



Strategic risk appraisal. Comparing expert- and literature-informed consequence assessments for environmental policy risks receiving national attention



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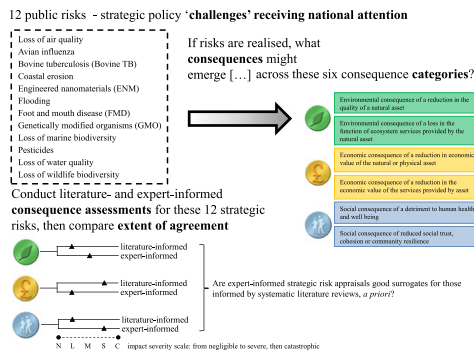
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HIGHLIGHTS

- Strategic risk appraisals frequently rely on the opinions of technical policy staff and researchers in workshop settings
- For the first time, we compare expert- and literature-informed consequence assessments for 12 strategic environmental risks
- Of 36 literature- and expert-informed assessments compared, only 8 couples were statistically distinct
- Expert-informed consequence assessment appears a robust surrogate for *a priori* literature informed assessment
- When designing workshops, full representation of the risks is required, especially for socioeconomic assessments

GRAPHICAL ABSTRACT



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ABSTRACT

Strategic risk appraisal (SRA) has been applied to compare diverse policy level risks to and from the environment in England and Wales. Its application has relied on expert-informed assessments of the potential consequences from residual risks that attract policy attention at the national scale. Here we compare consequence assessments, across environmental, economic and social impact categories that draw on 'expert'- and 'literature-based' analyses of the evidence for 12 public risks appraised by Government. For environmental consequences there is reasonable agreement between the two sources of assessment, with expert-informed assessments providing a narrower dispersion of impact severity and with median values similar in scale to those produced by an analysis of the literature. The situation is more complex for economic consequences, with a greater spread in the median values, less consistency between the two assessment types and a shift toward higher severity values across the risk portfolio. For social consequences, the spread of severity values is greater still, with no consistent trend between the severities of impact expressed by the two types of assessment. For the latter, the findings suggest the need for a fuller representation of socioeconomic expertise in SRA and the workshops that inform SRA output.

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1. Introduction

Government departments managing public risks (Cabinet Office, 2012; Beddington, 2013) operate within budgetary limits established

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within a political cycle and must prioritise the risks they manage across diverse policy portfolios. Some ministries have turned to policy-level (strategic) risk appraisals (SRA), among other inputs, to inform decisions on public expenditure so the highest residual risks can be considered for additional funding; assuming onward investment would reduce them further. At this level of analysis, it is the likelihood of a public national scale risk being realised that is being assessed (e.g. a substantive regional flood event; a national scale foot and mouth disease incursion), along with the associated consequences (environmental, economic and social) that might ensue. In SRAs, risks of varying character (Department for Environment, Transport and the Regions, 1998; Klinke and Renn, 2002; Pollard et al., 2004; Prpich et al., 2011) are appraised alongside one another and presented in a comparative analysis, often in a single schematic or 'heat map' (Prpich et al., 2013). This differs markedly from conventional environmental risk assessments where the analyst is concerned with estimating the likelihood of an adverse outcome (usually) in a spatiotemporal context; say the inhalation risk associated with emissions from a hazardous waste incinerator; or of hydrocarbon exposures to workers remediating a parcel of petroleum-contaminated land (see Defra, 2011 for examples).

For strategic risk appraisals, policy experts and their advisors assimilate expert knowledge at the policy level; drawing on the expertise of technical policy staff, their evidence programmes and the academic communities that research the risks being appraised; and then make well-reasoned judgements by interpreting the science base to compare risks alongside one another (Environment Agency, 2005; Mauelshagen et al., 2014). In SRA, expert-informed assessments of policy risk have become a practical, rapid surrogate for rigorous literature-informed assessments. But are we right to assume this surrogacy is valid? Do expert- and literature-informed assessments correlate?

Since the late 1980s, a substantive literature has grown around strategic environmental risk appraisal; to be specific, on the comparative analysis of multiple policy-level risks by environment ministries and their regulatory agencies (US Environmental Protection Agency, 1987; Morgan et al., 1996; German Advisory Council on Global Change, 1998; Feldman et al., 1999; Long and Fischhoff, 2000; Morgenstern et al., 2000; DeKay et al., 2001; Florig et al., 2001; Klinke and Renn, 2002; Morgan et al., 2001; Environment Agency, 2002, 2005; New Jersey Department of Environmental Protection, 2003; Pollard et al., 2004; Andrews et al., 2004; Linkov and Ramadan, 2005; Fischhoff and Morgan, 2009; International Risk Governance Council, 2011; Vlek, 2013). A compendium of techniques has been compared, their communication challenges described, the traction SRAs get with publics analysed and reviewed, and the visualisation of SRA outputs experimented with (Perhac, 1998; van Asselt, 1999; Klinke and Renn, 2002; Haimes et al., 2002; Environment Agency, 2002; Willis et al., 2004, 2010; Prpich et al., 2011, 2013; Soane et al., 2016; Rocks et al., 2017).

