An evaluation of ecological impact assessment in England

Katherine Drayson (2012)

AN EVALUATION OF ECOLOGICAL IMPACT ASSESSMENT IN ENGLAND

Katherine Drayson

A thesis submitted in partial fulfilment of the requirements of the award of

DOCTOR OF PHILOSOPHY

Oxford Brookes University

DECEMBER 2012

ABSTRACT

Ecological impact assessment (EcIA) has historically been poorly performed, resulting in poor quality EcIA chapters. No research has been conducted to identify whether poor quality EcIA chapters result in poor quality mitigation and therefore potential net loss of biodiversity.

A review of 112 EcIA chapters was conducted to determine whether there have been improvements since the last review in 2000 and which factors are linked with EcIA chapter quality, such as the introduction of professional guidance in 2006. The link between EcIA chapter quality and mitigation on completed development sites was also examined. Both mitigation implementation (whether the mitigation was put in place) and implementation effectiveness (how well mitigation was implemented) were investigated on seven case study sites. Implementation effectiveness was limited to a subset of habitat mitigation measures; grassland and marginal habitat creation and management.

The EcIA chapter review identified significant improvements since the last review. However, considerable scope for improvement remains due to the low baseline established by the earlier reviews. The introduction of professional guidance has significantly improved EcIA chapter quality. Calculation of an EcIA chapter quality index identified that, on average, EcIA chapters only include half of the EIA legislation's information requirements. Investigation of the case study sites identified high rates of mitigation implementation (84.1% of auditable measures were at least partially implemented). However, implementation effectiveness was found to be poor (only three out of ten measures achieved the goals stated in their EcIA chapters or Ecological Management Plans). EcIA chapter quality was found to be significantly linked to mitigation implementation but not to implementation effectiveness.

This investigation has identified aspects of the professional guidance that require amendment to help improve EcIA chapter content. Recommendations have also been made for practitioners when recommending ecological mitigation measures. In addition, the requirement for further research into mitigation success has been highlighted.

ACKNOWLEDGEMENTS

"Whether ecological problems are harder than those of other sciences or not, someone must address them" (Peters, 1991, p. 11).

This research was made possible by funding from a Nigel Groome Research Studentship.

Grateful thanks go to my supervisors Stewart Thompson and Graham Wood, who provided invaluable guidance during the writing of this thesis. Stewart, in particular, has been a rock and a good friend over the past three years, providing unwavering support, random snippets of 1970s history (how had I never heard of the cod wars?), and of course the Thompson's Tours trip to Kenya.

Thanks also go to all of the local planning authorities, developers and consultants who kindly allowed me access to sites, data and their photocopiers, and gave me their time and help. I would also like to thank particular members of staff at Oxford Brookes: Peter Grebenik for his early help with, and infectious enthusiasm for, Excel; Andrew Lack for his near-miraculous identification of some shrivelled botanical samples; and Reza Oskrochi and Casper Breuker for their help with statistics.

The S109/S107 crew provided their unconditional support, laughter and sage (mostly!) wisdom, which I'll always remember and treasure. Nicola, Mary, Irene, Rien, Ruth and Laura, you're the absolute best. May your custard creams and coffee never run low.

Finally, thanks to my family and Martin for not letting their eyes glaze over whenever I waxed lyrical about great crested newts or planning policy – greater love hath no man than this…

ABBREVIATIONS

ANOVA	Analysis of Variance
BAI	Biodiversity Assessment Index
CPA	Competent Planning Authority
AONB	Area of Outstanding Natural Beauty
BANC	British Association for Nature Conservationists
BAP	Biodiversity Action Plan
BES	British Ecological Society
CWS	County Wildlife Site
df	Degrees of freedom
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EcIA	Ecological Impact Assessment
EcMP	Ecological Management Plan
EIA	Environmental Impact Assessment
EIA Directive	Council Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment (85/337/EEC), as amended
EIA Regulations	Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations (1999), as amended
EMP	Environmental Management Plan
EMS	Environmental Management System
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
GIS	Geographic Information System
GPS	Global Positioning System
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IoB	Institute of Biology

ha	Hectare
Habitats Regulations	Conservation (Natural Habitats, &c.) Regulations (1994), as amended
JNCC	Joint Nature Conservation Committee
LNR	Local Nature Reserve
LWT	Local Wildlife Trust
NE	Natural England
NGO	Non-governmental Organisation
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NTS	Non-Technical Summary
PPS 9	Planning Policy Statement 9
RGS	Royal Geographical Society
RSPB	Royal Society for the Protection of Birds
S106 agreement	Section 106 agreement
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SINC	Site of Importance for Nature Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TPO	Tree Preservation Order
UK	United Kingdom
ZoI	Zone of Influence

CONTENTS

APPENDICES (on CD-ROM)

PART 1: ECOLOGICAL IMPACT ASSESSMENT

CHAPTER 1: Ecological Impact Assessment in the Context of EIA

1.1 Environmental Impact Assessment

1.1.1 Why is the Environment and Environmental Impact Assessment Important?

Environmental degradation has been a feature of human history for centuries, but became most noticeable in the UK with the onset of the industrial revolution in the 18th century. Large-scale, uncontrolled built development resulted in various environmental problems, including air pollution, water pollution, biodiversity loss, loss of cultural heritage and increased flood risk. Some of these problems also had impacts on human health. Indeed, recent research has emphasised the role of biodiversity and ecosystem services in human health and wellbeing (e.g. Millennium Ecosystem Assessment, 2005; UK National Ecosystem Assessment, 2011).

Prior to the 19th century, there was little to prevent landowners from uncontrolled development of their land, with the exception of limited legislation designed to improve public health. Whilst the first planning act was introduced in 1909, it was the post-Second World War planning legislation that formed the basis of the planning system we are familiar with today (Duxbury and Telling, 2009, Chapters 1 and 2). Crucially, the Town and Country Planning Act (HMG, 1947) made it possible for developers to be refused planning permission for their built development projects. This resulted in a greater degree of government (whether central or local authority) oversight, forward planning and development control.

However, greater control did not necessarily equate to greater environmental protection. Environmental law in the UK tended to focus on pollution, initially at the local scale and subsequently at the national and transnational scale (Wolf and Stanley, 2010, Chapter 1). Both changes in public opinion of environmental issues and the UK's membership of the EU resulted in environmental protection playing a greater role in the planning system (Wolf and Stanley, 2010, Chapter 1). This was complemented by the release of the Brundtland Report, which first defined the concept of sustainable development (World Commission on Environment and Development, 1987).

In 1985, the EU agreed the "Council Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment (85/337/EEC)", which was an important step in the formalised consideration of the environment in the planning system (Council of the European Union, 1985, as amended, and hereafter referred to as the 'EIA Directive'). Previously, the onus had been on Competent Planning Authorities (CPAs) to demonstrate that a planning application should be refused. With Environmental Impact Assessment (EIA) and other environmental procedures, however, the emphasis is shifted and planning permission can be withheld if the development proposals are not "demonstrably acceptable" (Cullingworth and Nadin, 1994).

1.1.2 What is Environmental Impact Assessment?

The process of EIA is legislated for and/or practised in approximately 200 countries worldwide (Morgan, 2012) and has consequently been defined in many ways since its inception in the US National Environmental Policy Act (United States Congress, 1969). One of the simplest and most universally applicable definitions describes EIA as "a process for assessing the environmental impacts of [built] development actions in advance" (Glasson, 1994a). The environment in EIA comprises not only the biophysical environment (e.g. hydrology, air quality, geology, etc.) but also the social environment (e.g. cultural heritage, socio-economics, landscape and visual). The aim of EIA is therefore to ensure that project proponents (hereafter referred to as 'developers') and CPAs consider the likely environmental impacts of a built development project. As a result of this process, environmental impacts can potentially be avoided or reduced, and better informed decisions made (Armstrong *et al.*, 2010).

EIA is frequently conducted in the UK, with over 10,000 projects subject to EIA up to 2011 (Fothergill, 2011). An average of 341 ESs were submitted in England each year under the EIA Regulations between 1999 and 2008 (DCLG, unpublished data), with 390 submitted in 2011 (DCLG, 2012c). Although it is unknown how many of these EIA developments were granted planning permission, approximately 80% of all English planning applications between 2001 and 2011 gained planning permission (DCLG, 2012b). Underpinning this research is the assumption that the number of EIA planning applications is unlikely to change significantly in the future.

1.1.3 EIA Legislation

The UK, as a Member State, was bound to transpose the EIA Directive into national legislation by July 1988. This was achieved via secondary legislation rather than an Act of Parliament, and resulted in a series of statutory instruments being created to introduce Environmental Impact Assessment (EIA) into the existing UK planning system. A simplified schematic of the relationship between the EU EIA Directive and the UK's transposition of it (with a particular focus on England) can be found in Figure 1.

The main statutory instrument transposing the EIA Directive in the UK was the Town and Country Planning (Assessment of Environmental Effects) Regulations (HMG, 1988) and its subsequent amendments and replacements. The most relevant amendment / replacement for this study is the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations (HMG, 1999, as amended, and hereafter referred to as the 'EIA Regulations').

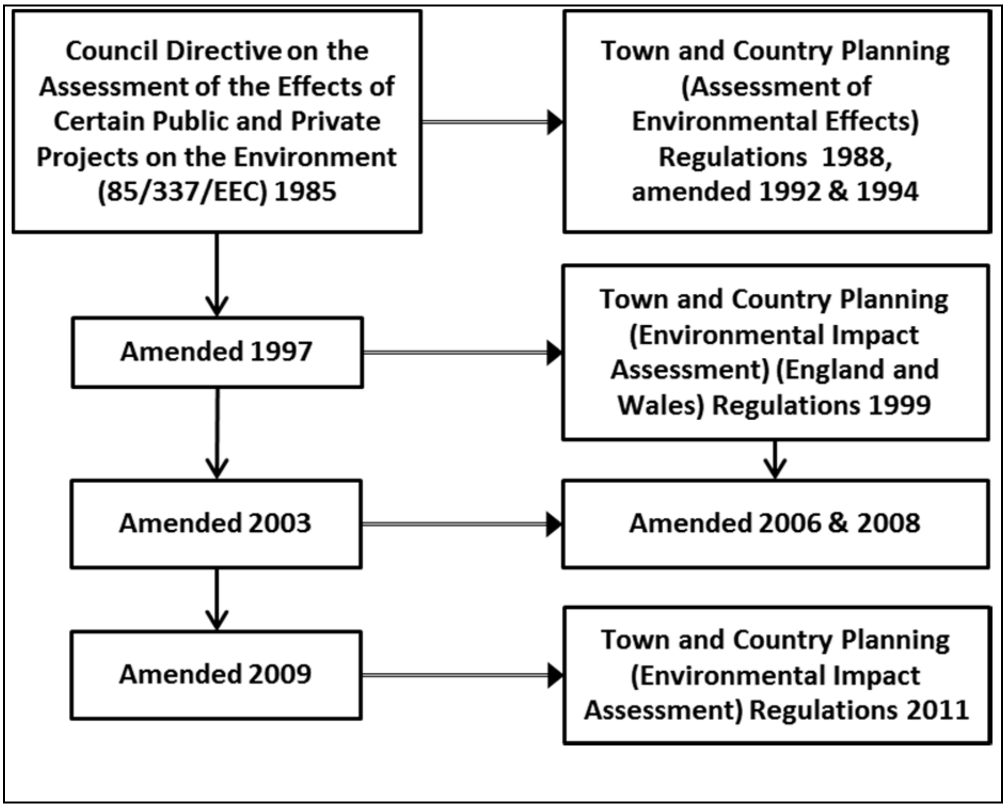


Figure 1: Schematic of the relationship between the EU's EIA Directive and the UKs transposition of it (with a focus on England) within the context of town and country planning. Closed arrowheads refer to transposition, open arrowheads refer to amendments and gaps indicate replacement.

1.1.4 How is Environmental Impact Assessment conducted in England?

Being a lengthy process, EIA is not feasible for, or applicable to, every built development project. The EIA Directive provides a list, known as Annex I, of projects and their thresholds that will always require an EIA (for example, paper production industrial plants must exceed 200 tonnes per day to qualify as an Annex I development). Annex I was transposed in the EIA Regulations as Schedule 1. The EIA Directive also provides a list of projects that may require EIA, depending on thresholds imposed by the EU's Member States and on the criteria provided in Annex III. Annex II was transposed as Schedule 2 of the EIA Regulations, which also provides further detail as to the thresholds to be met or exceeded for an Annex II development project to require an EIA.

