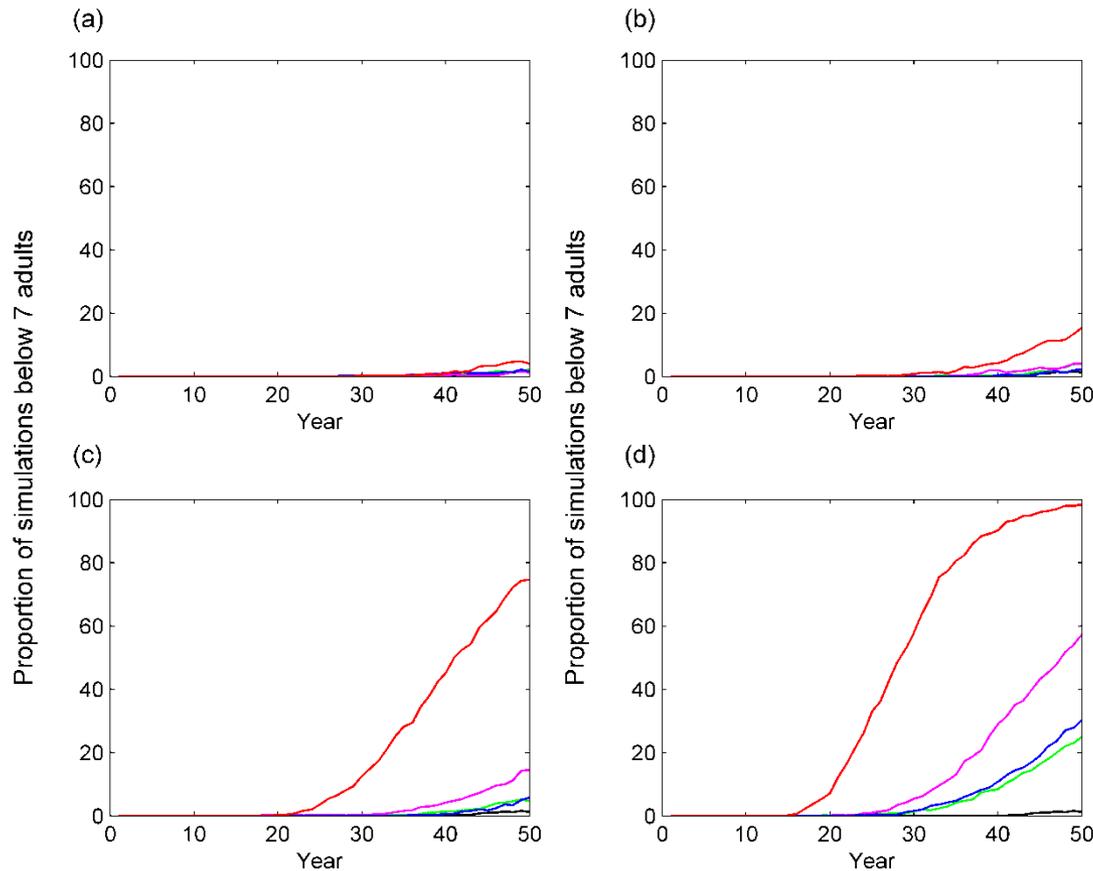
Short term and long term effects

Temporal lag of receptor response/effect

Examples

Time (t)

Hen harriers in Orkney, Scotland



Summary



- Confusion regarding cumulative impacts
- Framework to help clarify
- Explicitly state what is included (and not included) in assessment

BUT...

- Still lacking a means by which to make consistent decisions on what to include in assessments



Acknowledgements



Dan Haydon
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Ib Krag Petersen
Thomas Kjær Christensen
Finnish Ringing Centre
James Pearce-Higgins
Eric Meek
CWW2011 for the invite
...and many more.



The future

Can we assess cumulative impacts adequately?



Should cumulative impact assessment be strategic?



“Wicked problems [such as the planning of wind farms] require innovative policy but also innovative methods of arriving at the policy.” (Ludwig et al., 2001)