SHEDDING LIGHT ON A DARK ART

OXFORD BROOKES UNIVERSITY

IEMA Transforming the world to sustainability

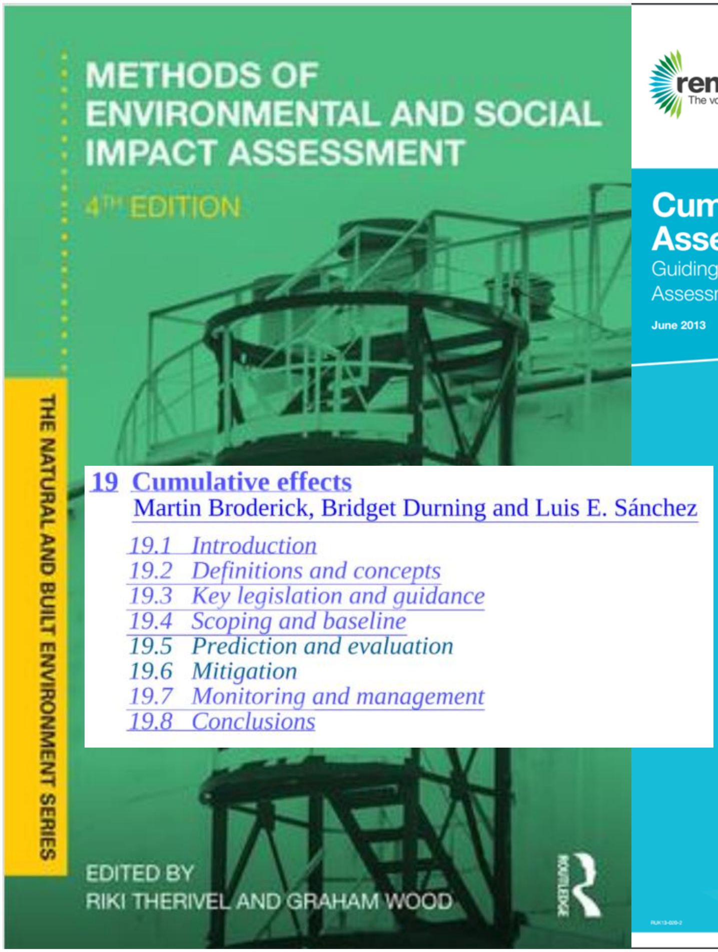
EIA Spotlight: Demystifying Cumulative Effect Assessment

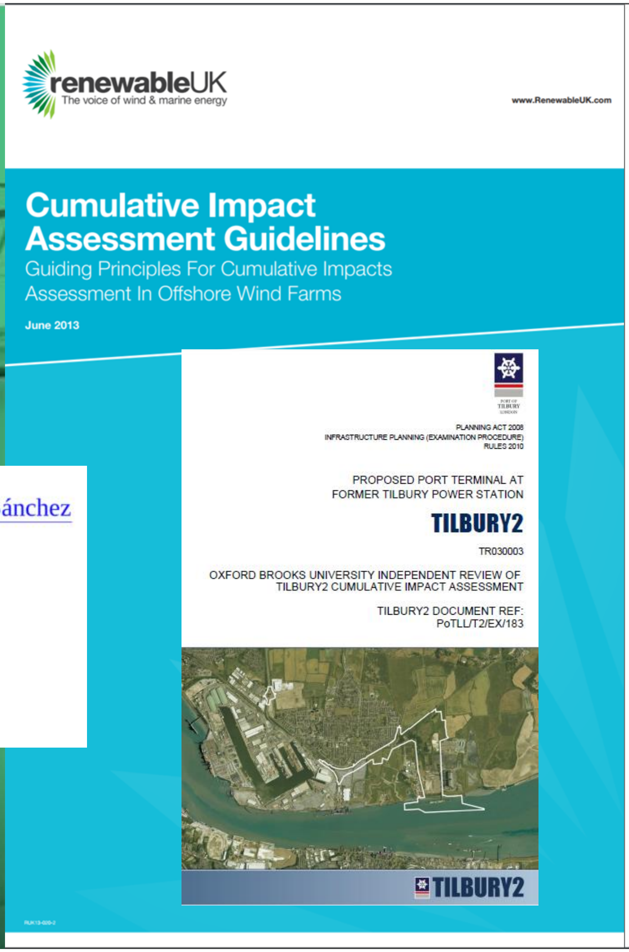
The views of Bridget Durning and Martin Broderick
Oxford Brookes University