In England, EIA is now most frequently conducted by environmental and specialist consultants (Oxford Brookes University Impact Assessment Unit, 1996). A common, though by no means the only, organisational structure is shown in Figure 2. The developer may commission a lead (often multidisciplinary environmental) consultancy to conduct screening and scoping, and to co-ordinate the EIA process. Depending on its in-house expertise, the lead consultancy may also conduct some of the technical surveys and assessments, and sub-contract others to specialist consultancies.

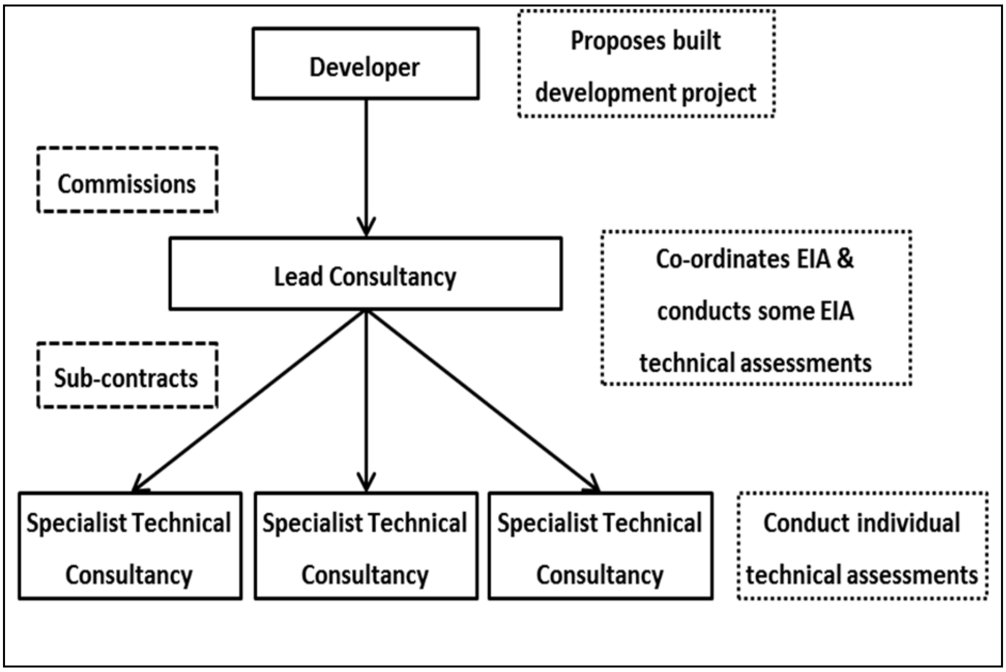


Figure 2: Common organisational structure for conducting Environmental Impact Assessment (EIA).

Whilst it is possible for the same lead consultancy to be employed by the developer throughout the entire EIA, this is not always the case. In addition, the lead consultancy may not always be independent from the developer. The energy company E.ON, for instance, owns a technology and new build consultancy (E.ON Engineering Ltd.) in the form of a subsidiary company (E.ON, 2006), which co-ordinates EIAs and compiles the resultant reports.

In England, the main stages involved in the EIA process are shown in Figure 3. A brief description of each stage is provided for clarification and further detail is provided in the literature, such as the Guidelines for Environmental Impact

Assessment (IEMA, 2004). Importantly, EIA is an iterative process and components of many of these stages should be repeated throughout the EIA process, particularly consultation and public participation (Wood, 2003, p. 6).

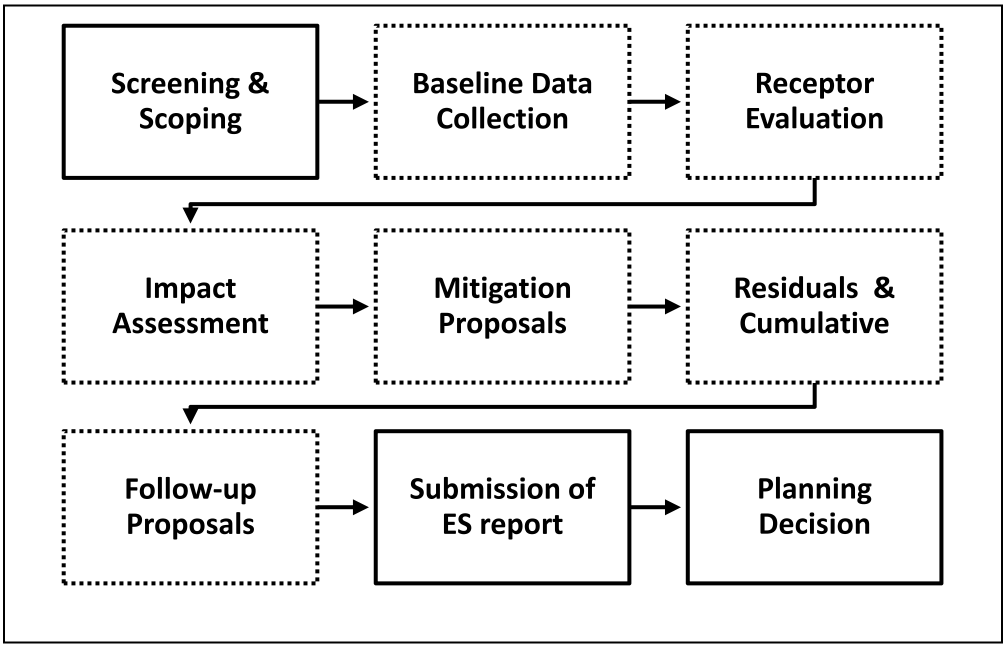


Figure 3: Key stages in the EIA Process. Stages with dashed outlines are those that are typically conducted within each individual technical chapter, such as the ecology chapter. Stages with bold outlines tend to occur only once during the EIA process.

A formal screening determination involves the CPA providing an opinion to the developer as to whether or not an EIA is required for the project (i.e. whether it is a Schedule 1 or Schedule 2 development, and if the latter whether it meets or exceeds the thresholds and criteria required for an EIA). A formal scoping request involves the CPA giving an opinion as to which environmental components should be considered within the EIA process, for example whether a consideration of ecology would or would not be required.

Baseline data collection generally comprises desk study (including consultation) and survey data to determine the presence and/or absence of potential receptors of environmental impacts that may arise as a result of the proposed development (such as flora, fauna, humans, etc.). Crucially, baseline data collection is not limited to within the planning application boundary but can extend several kilometres from it, depending on the technical discipline and the likely potential impacts (e.g. air pollution can travel long distances depending on weather conditions). Comprehensive baseline data collection will aid the evaluation of identified receptors, i.e. help to determine how sensitive or important they are. For example, the legally protected great crested newt (*Triturus cristatus*) may be evaluated as more important than a more commonly found species, such as smooth newt (*Lissotriton vulgaris*).

Impact assessment may be summarised as comprising three main steps. The aim is first to identify all possible significant environmental impacts resulting from the proposed development, second to characterise them in terms of, for example, their magnitude and frequency, and third to determine the significance of their impact on identified receptors. Once this has been conducted, significant impacts can be reduced, avoided or compensated for with mitigation measures, according to the mitigation hierarchy (Mitchell, 1997). In an ideal model, the third step of the impact assessment process (determination of significance) is then repeated to take into account the effects of mitigation and determine the residual impacts of the proposed development. The overall impact assessment is then used to establish whether cumulative impacts would be likely. Cumulative impacts are "incremental changes caused by other past, present or reasonably foreseeable actions, together with the project" (Walker and Johnston, 1999) but the cumulative impact assessment will frequently also include assessments of interactive and secondary impacts.

The EIA is written up and submitted with the planning application to the CPA as a report known as an Environmental Statement (ES). The structure of a typical ES is shown in Figure 4, although there are many possible variations, particularly in terms of the order of the front-end and technical chapters. The technical chapters included within an ES, as well as their contents, will depend on the scoping opinion given by the CPA and/or the expertise of the contributing consultancies. Each technical chapter is likely to have its own appendices and figures. The entire ES is summarised for the public in the Non-Technical Summary (NTS), which is legally required by the EIA Directive.

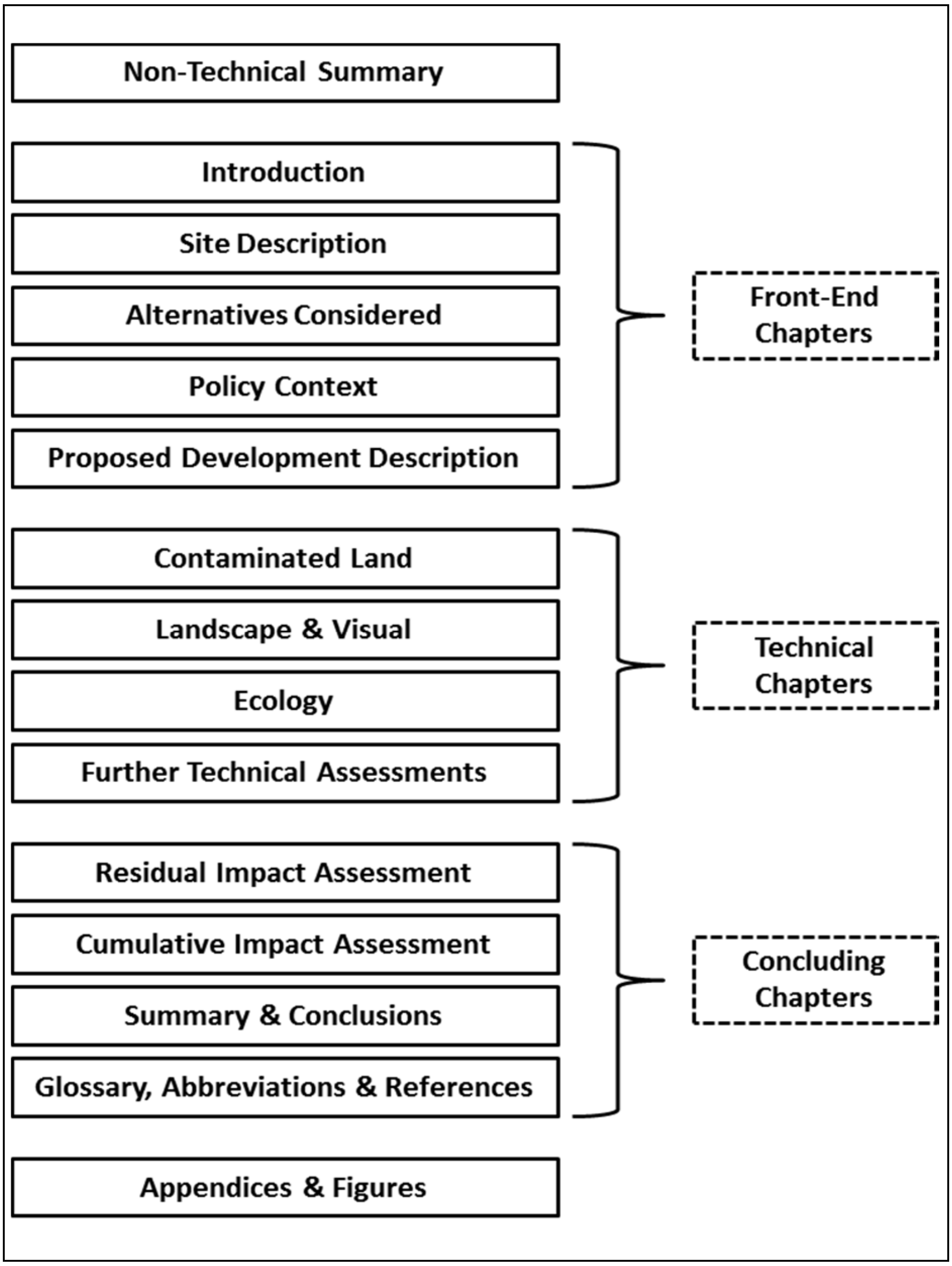


Figure 4: Structure of a typical Environmental Statement (ES).

ES submission may result in the CPA formally requesting further information, which under the EIA Regulations was referred to as a Regulation 19 request. If this information is not provided, the application can only be determined by a refusal. The CPA will also request opinions from the statutory and non-statutory consultees, and make the planning application documents available for public comment. Depending on many factors, including the consultation responses, the planning application documents, and the legislative and policy context, the CPA will make one of three possible decisions: grant of planning permission (with planning conditions and potentially planning obligations), refusal of planning permission (with an explanation of the refusal), or non-determination (failure to either grant or refuse planning permission). The developer can appeal against both refusal and non-determination via public inquiry, where the ultimate decision is taken by the Secretary of State informed (though not bound) by the planning inspector's report and recommendations.

