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Internship Report

Developing methods for cumulative impact assessments in relation to marine renewables and seabirds.

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in partnership with the Royal Society for the Protection of Birds.

FINAL REPORT: NERC MREKE INTERNSHIP

DEVELOPING METHODS FOR CUMULATIVE IMPACT ASSESSMENTS IN RELATION TO MARINE RENEWABLES AND SEABIRDS

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INTRODUCTION

CUMULATIVE IMPACTS

Cumulative impacts can be defined as the net result of environmental impacts from multiple projects or activities (Sadler 1996) and originally gained status in the United States' National Environmental Policy Act, later being incorporated into the Environmental Impact Assessment (EIA) Directive (85/337/ EEC) of the European Community. Whilst all individual projects or actions affect the environment, the combined or cumulative effects of multiple actions can be greater than the sum of the individual parts (Canter & Kamath 1995). A cumulative impact assessment is therefore the procedure for identifying and evaluating the significance of these impacts over space and time, providing information to aid the management of developments so resultant effects or impacts do not exceed specified threshold levels (Canter & Kamath 1995).

Increasing numbers of proposed developments create greater pressures on the environment, making cumulative impacts a pressing issue. Such is the case for wind farms in the UK, where concerns have been raised over the negative impacts of increasing numbers of wind farms on bird populations (Stewart, Pullin, & Coles 2007). Within the UK, the assessment of cumulative impacts is legislated through the EIA Directive (97/11/EEC) and the Habitats Directive (92/43/EEC) and requires that the impacts of a project be assessed `cumulatively' or `in combination' with other projects. It is important to note that, at present, cumulative impacts are therefore assessed at the project level, i.e. a component of an EIA, to inform the decision making process with respect to a single project application, rather than at a strategic level. The assessments are centred on the project rather than the receptors, for example, seabird populations.

In recent years there has been a marked improvement in the quality of environmental impact assessments in the UK, with cumulative impacts now routinely reported in environmental statements. In the past, reasons for the lack of consistency in the consideration of cumulative impacts have included the absence of guidelines and a lack of definitions, therefore recent improvements are likely due to the publication of specific guidelines for ornithological cumulative impact assessment, particularly King et al. (2009). Even so, variation remains in both the quality and quantity of information provided and many remain less than satisfactory. Confusion also remains over matters such as spatial and temporal scale, and projects to include in assessments (Masden *et al.* 2010), meaning the interpretation and representation of results is often inconsistent between reports. Subsequently, there is still a vast amount of uncertainty surrounding cumulative impacts and their inclusion in EIA.

UNCERTAINTY AND RISK

Uncertainty is an often misunderstood term. Uncertainty can be considered incomplete information on a particular subject and is common in scientific research because scientists are investigating the unknown. In everyday language however 'uncertain[ty]' often has a negative connotation (Sense about Science 2013). This is important to consider when working at the interface between science and policy or science and the public, where uncertain results may be considered unreliable. Therefore where possible, uncertainty should be calculated and expressed in an appropriate manner for the relevant audience. It is also beneficial to reduce uncertainty as much as possible to reduce risk.

When uncertainty relates to real-life situations with potentially detrimental consequences, it may be more suitable and tangible to consider risk, i.e. the probability of an unwanted or hazardous event occurring (Harwood & Stokes 2003; Sense about Science 2013). When considering ecological systems, uncertainty can cause difficulties if the knowledge is used for regulatory purposes because risk is introduced into the decision-making process (Ludwig, Mangel, & Haddad 2001). One example of this is the development of renewable energy in the UK where planning decisions have to be made based on information on the potential environmental impacts of the developments, but there may be uncertainty around those impacts. Consequently, there is a risk that a development may have an impact greater (or lesser) than predicted. This is increasingly becoming a problem when cumulative impacts of multiple projects have to be considered. The uncertainty and risk are not only problems for the regulator charged with decision-making but also for developers and their financial investors. This is because the precautionary principle states that if an action has a suspected risk of impacting the environment, in the absence of scientific agreement, the burden of proof that it is not harmful falls on those undertaking the action (Inter-Departmental Liaison Group on Risk Assessment 2002; SNIFFER 2005). "…where there is scientific uncertainty the precautionary principle establishes an impetus to make a decision that seeks to avoid serious damage if things go wrong" (Inter-Departmental Liaison Group on Risk Assessment 2002).

UNCERTAINTY IN CUMULATIVE IMPACT ASSESSMENTS

Within environmental statements, there is very little recognition of the inherent uncertainty within the EIA process (including CIA). Guidance often remains vague with no standard for how predictions and associated uncertainty should be presented. The Institute of Ecology and Environmental Management (IEEM) do provide some guidelines which mention uncertainty, though not rigorous, and they seem to be an exception. Other guidance documents simply refer to the types of impacts that should be considered but not how the results/predictions should be reported. IEEM state that it is important to consider the likelihood that a change may occur as predicted and suggest that this can be done qualitatively using descriptors such as certain, probable, or unlikely. Alternatively it could be based on statistical significance or probability. Despite their guidelines however, the inclusion of uncertainty in predictions of impacts is rare in environmental statements, particularly for wind farm developments. Consequently, it is not possible to assess the level of risk associated with these development applications. Also, there is rarely a methods statement for how the cumulative impacts (along with the associated uncertainty) are estimated.