Researchers and advisors assisting policy officials with SRA have facilitated numerous workshops in which policy-level risks have been appraised, typically over one or two days, to inform outputs similar to those in Fig. 1. Fig. 1 style outputs are then used to stimulate discussions about the efficacy of existing risk management measures and the suitability of onward investments in risk management within available budgetary limits. Notwithstanding efforts to secure a representative make-up of technical expertise in SRA workshops, there has been little a priori analysis of whether the assessments garnered by them correlate with those gained from a more considered, albeit lengthy, analysis of the evidence for the same risks from the published literature. This paper attempts such an analysis and seeks to validate, or otherwise, the use of expert-informed SRA; our null hypothesis being 'there is no significant difference between literature- and expert-informed assessments of the environmental risks that attract national attention in SRA'.

In SRA, evidence must be synthesised, simplified and made available for comparison, even though the risks appraised may seem incommensurate. The risks previously appraised by the authors (Prpich et al., 2011,

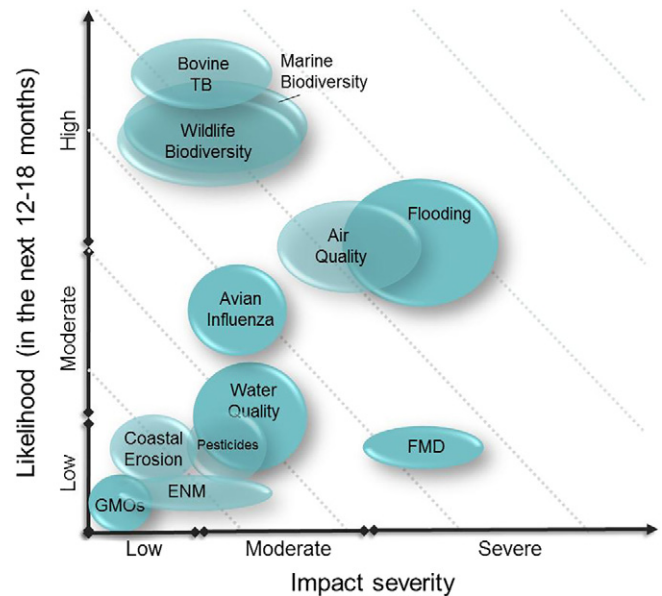


Fig. 1. Illustrative appraisal of 12 strategic risks for Defra (Science Advisory Council, 2012; Prpich et al., 2011, 2013). Ellipses reflect the relative magnitude and 2-dimensional uncertainty in likelihood and consequence (impact severity) for residual risks, assessed over a 12–18 month horizon, assuming existing risk management measures are in place. Their positions are informed through a flow of supporting evidence, independent analysis and deliberative process. Key for ellipses: GMOs genetically modified organisms; Bovine TB tuberculosis; ENM engineered nanomaterials; FMD foot and mouth disease.

2013; Fig. 1) were associated with environmental hazards such as regional flooding, coastal erosion, pesticide impacts and engineered nanomaterials, and differed widely in their potential for harm, in how they were perceived and in the costs required to mitigate them (Science Advisory Council, 2012).

In SRA workshops, policy experts appraise environmental risks that receive national attention, within a specific timeframe. Risks are expressed, usually logarithmically, in terms of a magnitude of likelihood and a severity of combined impact (Fig. 1); the latter being a mean of the impacts aggregated across environmental, economic and social categories of consequence. SRA methods are contentious among research and practitioner communities (Fischhoff and Morgan, 2009; House of Commons Science and Technology Committee, 2011; Cox, 2008; Vlek, 2013) because of the pragmatism necessary to deploy them and what are claimed as deviations from theoretical robustness in doing so (Cox, 2008). The authors, with others, have discussed the challenges and shortcomings of the methods elsewhere (Hofstetter et al., 2002; Pollard et al., 2004; Cox, 2008; Prpich et al., 2011, 2013; Vlek, 2013). This said, SRA tools see increasing use within Government and business circles (Beddington, 2013; Ernst and Young, 2010; World Economic Forum, 2011, 2017; Deloitte, 2013) and our research interest has been, therefore, to hone the tools used for strategic environmental risk appraisal (Duarte-Davidson et al., 1999; Environment Agency, 1999, 2004; Pollard et al., 2001, 2004; Prpich et al., 2011, 2013; Rocks et al., 2017). Particularly challenging for SRA workshops has been the assessment of consequences from residual risks, the aggregation of impacts and the overall presentation of their combined severity – the consequence assessment – which is the focus of this paper. A combined assessment of consequences and probabilities is necessary in SRA so to present the total risk for discussion. The probability assessment in SRA is not addressed here.

In this paper, we explore two sources of consequence assessment, experts and the literature, for 12 public risks. We have published a means of visualising differences between literature- and expert-informed assessments of consequence in SRAs (Fig. 2; Prpich et al., 2013; Dagonneau, 2013). In brief, the approach adopts six attributes of

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