As the ES (including its mitigation measure proposals) is not a legally binding document, there are two main mechanisms securing the implementation of environmental mitigation measures once planning permission has been granted. The first mechanism involves planning conditions attached to the decision notice. These can vary in number and content, and are subject to a series of tests for validity. Of these, two are of particular interest in this context of securing implementation, i.e. that they should be "enforceable" and "precise" (ODPM, 1995). The description and wording of the mitigation measures proposed in the ES therefore needs to be sufficiently clear to allow them to be included as planning conditions. Planning conditions (whether or not they are based on ES mitigation measures proposals) are legally binding but can be removed or amended by a further planning application or an appeal.

Planning conditions are the preferred mechanism (ODPM, 2005a), partly as they are easier to amend or remove. However, it is also possible for a developer to enter into a private, negotiated legal agreement with the CPA through what is known as a Section 106 (S106) Agreement (unilateral undertakings are not considered further in this study). S106 Agreements comprise various legally binding obligations, which may be either monetary or in kind. Planning obligations can "prescribe the nature of a development", "secure a contribution from a developer to compensate for loss or damage created by a development" and/or "mitigate a development's impact" (ODPM, 2005a). It is common for EIA Developments to be subject to both planning conditions and planning obligations (Drayson, unpublished data), though obligations will not necessarily be required in every case.

All of these stages are important but there is also potential at each stage for error, for example for information to be lost or processes to be conducted incorrectly. Some form of feedback mechanism is therefore required to ensure that mistakes are learned from and best practice followed in future projects.

1.2 EIA Audit

EIA audit comes in many shapes and sizes, with different methods and outcomes depending on the objectives (e.g. Tomlinson and Atkinson, 1987b) but may include document review, and post-construction follow-up. There are several advantages to conducting at least some form of EIA audit:

- It may help to prevent bias from entering the ES, thereby potentially increasing its reliability and use by CPAs in decision-making (Dipper, 1998).
- It may help ensure that critical environmental thresholds are recognised and avoided, and that unforeseen impacts are mitigated (Bisset and Tomlinson, 1988; Frost, 1997a).
- It may help ensure that proposed and legally required mitigation measures are implemented (Sánchez and Gallardo, 2005) and ensure better post-consent environmental design (e.g. via adaptive environmental management).
- It allows practitioners to learn from earlier mistakes in impact prediction and/or mitigation and improve future ESs and EcIA chapters; follow-up "closes the loop"(Shepherd, 1998).
- It helps to address the uncertainty that is inherent in EIA (Morrison-Saunders and Arts, 2004).

Given the time, money and manpower invested in EIA, it makes sense for developers, consultants and CPAs to learn from past experience through some form of audit. However, EIA audit is not legally required in the UK under the EIA Directive or EIA Regulations (monitoring may be required under other legislation, such as emission or discharge consents). As a result, there is little incentive for consultants to propose a potentially costly, time-consuming and potentially self-incriminating audit regime to developers (Shepherd, 1998). This is particularly the case for small developers with few projects; the benefits of learning from experience will be more important for larger and more frequent developers (Glasson, 1994b). The UK is not alone in poor implementation of EIA audit activities. A review of international EIA effectiveness by Sadler (1996) found that EIA follow-up was “critically deficient”, and a general introduction to EIA follow-up (in this study, follow-up refers to audit of completed developments, rather than documentation) identified it as “the weakest stage in most jurisdictions where EIA is practised” (Morrison-Saunders and Arts, 2004). Without audit, there is the risk of EIA being used “purely to achieve development consent rather than as a tool for sound environmental management and protection” (Dipper, 1998).

Whilst EIA audit is a critical part of the EIA process that should be more widely used, it is not without its own procedural issues. For example, there is little guidance available on how to conduct audits, particularly in a UK context (linked to the lack of legal requirement). In addition, to be effective, audits must not only be able to identify problems but include a mechanism to rectify them.

1.3 Biodiversity Loss and the Role of Ecology in EIA

One of the many environmental impacts that increased as a result of the industrial revolution in England was biodiversity loss. Of the approximately 500 species that have become extinct in the UK since the first century AD , the majority became extinct in the last 200 years, i.e. during and since the industrial revolution, and mainly as a result of human activities (Natural England, 2010a). A similar picture is seen globally, with the current rate of human-induced extinction estimated to be approximately 1,000 times greater than the ‘background’ rate of extinction typical over the history of the Earth (Millennium Ecosystem Assessment, 2005). In addition, attempts to reduce the rate of biodiversity loss have been unsuccessful (CBD Conference of Parties, 2002; Butchart *et al.*, 2010).

Whilst biodiversity underpins many ecosystem services we depend on, such as clean air and water, the effects of biodiversity loss are difficult to predict. We do not yet know how much, or which components of, biodiversity can be lost before those systems deteriorate. However, there are indications that terrestrial biodiversity loss could affect productivity and decomposition at a comparable scale to climate change (Hooper *et al.*, 2012), and marine biodiversity loss has been linked with exponential declines in water quality (Worm *et al.*, 2006).

The EU has been instrumental in developing environmental legislation and policy in its Member States (Wolf and Stanley, 2010, Chapter 1). The EU's environmental policy rests on four main principles; precaution, prevention, rectification at source and polluter pays (Lauranson, 2012). Given the absence of scientific consensus about the effects of biodiversity loss, both the precautionary and prevention principles suggest that biodiversity protection should be a high priority from the global to the local scale.

The main cause of global terrestrial biodiversity loss is widely recognised to be habitat change and/or loss (Millennium Ecosystem Assessment, 2005). In England, the main drivers of habitat change / loss are agriculture, forestry and built development (Land Use Consultants, 2005), although climate change and invasive species will likely play an increasingly important role (UK National Ecosystem Assessment, 2011). Given predictions of likely population increases and the consequent need for major infrastructure creation and renewal over the next ten years (Fothergill, 2011), a focus on the built environment's impacts on ecology is of importance. EIA has a potentially important role to play in this, given its anticipatory nature and role in land use decision-making.

England has two main mechanisms to ensure the protection of the rarest and most vulnerable species and habitats: legislation and policy. Both of these mechanisms, particularly since 2000, are discussed in further detail in Chapter 2. However, it was the EIA Directive and its transposition into the EIA Regulations that ensured that biodiversity, and more particularly ecology, was considered within the context of large and/or particularly damaging built developments, which would therefore be the most likely to have the greatest impacts on biodiversity (Thompson *et al.*, 1997).

Depending on the circumstances of each case the EIA Directive, and therefore the EIA Regulations, includes a requirement to consider the impacts on "fauna and flora", i.e. biodiversity. The EIA legislation also takes this one step further by including a requirement to consider the interaction between fauna and flora and a variety of other factors, including “soil, water, air, climate and the landscape”. Given that the definition of ecology is the “the interrelations between living organisms and their environment, including both the physical and biotic factors” (Lackie, 2007), the EIA Directive explicitly requires the consideration of ecology in relevant EIA planning applications. This is known as ecological impact assessment (EcIA), and is defined as “the process of identifying, quantifying and evaluating the potential impacts of defined actions on ecosystems or their components” (Treweek, 1999) The resulting ES chapter is in this study referred to as an EcIA chapter.

1.4 Research Focus

This study focuses on EcIA audit, in terms of both EcIA chapter review and on-site ecological mitigation measure assessment. The focus on EcIA in this study reflects several different factors:

- Ecology has been the subject of several high profile public inquiries, such as the Dibden Bay Container Terminal (Secretary of State for Transport, 2004). This suggests that current practice is worth further investigation.
- The lack of progress the UK has made in meeting its EU commitments to halt biodiversity loss (Butchart *et al.*, 2010; Natural England, 2010a) urgently needs addressing.
- Third, the focus on ecological mitigation in the second half of this study will have relevance to the proposals to introduce biodiversity offsetting into the UK (Defra, 2011b). Biodiversity offsetting is currently used in other countries, such as the USA and Australia (McKenney and Kiesecker, 2010). The aim is to ensure that built developments resulting in ecological damage that cannot be mitigated for on-site, do not result in net loss of biodiversity. This would be achieved by securing “compensatory habitat expansion or restoration elsewhere” (Defra, 2011b). However, there has been little previous research conducted on the efficacy of current EIA practice in mitigating ecological impacts to help support the introduction of biodiversity offsetting into the UK planning system.
- Whilst there is relatively little past research conducted on other technical disciplines, there is potential for some of the conclusions drawn from, and methods used in, this study to be applicable to other technical disciplines

within EIA, such as hydrology, air quality and landscape. This is particularly the case since all the technical disciplines within EIA should be given appropriate treatment in keeping with the 'spirit' of the EIA Directive.

Both ESs and EcIA chapters have been the subject of considerable study, which has identified numerous flaws in practice that are discussed in greater detail in Chapter 2. Commonly found flaws in ESs included, for example, overlooking the consideration of alternatives (Bagri *et al.*, 1998) and poor consideration of cumulative impacts (Cooper and Sheate, 2002). Reviews of EcIA chapters revealed issues such as vague habitat descriptions (Treweek and Thompson, 1997) and a failure to quantify many impacts, including habitat loss (Thompson *et al.*, 1997). However, the majority of ES and EcIA chapter review studies were conducted prior to 2000 and so a new review is timely. Completed EIA developments, in terms of their mitigation implementation and effectiveness, have been less well researched, with very few studies of ecological mitigation conducted (see Section 2.3). This is a critical failure, as it is only with follow-up of EIA developments that improvements can be made to future EIA practice.

1.5 Aims and Objectives

Given that:

1) one of the main contributors to biodiversity loss in England is built development,
2) population increases and pressure for built infrastructure is likely to increase,
3) EIA developments are by their nature those most likely to have significant impacts on biodiversity,
4) the rate of EIA application submission is unlikely to decrease in the foreseeable future, and
5) past EIA and EcIA practice has been demonstrated to be flawed (see Chapter 2),

the emphasis must be on improving EcIA practice, EcIA chapters and the implementation and effectiveness of EcIA mitigation measures in completed developments to ensure that EIA developments' impacts on biodiversity are reduced as far as practicably possible.

The primary aim of this study is to identify those features of the planning system and EcIA process that have the potential to result in the failure of completed EIA developments to achieve no net loss of biodiversity. The secondary aim is to identify how those features could be modified to ensure that completed EIA developments not only achieve no net loss, but achieve net gain of biodiversity. The objectives of this study are therefore to:

- conduct a review of EcIA chapters (these are often the first auditable ecological components of the EIA process); and
- conduct surveys of completed EIA development sites (these are the final auditable ecological components of the EIA process).

The EcIA chapter review has been split into two separate chapters (see Figure 5). The first primarily involves a comparison with earlier EcIA chapter reviews, whilst the second investigates the factors that affect EcIA information content. The completed development surveys have also been split into two chapters. The first comprises a simple investigation of ecological mitigation measure implementation, whilst the second explores the implementation effectiveness of a subset of ecological mitigation measures. The next chapter explores the literature behind both ES and EcIA chapter review, and completed EIA development audits.