PROJECT AIMS AND OBJECTIVES

The aim of this project is to improve the cumulative impact assessment process by scoping possible alternative methods that are not currently used by the industry. To date, initial guidance has been published on cumulative impact assessment for birds in relation to on- or offshore renewable developments. The methods however, remain vague and with little quantification of the uncertainty that pervades the cumulative impact assessment process, in the form of both biological uncertainty and also development uncertainty. The main objective of the internship was therefore to build on current methods and best practice to determine if it is possible to move the cumulative impact assessment from a largely qualitative process to a more quantitative process, including uncertainty around outcomes, and using data made available by RSPB to develop a case study.

SUMMARY OF ACTIVITIES UNDERTAKEN

During the internship three main activities were undertaken which can be categorised as i) philosophical (uncertainty report), ii) practical (uncertainty checklist) and iii) mathematical (collision risk modelling). These activities are described below.

UNCERTAINTY REPORT

`The first step to quantifying risk is to identify the sources of uncertainty' (Harwood & Stokes 2003). The aim of the uncertainty report was to highlight where uncertainty may be present within cumulative impact assessments (CIAs). RSPB staff frequently have to respond to, or comment on, environmental statements from environmental impact assessments with respect to ornithological impacts, singular or cumulative. These documents can be large in volume and therefore determining whether the EIA has been conducted satisfactorily can be onerous, particularly when not only impacts but also methodologies can be uncertain. The uncertainty report was therefore written as a document to aid RSPB staff navigate through cumulative impact assessments, with respect to uncertainty. Discussed within the report are the sources and types of uncertainty, and recommendations are provided on methods and practices to describe, address, and potentially reduce uncertainty in CIAs. The report is based around Ascough et al. (2008) which reviewed future research challenges for incorporating uncertainty into environmental and ecological decision-making. The task for Dr Masden therefore was to communicate the science from Ascough *et al.* (2008) and present it in a functional manner for RSPB to use on a daily basis. Assessing the cumulative impacts of multiple developments will likely be a challenge for many years to come but by addressing and highlighting uncertainties in the assessment process, the challenges may become more tractable and it may also be possible to cope with those uncertainties that are irreducible (Udovyk & Gilek 2013).

UNCERTAINTY CHECKLIST

To complement the uncertainty report, Dr Masden (with the guidance of RSPB staff) produced an uncertainty checklist. The purpose of the checklist was to act as a reference card for RSPB staff tasked with reviewing cumulative impact assessment documents. The checklist provides a reminder of the issues which should be considered when reviewing such documents. For example, regarding linguistic uncertainty, is there consistent use of terms throughout the CIA document? Alternatively, when considering knowledge uncertainty, are results presented with either a quantitative (confidence interval/standard deviation/variance/error/etc.) or qualitative (certain/probable/unlikely/etc. - defined) measure of uncertainty? Although the checklist was designed for RSPB staff, it has been suggested that it may be useful to circulate amongst the marine renewable energy stakeholders to ensure that developers and their environmental consultants are aware of the expectations of RSPB, regarding uncertainty in development documents. RSPB are very supportive of this suggestion. The impact of this document and the checklist may therefore be greater than expected.

COLLISION RISK MODELLING

During the environmental impact assessment of a wind farm development, the developer is required to assess the likely impacts of their proposed project. For bird populations, this will include an estimate of avian collision mortality i.e. the number of birds likely to be killed directly through a collision with the turbine; estimating collision mortality requires the use of a mathematical collision risk model which describes the interaction of a bird with a wind turbine and predicts the risks of bird collisions with turbines. There are a limited number of collision risk models in use, not only in the UK but globally (Tucker, 1996; Band et al., 2007; Smales et al., 2013). Within the UK a collision risk model produced by Scottish Natural Heritage (and known as the Band model) is most frequently used (Band et al., 2007). However, it is recognised by many, including industry, environmental consultancy practitioners, statutory nature conservation agencies and academics that there is room for improvement of collision risk models. For example, collision risk models are deterministic and rarely include variation or uncertainty in the input parameters such as bird density, or bird biometrics, but instead use mean values. Adopting a single best value for parameters may reduce complexity and increase the accessibility for decision-makers however it can be misleading because it ignores the variability and the range of consequences that are plausible. Therefore the use of single values for input parameters, and model outputs (number of collisions) and a lack of recognition of the inherent uncertainty and variability in collision risk modelling can either i) present a false impression of confidence about the likely impacts to decision makers making important planning decisions; or ii) delay planning decisions.