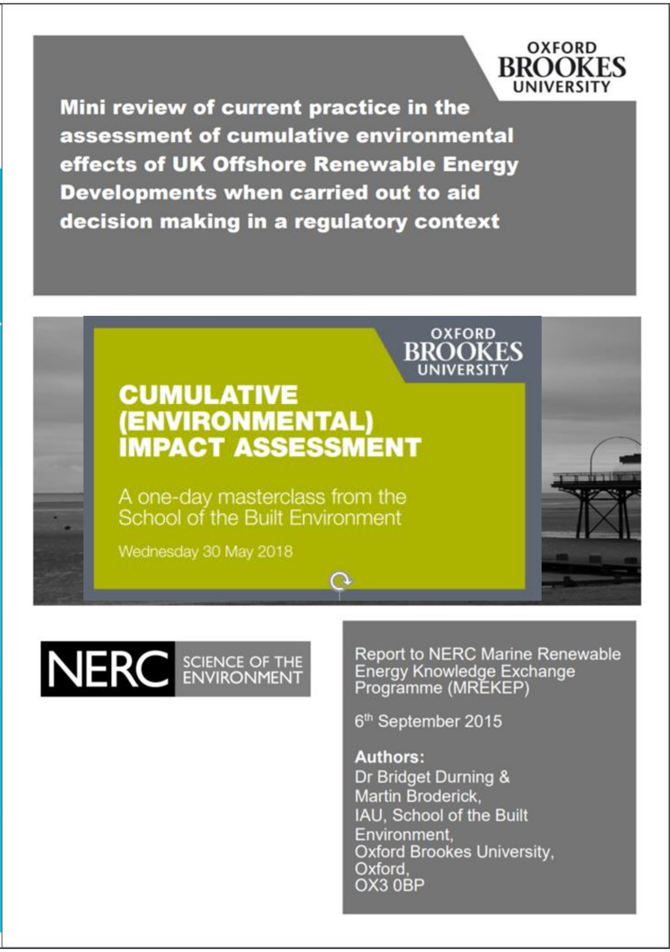
17th July 2020

Dr Bridget Durning, Senior Lecturer in Environmental Assessment and Management
Prof Martin Broderick, Visiting Professor and Examining Inspector (PINS)
IAU, School of Built Environment,
Oxford Brookes University

OXFORD BROOKES UNIVERSITY







THE DARK ART

Global practice in assessing cumulative effects is poor

'like forecasting weather or climate the system under examination is complex and often responds to disturbance in a non linear fashion'

(George Hegmann and Tony Yarranton

'Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management**. '**

Environmental Impact Assessment and Review 31 (5) 2011)

- few assessments at any level adequately considering cumulative effects.

- reason - lack of guidance and particularly the absence of comprehensive definitions:

- without a clear definition it is not possible to ensure an assessment demonstrates adequate consideration of all characteristics of the effects including spatial and temporal scale.

Definitions

Spaling (1994):

Cumulative effects refer to the accumulation of changes in environmental systems over time and across space in an **additive** or **interactive** manner

Broderick, Durning and Sanchez (2018):

Cumulative effects are those that result from

additive effects caused by other past, present or reasonably foreseeable actions **together** with the plan, programme or project itself and

synergistic effects (in-combination) which arise from the **interaction** between effects of a development plan, programme or project, on different components of the environment ”