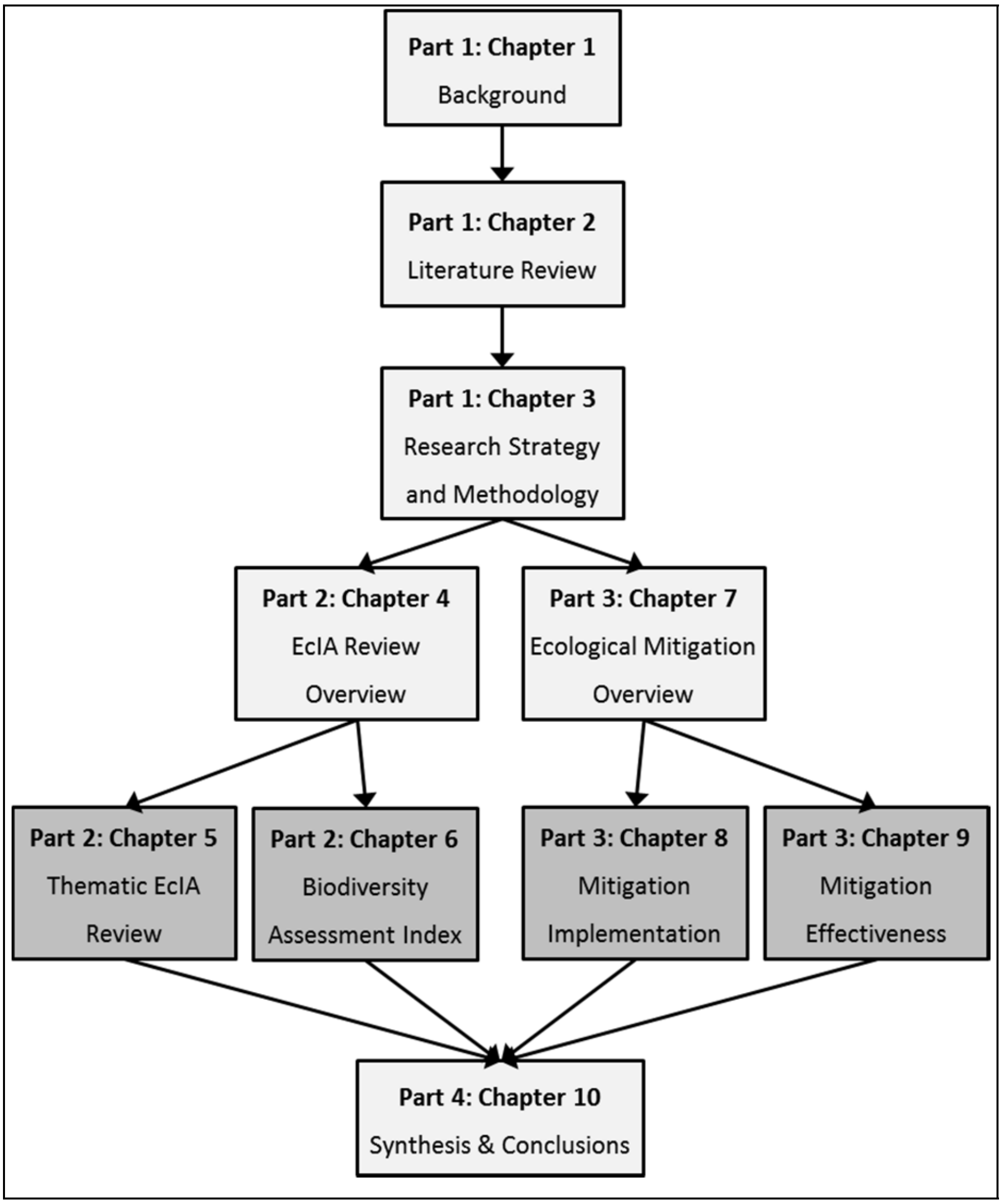


Figure 5: Thesis structure diagram. Chapters shaded in dark grey are results chapters.

CHAPTER 2: Literature Review

This chapter first explores the issue of EIA effectiveness and the need for research in this area. EIA and EcIA audit literature is then explored in greater detail in order to determine the current status of EcIA practice, both in terms of the EcIA chapter and in terms of on-site ecological mitigation measure implementation.

2.1 Effectiveness of EIA

EIA is, in theory, an ideal means to ensure that environmental impacts are identified and ameliorated prior to development, in an efficient and cost-effective manner. Establishing the effectiveness of EIA is "an overarching and integral theme of EA theory and practice" (Sadler, 1996) and EIA audit is an important tool to help determine EIA effectiveness.

There are several different types of effectiveness, but the two most commonly researched are procedural effectiveness (i.e. whether EIA conforms to established provisions and principles), and substantive effectiveness (i.e. whether the purpose of EIA is achieved) (Sadler, 1996). As with any system that requires human input, EIA as conventionally practised has been subject to considerable criticism. Numerous analyses of the EIA system, both in the UK and internationally, have consistently found flaws in EIA practice (UK-based studies include, for example, CPRE, 1991; Glasson, 1999; Barker and Wood, 1999; Fothergill, 2011). The focus in the following two sections is on the procedural effectiveness of EIA and EcIA; research on the substantive effectiveness of EIA is discussed in Section 2.4 .

2.2 Procedural Effectiveness: Document Audit

One of the simplest and most cost-effective methods of researching EIA procedure is to review the key EIA documentary output, i.e. the ES (Treweek, 1996). Site visits, interviews and questionnaires will provide a richer context and higher level of detail, particularly since not all of the processes and findings from undertaking the EIA are necessarily reported in the ES (Treweek *et al.*, 1993). However, ES review is relatively inexpensive and less time-consuming (allowing for examination of larger numbers of ESs and therefore providing a wider picture of practice). In addition, it allows for detailed and systematic comparisons and the identification of patterns and trends.

One of the most common methods used to evaluate ESs is a checklist-based review. There are two main possible aims of such a review. The first is a determination of 'quality' of an ES in such a way that it can be readily compared with other ESs. The second is an exploration of particular themes within ESs, or within a particular technical chapter.

2.2.1 Exploring ES Quality using Checklist-based Reviews

Many studies developed and used their own bespoke ES review criteria, depending on the authors' area of interest and requirements (e.g. Ross, 1987; Bojórquez-Tapia and García, 1998). However, there are also several publicly available ES review packages that have been frequently used in the literature. Two of the most commonly used packages are the European Commission's EIS Review Checklist (Environmental Resources Management, 2001) and the Environmental Statement Review Package (Lee and Colley, 1992).

Both ES review packages use a similar grading system to help "inform the decision on development consent"(Environmental Resources Management, 2001). The Environmental Statement Review Package grades range from 'A' (generally well performed) to 'F' (very unsatisfactory), and the EIS Review Checklist grades range from 'A' (full provision of information) to 'E' (very poor provision of information). However, the methods to assign an overall grade to an ES vary. Table 1 provides an outline of the review sections for each of these review packages, highlighting their similarities. However, whilst the EIS Review Checklist simply aggregates the answers to a series of 144 questions arranged in seven sections, the Environmental Statement Review Package has a four-level hierarchical structure, with aggregation of grades occurring between levels.

Table 1: Organisation of the review sections for the two most commonly used ES review packages.

Environmental Statement Review Package (Lee and Colley, 1992)	EIS Review Checklist (Environmental Resources Management, 2001)
"Description of the development, the local environment and the baseline Conditions"	"Description of the project"
	"Description of the environment likely to be affected by the project"
"Identification and evaluation of key impacts"	"Description of the likely significant effects of the project"
"Alternatives and mitigation of impacts"	"Alternatives"
	"Description of Mitigating Measures"
"Communication of results"	"Non Technical Summary"
	"Quality of presentation"

The main advantage of these ES review packages is that they require only basic technical expertise on the part of the reviewer, and so can be used by developers, CPAs and consultees. In addition, the grading system can be used to compare ES 'quality' according to the criteria of interest. However, a recent review by Põder and Lukki (2011) identified several issues with checklist-based reviews, particularly those that result in aggregated grades. One of the most important is the lack of a definition of ES 'quality'. Indeed, they suggest that such a definition cannot encompass every possible aspect of ES quality (for example, a definition of quality given by a consultee could differ markedly from a definition given by the CPA, and there is a difference between quality of content and quality of process). As a result, each ES review must be very clear about what aspects of ES quality are being assessed.

Another major issue is that both the EIS Review Checklist and the Environmental Statement Review Package fail to include certain key aspects of ESs in their review criteria, specifically the consideration of alternatives, public participation and uncertainty (e.g. in impact predictions and mitigation success). This has been rectified in a more recently developed ES review package (Oxford Brookes University Impacts Assessment Unit, 2009). However, all three review packages require score aggregation: given the issue of inter-reviewer variability, aggregation can differ between individuals. Finally, the grading system is ordinal rather than scale, meaning that the distribution of the grades may not necessarily be equal. For example, the difference in quality between grades ‘A’ and ‘B’ may be greater than the difference between grades ‘B’ and ‘C’, making interpretation more open to challenge.

Several ES review studies were conducted in the 1990s, and a few in the early 2000s, using various review packages. A summary of some of the main findings from major ES review studies is included in Table 2. Across the studies, there is an underlying pattern of high proportions of ESs being of unsatisfactory quality, but with some improvements being seen over time.

Table 2: Summary of the main findings from major ES review studies.

Study	**ES Year Range**	**Checklist Used**	**No. of UK ESs Reviewed**	**Main Findings**
(Jones *et al.*, 1991)	1988-1990	Simple, based on legislation. No aggregation to produce a score.	100	A quarter failed to contain the necessary data for identifying and assessing the development's impacts. Complex and interactive effects were neglected in most ESs. Deficiencies in describing alternatives and limitations were also noted.
(Lee and Colley, 1991)	1988-1989	Environmental Statement Review Package	12	Only 25% were assessed as being satisfactory. More than 40% were assessed as being more than marginally unsatisfactory. Deficiencies included impact identification, impact assessment, consideration of alternatives and presentation bias.
(Wood and Jones, 1991)	1988-1989	Environmental Statement Review Package	24	Approximately two-thirds of ESs were judged to be unsatisfactory, i.e. not fulfilling the requirements of legislation. ES quality was very variable with some containing little extra information than a non-EIA planning application.
(Lee and Brown, 1992)	1988-1991	Environmental Statement Review Package	83	Some improvements seen over time, but by 1990/91 approximately 40% of ESs were still assessed as unsatisfactory.

Study	ES Year Range	Checklist Used	No. of UK ESs Reviewed	Main Findings
(Wood *et al.*, 1996)	1990-1996	Environmental Statement Review Package	24	Some improvements seen over time, with two-thirds of later ESs being judged as satisfactory or better. However, deficiencies remained in impact identification and assessment, consideration of alternatives and monitoring provisions.
(Glasson *et al.*, 1997)	1988-1994	Oxford Brookes University review package, Environmental Statement Review Package & EIS Review Checklist	50	Some improvements seen over time with all three review packages. However, coverage of alternatives remained poor and there were only marginal improvements in mitigation and monitoring descriptions.
(Jones *et al.*, 1998)	1988-1994	Environmental Statement Review Package	40	Just over 50% of the ESs were assessed as satisfactory.
(Gray and Edwards-Jones, 2003)	1988-1998	Environmental Statement Review Package, slightly modified for forestry	89	Only one ES was considered wholly satisfactory and this was also the only ES that satisfactorily identified and assessed development impacts. Alternatives were only discussed in a few cases.

2.2.2 Exploring EcIA Themes using Checklist-based Reviews

Reviews of individual technical chapters within the ES, such as the EcIA chapter, have been conducted relatively infrequently. One of the earliest EcIA chapter reviews was conducted by Beanlands and Duinker (1983). This thematic review of 21 Canadian EcIA chapters identified numerous issues, including descriptive and limited baseline surveys, lack of hypothesis testing, lack of ecological theory (e.g. nutrient cycling) and vague impact predictions. However, there is considerable variability in EIA jurisdiction, guidance and legal requirements across the globe, even within the EU (Barker and Wood, 1999). As a result, whilst international studies have been referenced and considered, the main focus of this study is on UK practice.

To date, there have been six main published reviews of UK EcIA chapters ranging in publication year from 1992 to 2000 and reviewing EcIA chapters from 1988 to 1997 (see Table 3 for further details). None used existing ES review criteria, instead creating study-specific criteria, based on legislation and guidance existing at the time. This has made comparison between the reviews difficult, but an attempt has been made in the current study to make comparisons where possible.

The main difference between these EcIA chapter reviews and those reviews conducted using ES review packages is the lack of an aggregated grade or score to summarise the overall assessment of the quality of the documentation. The EcIA chapter reviews were purely aimed at exploring the comparative performance of specific themes within EcIA, such as impact assessment and mitigation. There are advantages and disadvantages to this approach. For example, there is a slightly greater emphasis (in comparison to the ES review packages) on 'information quality' rather than simply on completeness. This is partly because technical ES chapter reviews tend to be conducted by those with knowledge of, and experience in, that technical discipline and therefore those better able to evaluate information quality. However it does not readily allow for empirically driven investigation of the variables likely to influence the quality of EcIA chapters.

One of the main limitations of a focus on just one technical chapter within an ES is the lack of context: several other technical chapters may contain ecological information, such as hydrology and landscape. None of the previous studies stated whether the EcIA chapter was analysed in isolation or whether all other parts of the ES were also considered for ecological information.

Of those early EcIA chapter reviews, all found elements requiring considerable improvement in almost every part of the EcIA process (Spellerberg and Minshull, 1992; Treweek *et al.*, 1993; RSPB, 1995; Thompson *et al.*, 1997; Treweek and Thompson, 1997; Byron *et al.*, 2000). These included, for example, lack of consultation, poor baseline survey, lack of quantification (of the ecological baseline and impact predictions), inadequate cumulative impact assessment, vague mitigation measure descriptions, and low levels of commitment to mitigation and follow-up (see Table 12). However, with the changes in legislation, policy and guidance summarised in Table 7, there is potential for some of those improvements to have been made. However, there has been little recent work evaluating EcIA performance. Increasingly strong ecological protection in legislation, as well as increased recognition of the importance of ecology in planning guidance, warrant a study that builds on these early EcIA thematic reviews.

Table 3: Characteristics of the six main published UK EcIA chapter reviews, in publication year order, in comparison with the current review.