As part of the internship, Dr Masden produced a case study focussed on collision risk modelling and followed on from Chamberlain et al. (2006) by conducting a sensitivity analysis of the SNH collision risk model (Band et al., 2007), exploring the effects of including variability in input parameters on the model outputs. In the case of the SNH model (Band et al., 2007), input parameters include those related to the wind turbine such as number of turbine blades, rotor radius and blade width, and others such as wingspan, body length and flight speed related to the bird. Some parameters such as the number of blades have a fixed value. However the majority, such as bird biometrics, have a distribution of possible values, but collision and encounter risk models regularly use single parameter values. Results showed that when input parameters were allowed to vary across a range of values extracted from empirical data or the scientific literature, the model output was a distribution of values for collision risk estimates rather than a single value. This is of relevance for cumulative impact assessments, which sum the collision risk estimates from several developments, as the sum of 'the worst-case scenarios' may be very different from a more average set of scenarios.

IMPACT OF PROJECT

WITH RESPECT TO RSPB

The RSPB is Europe's largest wildlife conservation charity, and uses the best scientific evidence available to guide its conservation policies and practice. Such evidence demonstrates that climate change is already affecting birds and wildlife in the UK and globally, and threatens to drive future biodiversity loss unless urgent action is taken to reduce carbon emissions. As such, the RSPB supports the UK's greenhouse gas reduction targets and recognises the critical role that renewable energy, including offshore wind, tidal and wave power, will play in delivering them. However uncertainty in CIA hampers the ability to critically assess environmental statements and necessitates a precautionary approach that could hinder development.

This internship set out to develop methods for cumulative impact assessments of wind energy, notably with respect to birds, particularly focussing on uncertainties in the assessment of cumulative environmental impacts. With increasing numbers of marine renewable developments, for wave, tidal and wind energy, there is a pressing need to be able to assess not only the individual environmental impacts of these developments, but also to assess their cumulative impacts. Carrying out these assessments is crucial, for the development of the industry, and tools to ensure that they are done correctly, and to enable the critical review of them, are currently lacking. This project and outputs provide:

- Better understanding of uncertainty and approaches to its quantification;
- Help to focus efforts when reviewing developments
- Guidance to allow RSPB to respond constructively to developers
- Methods to describe and reduce uncertainty
- A checklist (a practical tool) for assessing the adequacy of CIA reports, and has already been used in the review of CIAs produced for offshore wind energy developments in Scotland
- A sensitivity analysis for the Band avian collision risk model which highlights the importance of uncertainty in input parameters on model outputs which contribute to cumulative impact assessments.

Subsequently, the project benefits the RSPB greatly, by improving understanding of the projected impacts of renewables on birds, and therefore informing responses to proposed developments. The results of this work will have important implications for all stakeholders in the development of marine renewable energy.

WITH RESPECT TO DR ELIZABETH MASDEN

When considering the career progression of the early-career researcher, Dr Masden, the internship has had considerable impact. The internship has been of great value in securing an extension to her research contract at the Environmental Research Institute, as it demonstrated her skills in grant capture, a valuable asset to any research organisation. During the internship Dr Masden developed a good working-relationship with RSPB staff, who are keen to collaborate on future projects. This has already been realised with a joint application for a NERC CASE PhD studentship. Additionally, through the Marine Renewable Energy Knowledge Exchange Programme, Dr Masden (and her research) has been introduced to members of the marine renewable energy community which may not have happened so easily otherwise, which is of benefit to her research profile and reputation. Finally, it is likely that at least one peer-reviewed manuscript will be an output from this internship which will also benefit Dr Masden’s career progression.

LEARNING FROM THE PROJECT AND POTENTIAL FOLLOW ON ACTIVITIES

One objective of the internship was to develop improved analytical approaches for a key aspect of cumulative impact assessment, namely collision risk modelling. There is a lack of empirical data to determine the magnitude of impact arising from fatal collisions by birds with wind turbines and a predictive model is applied as a standard tool, but applies a correction factor, the avoidance rate, which incorporates a range of biological variation, not just flight avoidance of wind turbines by birds. Model outputs vary substantially depending on the correction factor applied. There is uncertainty associated with various biological input parameters to collision risk models, but uncertainty is rarely quantified. The implications of this are a lack of confidence in the capability of the model to produce realistic predictions and thereby the possibility of poor decision-making in terms of the likely risks associated with proposed wind farms. Quantifying uncertainty would help to determine the limitations of the model, and inform any necessary modifications, thereby informing policy and regulation for the development of marine renewables, notably wind energy. The internship has demonstrated that including uncertainty in collision risk modelling is possible.

Following on from the internship and with industry partners, as well as RSPB, Dr Masden submitted an application for (and was awarded) a 12-month knowledge exchange grant from NERC for a project entitled “Developing an avian collision risk model to incorporate variability and uncertainty”.

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