Term	Examples of related terms in European regulations and selected guidance
Additive Effects: those that result from additive effects caused by other past, present or reasonably foreseeable actions together with the plan, programme or project itself	• EIA Directive (2014) refers to these as 'cumulative effects' • EC (1999) guidance refers to these as 'cumulative impacts' • SEA Directive (2001) refers to these as 'cumulative impacts' • EC Habitats Directive refers to these as 'in-combination' effects
Synergistic Effects: which arise from the interaction between effects of a development plan, programme or project on different components of the environment	• EIA Directive (2011) refers to these as 'interrelationships' and effect 'interactions' • EC (1999) guidance refers to these as 'impact interactions' • SEA Directive (2001)refers to these as 'synergistic' impacts • EC Habitats Directive does not refer to these separately

Table 19.2: A Typology of cumulative effect mechanisms – with examples relating to offshore wind farms(adapted from Spaling 1994, DEAT 2004 (from Broderick et al 2018)

OXFORD BROOKES UNIVERSITY

Cumulative effect mechanisms	Description	Examples of effects for offshore wind farms for temporal and spatial attributes
Time crowding	Frequent, repetitive or simultaneous effects on an environmental resource	Piling noise Transport of materials Decommissioning activities
Time lag	Long delays between cause and effect	Sediment degradation Effects exacerbated by climate change
Space crowding	High spatial density of effects on an environmental system	Several wind farm developments in a single coastal zone; high use maritime areas – navigation, fishing, military
Cross boundary movement	Effects occur some distance away from source	Impacts on migratory birds Impacts on migratory marine mammals
Fragmentation	Change in landscape or seascape pattern	Habitat fragmentation of fisheries
Triggers	Fundamental changes in system behaviour or structure	Scouring triggers loss of VECs, bird collisions cause population decline
Nibbling	Incremental or decreasing effects	Gradual loss of natural areas at project margins, permanent incremental effects of scour Reduction in species density due to reduction in feeding grounds Population resilience may suffer as a result of collisions?

SOME PRINCIPLES OF CEA:

SOURCE – PATHWAY – RECEPTOR

- Proximate cause – how far to go in space and time? "forward to eternity and back to the dawn of mankind"? (Eccleston 2011)
- Source (of impact) – Pathway (route to impact) – Receptor (receives impact)
- For example: highway construction (source) generates **noise** which follows a pathway to a sensitive bird species (receptor) in adjacent habitat.
- There needs to be a **reasonably** close causal relationship, a **pathway**, in place and time, between the **source** and the **receptor**.
- The model is important in CEA because:

  - multiple sources (e.g. highway + housing development + factory) can affect one receptor, or

  - one source can affect a receptor via several different pathways (e.g. sensitive bird species affected by highway noise + fragmentation of their habitats + roadkill).

Some principles that have to be adopted due to complexity …

OXFORD BROOKES UNIVERSITY

- **Uncertainty** (due to the absence of data or uncertainty due to natural variation) can make it difficult to be definitive about a potential impact and it is crucial to define any uncertainty and seek to understand, minimise and communicate it.

- A "precautionary, proportionate but pragmatic" approach, based around the best available scientific evidence, will be used where baseline data or data about the environmental effect of a project are **incomplete.**

In conclusion…

- There are no set or required formulas for determining the appropriate scope of the cumulative impact analysis (although some have tried….

cumulative impact (CI) expressed as a multiple integral of the impact function (I) (Masden et al 2010)

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

- Both spatial (geographic) boundaries and time periods need to be defined on a **case-by-case and topic basis** depending on the characteristics of the resources affected, the magnitude and scale of the project's impacts, and the environmental setting.

- In practice, **a combination of natural and institutional boundaries** may be required to adequately consider both potential impacts and possible mitigation measures.

- Ultimately, the scope of the analysis will depend on an **understanding** of how the effects are occurring in the assessment area (think of the mechanisms for cumulative effects).

- Simple qualitative assessment may be considered adequate, or

- Quantitative modelling needing major resource inputs may be required

Ultimately whilst CEA can seem complicated (a ‘dark art’) it can be done…

Thank you

Bridget Durning – bdurning@brookes.ac.uk

Martin Broderick – mbroderick@brookes.ac.uk