Review Authors	Publication Year	EcIA Year Range	No. of EcIAs	Geographic Distribution of EcIAs	Planning Application Status	Comments
Spellerberg & Minshull	1992	1988-1989	45	UK	All	N/A
Treweek *et al*.	1993	1989-1991	37	UK	All	Road EcIAs only
RSPB	1995	1988-1994	37	UK	All	N/A
Thompson *et al*.	1997	1988-1993	179	UK	All	N/A
Treweek & Thompson	1997	1988-1993	194	UK	All	Mitigation only
Byron *et al*.	2000	1993-1997	40	UK	All	Road EcIAs only
Current Review	N/A	2000-2011	112	England	Granted permission	N/A

2.2.3 Exploring Variables Affecting EcIA Quality

One of the most important changes since the last published EcIA review was the release of the Institute of Ecology and Environmental Management (IEEM) EcIA Guidelines (IEEM, 2006 and hereafter referred to as the 'EcIA Guidelines'). This was the first EcIA-specific guidance available to practitioners and other parties involved in EcIA and provided much needed information on best practice methodology and structure. However, an assessment of the EcIA Guidelines' effectiveness in improving EcIA chapter information content has not yet been made. The role of IEEM is expanded further in Section 5.5.1.PART 2: 5.5.1

Few studies have attempted to assess the impact of new guidance on EcIA chapters. Some have conducted 'before and after' studies of EcIA chapter content (e.g. Atkinson *et al.*, 2000, examining the effect of the 1993 release of US Council on Environmental Quality biodiversity guidelines). Rather than conducting a laborious 'before and after' study, Byron *et al.* (2000) used the results from the Treweek *et al*. (1993) EcIA chapter review as a benchmark from which to assess the impact of the Design Manual for Roads and Bridges Volume 1 (Highways Agency, 1992, as amended). However, this approach suffers from a replicability issue, in that the interpretations of the criteria used for each comparative analysis may have been slightly different between the two studies.

A checklist-based thematic review of EcIA chapters cannot quantitatively determine the impact of the EcIA Guidelines on the content of EcIA chapters: any improvement in EcIA content over time could be due to a number of different factors. By implication, it is arguably more useful to provide a grade or score for each EcIA chapter and sub-component, in order to allow quantitative analysis of the variables affecting EcIA chapter quality. Rather than adapting an existing ES review package to EcIA chapters (for problems with two common existing ES review packages, refer to Section 2.2.1), a bespoke set of review criteria could in principle be used that does not require score aggregation, and thereby serves to maintain a 'fine-grained' analysis.

The provision of guidelines for EcIA was a recommendation made in several EcIA chapter reviews in order to improve EcIA information content (e.g. Spellerberg and Minshull, 1992). As a result, it was considered that the introduction of the EcIA Guidelines would in principle have a positive impact on EcIA chapter content. It is not, however, a legal requirement to meet the best practice recommendations within the EcIA Guidelines. In theory, therefore, the introduction of the EcIA Guidelines should have had no effect on the inclusion of legally required minimum information in EcIA chapters, as compliance with the EIA Directive should have occurred prior to the EcIA Guidelines being published. However, it is anticipated that in practice, those EcIA chapters stating the use of the final EcIA Guidelines would be more likely to include legally required information than EcIA chapters not stating the use of the EcIA Guidelines.

In addition to the introduction of the EcIA Guidelines, several other variables may influence the quality of information in EcIA chapters. Previous reviews of ESs and EcIA chapters have speculated on the roles played by these variables and Table 4 outlines these in detail. However, few have attempted to quantify the impact such factors have on EcIA chapter content and quality (e.g. Oxford Brookes University Impact Assessment Unit, 1996) and none have assessed the relative importance of potential explanatory variables. A quantitative score is therefore a useful means to facilitate the analysis of the relationship between these potential predictor variables and EcIA chapter quality.

Table 4: Factors identified from the literature review as varying with ES or EcIA information content and quality.

Factor	Identified Relationship
Year	"The quality of statements reviewed improved (in most cases) from 1992 onwards and were generally the best in all aspects in 1994" (RSPB, 1995).
	"There has been a marked improvement in the proportion of satisfactory EIA…over the last few years" (Barker and Wood, 1999).
Proposed development size	Small projects were more likely to have 'unsatisfactory' ESs (Lee and Colley, 1992).
	"The larger the project the more satisfactory the ES tends to be" (Oxford Brookes University Impact Assessment Unit, 1996).

Factor	Identified Relationship
	"Better EIA reports tended to relate to the larger projects" (Barker and Wood, 1999).
Location of the proposed development	"Many of the statements considered to be well balanced and detailed were for developments within the south-east of England" (RSPB, 1995).
CPA and consultee experience	"Experienced decision-makers demand and usually receive better quality statements" (RSPB, 1995).
	"There is a…correlation between (review) experience and ES quality for local authorities… With a few exceptions, the review experience of county councils far exceeds that of district councils" (Oxford Brookes University Impact Assessment Unit, 1996).
Consultancy type	"ESs produced in-house by developers are on average of much poorer quality than those produced by outside consultants" (Oxford Brookes University Impact Assessment Unit, 1996).
	"[There is a] difference in quality between ESs produced by an independent applicant in comparison with those produced by the decision maker (local authority)" (Oxford Brookes University Impact Assessment Unit, 1996).
	The type of consultancy was felt to be a "significant (if minor) determinant of EIA report quality" (Barker and Wood, 1999).
ES length	Short ESs were more likely to be 'unsatisfactory' (Lee and Colley, 1992).
	"[There is] a general improvement with increased length, from an average [grade] of E/F for ESs of less than 20 pages, to an average of [grade] C for those of more than 150 pages. As ESs become much longer than 150 pages, however, quality becomes more variable" (Oxford Brookes University Impact Assessment Unit, 1996).
	There was a "generally positive relationship between EIA report length and quality" (Barker and Wood, 1999).
Developer and	Inexperience in the preparation of ESs was found to result in higher percentages of 'unsatisfactory' ESs (Lee and Colley, 1992).

Factor	Identified Relationship
consultant experience	"The best [EcIAs] were those undertaken more recently by experienced assessors" (RSPB, 1995).
	"Whereas approximately only 50% of consultants with little or no prior experience produce satisfactory ESs, most of those with experience of eight or more ESs produce satisfactory statements" (Oxford Brookes University Impact Assessment Unit, 1996).
	Experience was "the single most important variable in explaining variations in the quality of EISs" (Barker and Wood, 1999).
Planning application type	"The quality of ESs for outline applications is significantly poorer than that for detailed applications" (Oxford Brookes University Impact Assessment Unit, 1996).
Proposed development sector	"ESs for landfills, mineral workings and sewage treatment works were usually good.... Afforestation and urban development projects were mainly poor" (RSPB, 1995).
	"Better quality ESs are associated with developments such as windfarms, (more recent) waste disposal and treatment plants, sand and gravel extraction schemes and opencast coal; whereas generally poorer quality ESs are associated with mixed use developments, new settlements, leisure proposals and agricultural schemes" (Oxford Brookes University Impact Assessment Unit, 1996).
	"More controversial projects [waste and toxic waste disposal projects] generally were supported by better-quality EIA reports" (Barker and Wood, 1999).

2.3 Procedural Effectiveness: Implementation Audit / Follow-Up

As the ES is "only one element in the EA process" (Lee and Brown, 1992), it is important not to confine "the analysis to the quality of the ESs produced at one stage of the process"(Kobus and Lee, 1993). Indeed, "Technical quality in EIA is a necessary but not sufficient condition for an effective EIA process" (Buckley, 1998). It is in theory possible for a high quality and informative ES or EcIA chapter to be produced and submitted, but this is of little use if the recommendations are either not implemented, or are not implemented effectively. As a result, the second half of this study (Chapters 7-9) will focus on the completed development, specifically the ecological mitigation that was implemented in comparison to the measures included within the planning documentation.

Tomlinson and Atkinson (1987b) identified implementation audit as a mechanism to help ensure that mitigation measures recommended within the ES are "installed and operate correctly". This limited definition was proposed with regard to plant and machinery rather than ecological mitigation and so the umbrella term follow-up has instead been used (Morrison-Saunders and Arts, 2004). Follow-up in this context can include both determining whether ecological mitigation has been implemented, but also whether measures are effective in meeting their goals.

2.3.1 Introduction to Mitigation

Part of the concept of sustainable development is the idea that "serious and irreversible environmental changes should be avoided so as not to jeopardize human survival or the welfare of future generations"(Cowell, 1997). Within the context of EIA, mitigation is a critical tool to help enable this.

Mitigation is "any feature of a proposed project which avoids, reduces or remedies its adverse effect on the environment or provides environmental benefits" (DETR, 1997). Critically, however, the measure "must be *intended*, at least in part, to mitigate an identifiable environmental effect" (DETR, 1997). It has been argued that mitigation is "one of the main aims of the European [EIA] Directive" (Wood, 2003, p. 43), making EIA mitigation practice an important area for research. Given the global biodiversity crisis and the state of the UK's natural environment, research into the success of ecological mitigation measures is crucial to help ensure the UK meets its EU commitment to halt biodiversity loss by 2020 (see Section 1.2).

Mitigation can be investigated at any one of four main stages in the EIA process. Proposed mitigation measures can be reviewed within the EcIA chapter, within the decision documents and within any environmental management plans, whilst implemented mitigation measures can be studied on the development site during construction and/or operation.

There is consensus in the literature and in EIA guidance that mitigation for built development should follow the ‘mitigation hierarchy’ (Mitchell, 1997; DETR, 1997). In terms of ecology, this entails avoiding impacts from the outset wherever possible (for example through considering alternative sites or designs), followed by minimising impacts, such as by reducing the impact’s duration, magnitude, physical extent or by altering its timing or frequency of occurrence. Only after impacts have been avoided or reduced, should rehabilitation or restoration be considered as appropriate. If residual impacts remain despite these first three stages, consideration should be given to compensation, or offsetting. Often included later within the mitigation hierarchy is the concept of enhancement. However, it has recently been effectively argued that enhancement should be considered as integral to every built development in order to deliver a net gain in biodiversity, rather than simply halting biodiversity loss (João *et al.*, 2011; Rajvanshi *et al.*, 2011).

Mitigation is seen as a means to help maintain the ‘stock’ of natural capital (Cowell, 1997). However, this economistic concept is not without controversy. For example, the principles of value and capital are inextricably linked, yet our ideas about what constitute valued landscapes are diverse and contradictory (e.g. humans value non-natural agricultural and urban landscapes, as well as natural landscapes, such as ancient woodland). In addition, there are issues about what can and cannot be considered equivalent (Cowell, 1997). Nevertheless, mitigation is embedded within the EIA Directive and its subsequent implementation within the English planning system, and therefore requires close examination.

Critically, there is no legal requirement under the EIA Directive or EIA Regulations for mitigation measures proposed in an ES to be implemented in the completed development, as the ES is not a legally binding document. CPAs must include mitigation measures either as conditions within the decision notice or as obligations within a S106 agreement (see Chapter 1) for there to be any legal requirement for developers to implement proposed mitigation measures. However, this approach has several flaws. Not all proposed mitigation measures are suitable for inclusion as conditions or obligations. The guidance available to CPAs for the use of planning conditions provides six tests that conditions must meet (DoE, 1995b). One test is that conditions must be necessary, yet many CPAs lack the technical expertise to determine which mitigation measures ought to be conditioned or obligated. For example, only 41% of CPAs employed a full-time ecologist (Newey, 2012). A second test is that the conditions must be precise, yet ecology is almost by definition subject to considerable uncertainty and mitigation descriptions in EcIA chapters are often vague (Treweek and Thompson, 1997). As a result, there is potential for mitigation measures to 'fall through the gaps' of planning conditions and obligations and not be implemented in the final development.

2.3.2 Follow-Up of Completed EIA Developments

Previous research on ESs and EcIA chapters revealed considerable shortcomings in their information provision (see Section 2.2), and it would seem logical that poor information provision would result in mitigation and monitoring being of reduced value (Buckley, 1998). However, given the benefits that follow-up can provide in terms of improved design and mitigation implementation, it is possible that the overall quality of an EcIA chapter bears no relation to the quality of mitigation in the completed EIA development. In addition, because "even an imprecise prediction can lead to appropriate mitigation" (Dipper, 1998), it is theoretically possible for effective ecological mitigation to be implemented in the completed development, despite an otherwise poor-quality EcIA chapter. Indeed, an earlier unpublished study found no link between ES quality and mitigation implementation (Frost, 1997b), although the ES quality was in this case determined using an aggregated scoring system and all technical chapters were considered rather than just ecology. As yet, there has been no research conducted into the link between EcIA chapter quality and ecological mitigation implementation and effectiveness in England.

Despite a study of 675 UK ESs revealing that only 30% mentioned follow-up, it was found that ecological follow-up in particular was subject to 30% under-reporting in terms of number of monitoring methods (Glasson, 1994b). This was supported by more recent work based in South Australia (Ahammed and Nixon, 2006).

Whilst this is encouraging, the majority of EIA follow-up studies have tended to focus on verifying the accuracy of ES impact predictions (e.g. Culhane, 1987; Dipper, 1998; Wood *et al.*, 2000) rather than on the implementation or effectiveness of mitigation measures. This is of concern, as there is little use in all impact predictions being found to be correct if the mitigation proposed has not been implemented or is ineffective (Bailey and Hobbs, 1990). Indeed, a study in Western Australia identified no relationship between impact prediction success and the management response (mitigation) to them (Bailey *et al.*, 1992).

There is also the difficulty of how to design and conduct an informative mitigation follow-up programme based on uncertain and vague impact predictions and mitigation descriptions in the ES. Even where auditable predictions and descriptive mitigation measures are included in the ES, baseline data collection may not have been designed in such a way as to allow feasible pre- and post-construction comparisons to be made. On a cautionary note, inadequate mitigation follow-up could potentially cause more harm than no follow-up, as it can lead to misleading impressions that useful efforts are being made to identify and rectify problems (Legg and Nagy, 2006). As a result, mitigation follow-up should ideally be considered prior to baseline site survey, to ensure that pre- and post-construction survey methods allow meaningful comparisons to be made.

2.3.3 Mitigation Implementation

Partly due to the fact that mitigation measures included within ESs and EcIA chapters are not legally required to be implemented (unless included as planning conditions or obligations), there remains the possibility that measures (potentially even those that are conditioned or obligated) may not necessarily be implemented in the completed development. Whilst some theoretical work, predominantly linked to adaptive management (e.g. Bailey, 1997; Morrison-Saunders and Bailey, 1999), has been conducted to explore completed EIA developments, little empirical work has been undertaken. This is perhaps a symptom of the consideration of EIA to date as "an auxiliary to the procedure of obtaining planning permission " (Glasson, 1999).

Post-decision theoretical research on EIA mitigation implementation has tended to focus on the integration of EIA with Environmental Management Systems (EMSs), such as ISO 14001 (ISO, 2004). EMSs are distinct from, though linked to, EIA in that both involve action plans and management measures. In theory, EMSs start where EIA commonly ends (i.e. post-decision), transforming the vague mitigation measures and management proposals of the ES into "practical instructions for implementation" with "clearly defined objectives" (Sánchez and Hacking, 2002). As a result, EMS outcomes are easier to audit, and as a mechanism for improving mitigation implementation, there is much to recommend their use. However, there remain very few attempts to investigate ES or EcIA chapter mitigation measure implementation, even internationally. As a result, these studies have been split into quantitative and qualitative, rather than environmental and ecological.

Quantitative Research

The few studies that have quantitatively investigated EIA mitigation measure implementation in the UK, have revealed broadly similar findings. Larger than expected proportions of the mitigation measures contained in the ES and other planning documentation were implemented. For example, Frost (1997b) found that 81% of all auditable ES mitigation measures for 30 EIA developments were implemented, although "ecology measures fare worse than average". Boyden (1998) found that 79% of all mitigation measures for one EIA development were at least partially implemented, with "Uncertainties regarding implementation of mitigation measures largely relate[d] to the management of hedges, grassland and waterways".

International studies have shown similar results, with an early study of 22 completed EIA developments in the US finding 65% of proposed mitigation measures fully implemented or exceeding the original proposals (Young, 1993). A similar study of seven completed EIA developments in Western Australia identified that 88.6% of proposed mitigation measures were implemented (Bailey *et al.*, 1992). Whilst these findings are encouraging, there has been no recent work to identify whether there have been improvements in implementation rates over time.

More recent work on compensatory wetlands in the US identified 345 mitigation sites that were required to compensate for development activities. Of those sites, a fifth (20.3%) were found to be incomplete and 14.2% were found not to have been attempted (Robb, 2002). This is a less encouraging finding, as it encompasses entire sites, rather than individual mitigation measures within one development site.

Qualitative Research

There have been few qualitative investigations of EIA mitigation implementation. Of these, two international studies (the US and Brazil) have emphasised the importance of follow-up in ensuring mitigation implementation (Dodds, 1993; Sánchez and Gallardo, 2005, respectively). A UK study on the ecological impacts and mitigation of a road development through the Blackwater Valley found that "There were a number of ecological issues which were not recognised in the ES…but were picked up by the Conservation/ Landscape Working Group or Clerk of Works" (Atkins, 2004). These studies highlight the critical importance of a post-decision mechanism to ensure both proposed mitigation implementation but also monitoring and adaptive management.

Variables Affecting Mitigation Implementation

There has been little empirical work conducted to identify the variables affecting EIA mitigation measure implementation. This is largely due to a combination of the emphasis on qualitative work and the paucity of research in this field. However, a summary of the main potential variables identified in the literature, both theorised and investigated, can be found in Table 5. Interestingly, the inconvenience of the mitigation measure to the developer was not included in the literature as a variable potentially affecting implementation, despite mitigation measures that are more time-consuming and costly perhaps being less likely to be implemented. In addition, the use of management plans was not considered in the literature, despite the potential for mitigation measures included in a management plan to have a higher likelihood of implementation.

Table 5: Potential variables affecting EIA mitigation measure implementation.

Variable	Study	Finding
ES quality	Frost (1997b)	"Disappointingly, there is no association between overall EIS quality and implementation. There is not even a link between quality of the mitigation section of the EIS and implementation performance." "If anything, the results suggest that EISs with the lowest quality have high implementation rates. This may be because the measures are relatively simple and easier to carry out."
	Huggett (2003)	"The development of a clear, comprehensive Environmental Statement is essential. This must include a description of mitigation measures that – if developed in sufficient detail – can be carried through as a guaranteed commitment when carrying out the development."
Year	Young (1993)	"Results also show that mitigation compliance was correlated with the date of the EIS".
Legislation, planning conditions and obligations	Huggett (2003)	"Commitments must be made to ensure mitigation measures are carried out."
	Frost (1997b)	"For the best performing types of measure, there does seem to be a link between the level of imposition and the high implementation rates, however the opposite does not seem to be the case, those with low implementation rates are not necessarily those without many conditions."
	Boyden (1998)	"This shows a high success rate for achieving at least partial success in ensuring implementation through planning conditions and obligations, but less success in achieving full implementation."
	Johnston and McCartney (1991)	"Eight [out of 43 Californian CPAs] said that the use of permit conditions under CEQA and the state Subdivision Map Act were very important."

Variable	Study	Finding
	Bailey *et al.* (1992)	“Compliance was…proportionally lower for conditions [i.e. mitigation measures] that were not legally binding”.
Follow-up	Dodds (1993), cited within Hildebrand and Cannon (1993)	“A substantial follow-up effort can achieve environmental results on a complex and controversial project by assuring that the commitments contained in the NEPA documents are met.”
	Huggett (2003)	“… monitoring of compliance is important and may need to be undertaken on a regular basis during construction – and from time to time thereafter – to ensure that adverse effects are being or have been reduced and that mitigation measures remain in place and are effective.”
	Sánchez and Gallardo (2005)	“A robust follow-up scheme was the main driver for the successful implementation of mitigation measures”
Public Pressure	Johnston and McCartney (1991)	“Of the 43 [Californian CPA] respondents, 10 said that public pressure was essential to gaining mitigation.”
Mitigation description	Frost (1997b)	“Whether mitigation measures are implemented or not seems to depend on the way they are worded. [Many of] the unimplemented measures…were written using passive terms.”

2.3.4 Mitigation Effectiveness

As with implementation, the effectiveness of mitigation measures in EIA has been the subject of very limited research. However, it has become clear that a definition of effectiveness, or success, is required for such studies (e.g. Matthews and Endress, 2008). An excellent illustration of this requirement was provided by Roelle and Manci (1993), who describe the conclusions of three different investigations into the same built development. Two considered that the implemented mitigation had been unsuccessful, for different reasons, whilst the third concluded the mitigation had been successful because of the wildlife attracted to the site. This scenario also highlights the possibility that 'failed' mitigation, according to the goals specified in the planning documentation, may not necessarily be detrimental to the environment. Conversely, 'effective' mitigation may not necessarily be of benefit to the environment if the goals set for it were "too modest or otherwise inappropriate" (Matthews and Endress, 2008). There is therefore a difference between implementation effectiveness and ecological effectiveness. Because of this study's focus on EIA and EcIA process, only the effectiveness of implementation will be examined, in order to gain insights that could enhance practice.

EIA and EcIA Mitigation Effectiveness Studies

One of the earliest studies of EIA mitigation effectiveness (i.e. not just a single technical discipline) was conducted on six UK case study sites, and found that only 41% of proposed mitigation measures were effective in any way (Frost, 1997b). However, interpretation must be made with care, as this percentage was based on all proposed mitigation measures rather than only those that were implemented, which may have artificially reduced the effectiveness rate. Nevertheless, the low proportion of mitigation effectiveness is of concern and highlights the importance of follow-up work.

An early study on fish and wildlife mitigation measures using 61 US case studies determined that 66% of individual mitigation measures were at least 'mostly' successful, with particular mitigation techniques successful in up to 65% of the case study sites (Roelle and Manci, 1993). This suggests considerable inter-project variability in mitigation effectiveness, which makes publicly available follow-up reports even more important.

Both of these studies demonstrate that the implementation of effective mitigation, whether ecological or not, is not an exact science; it is context dependent and requires further research. However, given that there is an enormous diversity of possible ecological mitigation measures (e.g. the creation of reptile hibernacula and public education), the focus of this research is on one key specific type of ecological mitigation – habitat mitigation. Habitat mitigation measures are frequently proposed in EcIA chapters to minimise or compensate for adverse ecological impacts on flora and fauna.

Habitat Mitigation Measures

The term 'habitat' is a commonly misused term. In ecological consultancy and in this study, 'habitat' represents vegetation communities and associations, rather than the resources and requirements of a given species (Hall *et al.*, 1997). In this study, habitat mitigation measures comprise creation, re-creation, restoration, translocation and management, and brief definitions are provided in Table 6.

There are several justifications for the use of habitat mitigation measures, even outside of EIA, including buffering from incompatible adjacent land management and practices, linking existing fragments to form corridors or stepping stones, and restoring degraded land to achieve more equitable socio-economic development in developing countries (Anderson, 1995; Aronson *et al.*, 2006).

Table 6: Definitions of habitat mitigation measures.

Habitat Mitigation Measure	Definition
Creation	It may be possible to create a habitat where it has never previously existed, e.g. digging a pond in what has always been grassland.
Re-creation	Where a habitat type has been completely lost (e.g. to land use change or succession), there may be opportunities to re-create it.
Restoration	Where a habitat type has been neglected over time or damaged (e.g. by invasive species), but where there are still remnants of the habitat type remaining, there may be opportunities to restore it to a suitable condition.
Translocation	Re-location of habitats or flora species, either off-site or elsewhere on the site to prevent damage during development.
Management	It may be possible to manage an existing habitat type to improve its suitability for certain wildlife species, such as arable land for ground-nesting birds.

Issues with Habitat Mitigation Measures

Habitat creation and re-creation are popular mitigation proposals, with translocation being less popular (Treweek and Thompson, 1997). However, habitat mitigation measures are not without their problems. There is a perception that the relatively high media profile and frequent use of habitat creation and re-creation measures may have led to developers viewing these measures as a 'licence to trash' (Hopkins, 1989). This is particularly problematic as there is mixed evidence regarding our abilities to create or re-create habitats. For example, there has been some success in creating or re-creating marine and coastal habitats in "marginal or semi-enclosed areas such as coastal bays, estuaries and fringing habitats", although there are concerns over saltmarsh creation (Mossman *et al.*, 2012), with less success in "open coastal and marine habitats" (Elliott *et al.*, 2007). A similar situation is seen with terrestrial habitats. Some habitats are irreplaceable due to the time and/or geological processes required (e.g. ancient woodland and limestone pavement), some are re-creatable depending on former land use and management (e.g. lowland heathland (Walker *et al.*, 2004a)), whilst others are relatively easily created (e.g. reedbed (Morris *et al.*, 2006)).

Restoration research has tended to focus on habitats restored for compensatory purposes, such as wetland sites in the US (e.g. Cole and Shafer, 2002; Matthews and Endress, 2008). Once again, results are mixed, with some studies concluding that targets will never be met, even in the long term (e.g. Zedler and Callaway, 1999) and that restoration is a flawed approach due to issues in the wider area affecting the restoration site (Benstead, 2000). Other studies, however, take a slightly more positive view and suggest that restoration of some habitats is possible, such as tall herb and waterbody plant communities, whilst restoration of other habitats is less likely to be successful, such as heath and grassland communities (Tischew *et al.*, 2010).

Habitat translocation, being a less popular mitigation measure has also been the subject of less research than creation, re-creation and restoration. However, as with those forms of habitat mitigation, there is no guarantee of translocation success. Translocation tends to involve the movement either of turves or of soil, or a combination of the two (Bullock *et al.*, 1996), but a review of 24 translocations in the UK found that all suffered some kind of change in the flora or fauna communities, with many showing major changes (Bullock, 1998). However, some ecologists are now calling for translocation to be seen as a useful part of the habitat mitigation measure toolbox, so long as appropriate safeguards are in place (Box, 2011).

The reasons identified for the lack of habitat mitigation measure success are many and varied, including poor planning and after-care (Bullock *et al.*, 1996; Bullock, 1998; Tischew *et al.*, 2010), environmental differences between the donor and translocation site (Bullock, 1998; Box, 2003), and lack of knowledge (Elliott *et al.*, 2007; Matthews and Endress, 2008). There are also concerns about how the success of the habitat mitigation measures can be measured. Research conducted on EcIA chapter mitigation (Treweek and Thompson, 1997) identified that habitat descriptions within EcIA chapters tended to be very broad, such as 'woodland' and 'grassland', making implementation effectiveness almost a guarantee. More recent research on compensation schemes found that 16 of 57 sites suffered from "insufficient goal setting with respect to habitat functions damaged by infrastructural development and/or poor descriptions of the measures" (Tischew *et al.*, 2010), although many of these schemes were planned over 15 years previously when there was less experience of EcIA. The argument has therefore been made that clear and appropriate objectives for habitat mitigation measures are critical in order to determine whether habitat mitigation has been successful (e.g. Box, 1996; Bullock, 1998; Matthews and Endress, 2008). In the absence of an existing standard, this research will compare implemented habitat mitigation measures to a commonly used habitat classification system to identify whether objectives have been met.

UK EcIA Chapter Habitat Mitigation Measure Effectiveness Research

Whilst considerable research has been conducted on large-scale compensatory habitat mitigation measures, particularly in the US, little research has been conducted on the success of habitat mitigation measures in the context of the UK EIA process. Indeed, the only example that could be obtained was a study conducted on the success of ecological mitigation for road EIA developments (Chinn *et al.*, 1999). This research considered both implementation effectiveness for habitats and the ecological effectiveness of the implemented mitigation measures, and found that only three of the fourteen schemes could have been considered as entirely successful, with three regarded as failures. There is therefore a gap in the research relating to habitat mitigation measure effectiveness in other EIA development sectors for more recent developments.

2.4 Substantive Effectiveness

The previous two sections found that research into the procedural effectiveness of EIA was primarily conducted in the 1980s and 1990s. These studies found considerable flaws in both documentary outputs and on-site mitigation implementation and effectiveness. This section considers the substantive effectiveness of EIA.

Substantive effectiveness in EIA has traditionally been considered to comprise the effect of EIA on the final development design and the effect of EIA on CPA decision-making (Cashmore *et al.*, 2004). One of the main concerns raised by research into the conduct and performance of EIA was the apparently widespread incomplete understanding of the anticipatory and pro-active substantive purpose of EIA by practitioners and decision-makers. For example, Tomlinson and Atkinson (1987a) found that the EIA process was “too orientated towards project authorization rather than environmental management for the project” and Bagri *et al*. (1998) found that one of the main features of EIA, the development and consideration of alternatives, was being neglected. The incomplete understanding of the purpose of EIA is likely to be one of the main reasons for its identified lack of substantive effectiveness, particularly in terms of the influence of EIA on development design and decision-making.

If the EIA process is to fulfil one of its main aims of ensuring an optimal development design that balances the needs of the developer, the CPA, the public and the environment, it must have a demonstrable effect on the design of the development. There has been little recent research conducted in this area, but early studies determined that development designs were modified as a result of the EIA process in approximately 50-80% of the applications reviewed (Walsh, 1993; Frost, 1994; Wood and Jones, 1991; Kobus and Lee, 1993; Reeder, 1994; cited within Lee *et al.*, 1994). Whilst initially encouraging, the degree of design modification was difficult to determine and varied from minor to, less frequently, major changes. One noticeable finding was that many of the changes were made after the planning application had been submitted (Wood and Jones, 1991; Frost, 1994; Reeder, 1994; cited within Lee *et al.*, 1994). This has important implications, as is can be more difficult to add significant mitigation measures at the post-submission stage than at earlier stages in the EIA process (Lee *et al.*, 1994).

From these studies, EIA appears to have some impact on development design, but that impact is focused at the later stages of the application process and only infrequently results in major changes being made. However, a slightly more recent study of 6 UK ESs found an average of 2.2 modifications per project, with 76.9% proposed pre-submission and 75% of major significance, although the majority of modifications related to landscape and visual impacts (Barker and

Wood, 1999). Whilst the sample size in the Barker and Wood (1999) study is too small for a definitive conclusion to be made, it does suggest that time, and perhaps experience, have resulted in an increase in the impact of EIA on project design.

Another issue is the relationship between the ES and the final planning decision. If the content of the ES is considered by CPAs as unimportant in comparison with the other planning application documents and consultation responses, there is a risk that over time the entire EIA process will effectively become a 'tick box exercise'. There has been little recent research in this area but Wood and Jones (1997) found that "the importance of the ES in LPA decision-making varies from substantial to negligible but is often less than that of other material considerations".

Related to this is the impact of the ES on planning conditions and obligations once permission has been granted. A recent study of 40 planning applications found that approximately 50% of the mitigation measures proposed in the ES were not included as conditions or obligations and that "a significant number" of environmental obligations and conditions were not proposed in the ES (Tinker *et al.*, 2005). Whilst there is no requirement for ESs to be the primary source of environmental planning conditions or obligations, it is of concern that many of the mitigation measures proposed in ESs are not being conditioned or obligated to ensure they are implemented.

2.5 Theoretical Background of EIA

All of these previous studies, predominantly conducted in the 1980s and 1990s, investigated the effectiveness of EIA within the remit of its procedures and practical applications and found that EIA effectiveness was not as high as could perhaps be expected. Partly in response to this, more recent research has investigated EIA's theoretical background, particularly with regard to decision-making.

EIA, with its focus on science, objectivity and technical analysis, was a process formed in the 'rationalist' mould, on the implicit understanding that planning decisions were made using the rationalist approach (i.e. objectively and relying on facts) and would therefore improve once impartial information (i.e. the ES) was available (Weston, 2000a). Numerous studies have, however, questioned the legitimacy of assuming that the rationalist approach applies to decisions made during the EIA process or to EIA planning application decisions (e.g. Cashmore, 2004; Jay *et al.*, 2007; Weston, 2010). For example, research has shown that decision-making rarely conforms to the rationalist approach (Nilsson and Dalkmann, 2001) and that improved knowledge does not necessarily improve decision-making (Deelstra *et al.*, 2003). In addition, it has been argued that "Increasingly, practical limitations in the effectiveness of environmental assessment are attributed to its theoretical shortcomings", i.e. that decision-making is "irresolubly political" rather than rational and so the provision of improved information will not necessarily result in improved decision-making.(Cashmore *et al.*, 2008). As a result, it is perhaps not surprising that the ES is accorded so little weight in the decision-making process according to the earlier studies, although CPA concerns about the impartiality of ESs may also have played a role (Gwilliam, 2002; cited within Cashmore *et al.*, 2004).

The issue of EIA theory is an important area for debate, particularly since early research tended to focus on procedural and substantive effectiveness in the absence of a theoretical context. Several attempts have since been made to position EIA within different planning and decision-making theoretical frameworks (e.g. Lawrence, 2000; Weston, 2010). However, theory should not be the only discussion surrounding EIA. Indeed, a 2003 debate in the literature sparked by the suggestion that because of its rationalist basis the "EIA system does not, and probably will not, without radical improvement, offer a tool for sustainable planning" (Benson, 2003) provoked ripostes, such as "project-level EIA has continuing merit" (Bond, 2003), and "damning the tools of EIA and SEA is…eliminating the best opportunity that we have for improving current mechanisms" (de Garis, 2003). In addition, research has also acknowledged the potential importance of EIA in effecting subtle changes in stakeholders' and practitioners' perceptions, for example through indirectly and incrementally "stimulating changes in institutional environmental capacity, politics, values and accountability" (Cashmore *et al.*, 2004). The question, then, is how can EIA (and therefore EcIA) as it is currently used be improved to ensure that it fulfils its potential?

2.6 Need for Research

One potentially important avenue for current research is a return to investigations of the procedural effectiveness of EIA and EcIA (both in terms of the documentary outputs and implementation of mitigation in the final development) to identify changes over time and attempt to determine the causes of those changes. This could allow more effective targeting of future interventions to further improve EIA practice and procedure. In addition, the procedural basis of EIA has in itself become a target for legal action by environmental campaigners and local residents as a means to challenge or halt development (GHK Technopolis, 2008). For example, several cases have now been brought to court, based at least partly on a lack of information in the ES (e.g. , R v Rochdale Metropolitan Borough Council, ex parte Milne, 2000; R (on the application of Blewett) v Derbyshire County Council, 2003; R (on the application of Kent) v First Secretary of State, 2004). As a result, it is important to evaluate aspects of EIA to improve content and performance and reduce legal challenge.

The majority of the studies on procedural and substantive effectiveness of EIA were conducted in the 1990s and a more recent study only considered three examples as case studies (Cashmore *et al.*, 2008). In addition, very few focused explicitly on ecological considerations. Finally, EIA and decision-making do not exist in a vacuum (Cashmore *et al.*, 2004). They will be affected by shifts and changes in environmental policy, legislation and guidance (see Table 7 for a summary of those until 2010), as well as public perception (e.g. UEBT, 2012). At the level of individual EIAs, practice will also differ with the experience of the developer, the consultants and the CPA, as well as the level of participation of the public. As a result, an ES written today for a particular development, such as a motorway, could be very different from one written for the same development but twenty years ago. Indeed, changes have been found in, for example, the practice of determining impact significance in EcIA between 1999 and 2007 (Briggs and Hudson, 2013).

The UK's 2005 ratification of the UNECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (The Aarhus Convention) may also have had an impact on EIA practice and ES content (UNECE, 1998). This Convention establishes public rights with regard to the environment, particularly access to environmental information, participation in decision-making, and access to justice where these two rights have not been respected. This has a particular bearing on EIA: for example, the EIA Directive was amended in 2003, in light of the Aarhus Convention, to ensure public participation in the decision making process. Consequently, the entire EIA process is likely to have come under greater public scrutiny since the introduction of the Convention (e.g. Hartley and Wood, 2005), which may also have had an effect on the content of the ES, and potentially the effectiveness of the EIA process.

Rightly or wrongly, EIA in broadly its current form is here to stay for the foreseeable future. However, there is cause for hope with regard to EIA: "I remain optimistic for EIA and SEA. There is life in the old dog yet, and it can still even be taught a few new tricks" (Sheate, 2003). In the absence of viable alternatives, it is important to analyse and improve the system we have, as well as develop methods to incorporate decision-making theory into EIA practice. As a result, the purpose of this study is to determine the procedural effectiveness of EcIA to reveal improvements in practice over time, identify potential reasons for improvement, and pinpoint areas where improvement is still required.

Table 7: Legislative, Policy and Guidance Changes between 2000 and 2010.

Document Type	Document Title and Reference	Year Issued / Amended	Relevance to EIA / EcIA
EU Legislation	EIA Directive (Council of the European Union, 1985, as amended)	2003	Improved public participation and access to justice.
		2009	Expanded list of projects requiring EIA.
	Birds Directive (European Parliament and Council of the European Union, 2009)	2009	Codification of the Birds Directive (1979), as amended.
UK Legislation	EIA Regulations (HMG, 1999, as amended)	1999	Implemented the EIA Directive and its 1997 amendment.
		2006	Incorporated the 2003 amendment to the EIA Directive.
		2008	For outline EIA applications, additional EIA for reserved matters may be required before full planning permission is granted.
	Habitats Regulations (HMG, 1994, as amended)	2007	Increased protection of European Protected Species (EPS) by removal of certain defences.
		2009	Strengthens European designated site protection.

Document Type	Document Title and Reference	Year Issued / Amended	Relevance to EIA / EcIA
	Habitats Regulations (HMG, 2010)	2010	Consolidated and replaced the Habitats Regulations (1994) and its amendments. Ensured greater compliance with the Habitats Directive (1992).
	Countryside and Rights of Way Act (HMG, 2000)	2000	Increased protection for Sites of Special Scientific Interest (SSSIs) and certain wildlife.
	Natural Environment and Rural Communities Act (HMG, 2006)	2006	Formation of Natural England and strengthening of wildlife and SSSI protection. The Act states that "every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity".
International Policy	Strategic Plan for the Convention on Biological Diversity (CBD Conference of Parties, 2002)	2002	Convention on Biological Diversity agreement to "achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level".
	Plan of Implementation of the World Summit on Sustainable Development (UN, 2002)	2002	Endorsed the CBD's 2002 plan to significantly reduce biodiversity loss by 2010.

Document Type	Document Title and Reference	Year Issued / Amended	Relevance to EIA / EcIA
	Aichi Targets (CBD Conference of Parties, 2010a)	2010	Convention on Biological Diversity agreement to reduce biodiversity loss to certain levels by either 2015 or 2020, depending on the individual target.
EU Policy	Gothenburg agreement (Commission of the European Communities, 2001)	2001	EU agreement to halt the loss of biodiversity by 2010 and adoption of a Sustainable Development Strategy.
	Sixth Environment Action Programme (European Parliament and Council of the European Union, 2002)	2002	Endorsed the Gothenburg agreement to halt "biodiversity decline with the aim to reach this objective by 2010". Focused on "conservation" and/or "appropriate restoration" of natural areas, species and habitats.
	Biodiversity communication (Commission of the European Communities, 2006)	2006	Highlighted the importance of biodiversity as part of sustainable development, and set out a detailed EU Biodiversity Action Plan.
	Renewed EU Sustainable Development Strategy (Council of the European Union, 2006)	2006	Reiterated commitment to halt biodiversity loss by 2010 and references the EU's Biodiversity Strategy as one of the means to achieve this.
	Review of the European Union Strategy for Sustainable Development (Commission of the European Communities, 2009b)	2009	Stated that "the destruction of biodiversity is continuing at a worrying rate" and recommended "intensifying environmental efforts for the protection of biodiversity, water and other natural resources".

Document Type	Document Title and Reference	Year Issued / Amended	Relevance to EIA / EcIA
UK Policy	Planning Policy Statement 9 (ODPM, 2005c)	2005	Outlined government objectives to promote sustainable development, and conserve, enhance and restore biodiversity in England.
Guidance	Guidelines for Ecological Impact Assessment in the United Kingdom (IEEM, 2006)	2006	The first dedicated EcIA guidance available for practitioners, Competent Planning Authorities (CPAs), developers and others involved with EcIA.

2.7 Changes in Legislation and Policy since 2011

By necessity, this research has an ‘historical’ dimension in order to be practicable. For the EcIA chapter review, EIA needs to have been conducted and planning permission granted, whilst for the on-site mitigation assessment, the development also needs to have been completed. As a result, this section provides a synopsis of recent changes that have the potential to influence future EIA and EcIA practice. This section is split into two parts, considering the recent changes to environmental policy and legislation.

2.7.1 Policy

In 2001, the EU agreed to halt biodiversity loss within the EU by 2010 (Commission of the European Communities, 2001). This target was also included within the EU’s Sixth Environmental Action Programme (European Parliament and Council of the European Union, 2002), and in 2002 the EU were also signatories to a target of significantly reducing global biodiversity loss (CBD Conference of Parties, 2002). However, in 2010 it was globally acknowledged that these targets had not been met and that rates of biodiversity loss were in fact increasing (Butchart *et al.*, 2010). As a result, new commitments were made to halt biodiversity loss within the EU by 2020 (European Union Council, 2010) and to significantly reduce global biodiversity loss by 2020 (CBD Conference of Parties, 2010a).

In response to these commitments, the global community, the EU and England introduced biodiversity strategies to 2020 (CBD Conference of Parties, 2010a; European Commission, 2011; Defra, 2011a) with the aim to “take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services”. The publication of the Lawton Report (Lawton *et al.*, 2010) and the National Ecosystem Assessment (UK National Ecosystem Assessment, 2011), highlighting the fragile state of biodiversity and ecosystem services in the UK, helped influence the UK government’s first White Paper on the natural environment in over 20 years, focusing on net biodiversity gain rather than simply halting biodiversity loss (Defra, 2011b). The National Planning Policy Framework echoed this by requiring the planning system to achieve net gains in biodiversity, despite a "presumption in favour of sustainable development" (DCLG, 2012a). Both the White Paper and England's Biodiversity Strategy were well received by nature conservation NGOs (Wildlife and Countryside Link, 2012). The UK also no longer operates the UK Biodiversity Action Plan (UK BAP) system. Instead, individual countries operate their own BAP systems and the UK has agreed a Biodiversity Framework of shared purposes and priorities to achieve the UK's CBD commitment (Four Countries' Biodiversity Group, 2012).

The publication of the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment, 2005), the National Ecosystem Assessment (UK National Ecosystem Assessment, 2011), and The Economics of Ecosystems and Biodiversity (TEEB, 2010a) reports has resulted in a major shift in focus. There is now a recognition that the economic value of the benefits provided by biodiversity and ecosystems needs to be taken into account in decision-making to ensure at least no net loss of biodiversity. As a result, considerable research is currently underway in an attempt to fully capture the value of biodiversity and ecosystem services (e.g. NERC, 2011).

In theory, the high profile of recent biodiversity policy and the publicity associated with the UN's global decade (2011-2020) on biodiversity (CBD Conference of Parties, 2010b) should improve awareness of the importance of biodiversity by decision-makers and the public (including developers), potentially improving future EcIA practice. However, there have been concerns raised about the implementation of the recommendations laid out within the White Paper, particularly in terms of integrating the environment into policy (e.g. economic and transport policy) and achieving cross-government support (Environment Food and Rural Affairs Committee, 2012; Wildlife and Countryside Link, 2012). There is, therefore, an urgent need for mainstreaming the environment and biodiversity in national policies, strategies, action plans and every day decision-making (UNEP and CBD, 2008).

2.7.2 Legislation

Two main groups of legislation are considered under this section: environmental and wildlife legislation.

Wildlife and Nature Conservation

In 2010, the Habitats Regulations were consolidated to include the multiple amendments that had been made to the 1994 Regulations, with the intention of enhancing their ease of use (HMG, 2010). These were subsequently amended (HMG, 2012) to more clearly represent the EU's Habitats Directive (Council of the European Union, 1992). Whilst these consolidations and amendments are needed, a more comprehensive approach is being proposed. The Law Commission (2012) recently closed its consultation into its review of wildlife law. The aim of the review is to rationalise, consolidate and simplify existing wildlife legislation and a draft Bill is expected to be produced in 2014. This could result in more streamlined legislation that is of greater utility to EcIA practitioners and offers more comprehensive protection to flora, fauna and designated sites.

Environmental Impact Assessment

In 2011, the EIA Regulations were consolidated and additionally require the Secretary of State to review the extent to which the objectives of the Regulations are met every five years. In theory, this could potentially result in improved data collection (e.g. a national database of submitted ESs and their planning outcomes), in order to facilitate this review.

A proposal has also been made to amend the EIA Directive (European Commission, 2012), which has been passed to the European Parliament and the Council. If successful, the amended EIA Directive will likely enter into force in March 2014. Interestingly, the proposal states that "the ability to make valid decisions on the environmental impact of a project depends – to a large extent – on the quality of the information used in the EIA documentation and the quality of the EIA process". The EU, therefore, considers decision-making as conforming to the rationalist model. Yet the assumption that better information will result in better decision-making "flies in the face of what a century of social science has told us about how decision making and policy making occur in virtually all instances" (Bartlett and Kurian, 1999). Decision-makers are not, after all, computers able to process large quantities of complex information impartially. Whilst focusing on improvements in EIA practice and procedure is of considerable importance and requiring continuing research (see Chapter 1), this should not be at the expense of considering how EIA could be better integrated with decision-making at the EU, national and local levels.

The proposal includes four main amendments that will impact on EcIA. The first is located within the preamble to the EIA Directive. For the first time, EIA is linked to specific EU environmental targets:

> "(7)…This prior assessment of impacts should contribute to attaining the Union headline target adopted on 2010 of halting biodiversity loss and the degradation of ecosystem services by 2020 and restoring them where feasible.
> (8) The measures taken to avoid, reduce and, if possible, offset significant adverse effects on the environment should contribute to avoiding any deterioration in the quality of the environment and any net loss of biodiversity, in accordance with the Union's commitments in the context of the Convention and the objectives and actions of the Union Biodiversity Strategy up to 2020".

The second important amendment is the specific inclusion of the terms 'biodiversity' and 'climate change' within the EIA Directive. This will both raise the profile of EcIA, which was previously considered as an under-resourced discipline within EIA (Treweek, 1996), and likely improve the currently poor consideration of climate change in EcIA chapters and more generally in ESs (see Chapter 5).

The third important amendment is the introduction of mandatory quality control of EIA information under Article 5:

> "To guarantee the completeness and sufficient quality of the environmental reports…:
> the developer shall ensure that the environmental report is prepared by accredited and technically competent experts or
> the competent authority shall ensure that the environmental report is verified by accredited and technically competent experts and/or committees of national experts.
> …The detailed arrangements for the use and selection of accredited and technically competent experts (for example qualifications required, assignment of evaluation, licensing, and disqualification), shall be determined by the Member States."

Whilst representing an improvement over the current EIA Directive, where formal review is not statutorily required and is infrequently conducted, this amendment is weakened by the use of the word "or". Ideally, the EIA should be carried out and the ES written by competent experts but *also* reviewed. This is particularly important since there is currently no disconnect between developers and consultants in the planning process, which increases the risk of pressure being placed on consultants to modify their findings and/or recommendations. Nevertheless there is potential for this to change into the future, and the emphasis on "accredited and technically competent experts" represents an opportunity for IEEM to initiate an accreditation scheme with a mandatory EcIA training component (see Section 6.5.1 for further discussion of this proposal).

The fourth important amendment is the proposal for mandatory post-construction monitoring in Article 8:

> "If the competent authority decides to grant development consent, it shall ensure that the development consent includes measures to monitor the significant adverse environmental effects, in order to assess the implementation and the expected effectiveness of mitigation and compensation measures, and to identify any unforeseeable adverse effects.
> The type of parameters to be monitored and the duration of the monitoring shall be proportionate to the nature, location and size of the proposed project and the significance of its environmental effects."

This is a considerable improvement over the current EIA process, particularly in terms of raising awareness of follow-up amongst CPAs and developers. However, there is no requirement for a mandatory mitigation implementation audit for all EIA projects. In addition, current EcIA practice makes it difficult to identify whether "significant adverse" effects will result from a proposed development. Given the lack of mandatory ES review if the authors are accredited and technically competent, it is also possible that developer pressure may result in less precautionary assessments of ecological impacts that would fail to trigger the requirement for monitoring. Finally, the amendment does not include a requirement for monitoring to feedback into management, or for the results of monitoring to be publicly available.

The proposed amendments to the EIA Directive, therefore, are a step in the right direction, in that they help to close some of the gaps in the current EIA process.

However, improvements can still be made, such as mandatory review of all ESs, mandatory audits of mitigation implementation, requirements for monitoring to feedback into management, and for monitoring results to be publicly available. However, given the UK's past history of directly transposing the EIA Directive with few modifications, it is considered unlikely that such recommendations will be included in domestic legislation unless they are included in the EIA Directive.

CHAPTER 3: Research Strategy and Methodology

3.1 Approaches to EIA Research

Quantitative methodologies are embedded within a positivist approach to research that seeks to determine the causes of changes in objectively observed facts, ensuring that results are replicable and can be generalised (Bryman, 1984). It is often described as 'positivist' and ‘empiricist’. Positivism asserts that sensory experience that can be verified is genuine knowledge (Patton, 2002). In contrast, qualitative methodologies are based on a phenomenological epistemology, or theory of knowledge, to understand phenomena from the view of the actor(s) involved and with an emphasis on context. It is often described as 'interpretivist' and 'constructivist' (Bryman, 1984; Firestone, 1987). Each methodology has its advantages and disadvantages and is traditionally associated with particular research methods and techniques. For example, qualitative research may include techniques such as interviews and case study research, which may be more affected by researcher bias (Johnson and Onwuegbuzie, 2004). However, it should be noted that quantitative methodology is not entirely free from researcher bias and subjectivity, for example in the choice of research topic.

The field of EIA research is characterised by the use of a mix of research methods and techniques (e.g. Jones *et al.*, 1998; Barker and Wood, 1999). Importantly, the data generated from many research methods, such as surveys and interviews, can be analysed both quantitatively and qualitatively. Whilst research methods traditionally associated with the quantitative approach are more likely to be analysed quantitatively than those traditionally associated with the qualitative approach, there exists a continuum (Firestone, 1987). As a result, a specific distinction between quantitative and qualitative research methods (as opposed to methodologies) is not considered to be helpful (Bryman, 1984). In addition, it is now recognised that triangulation, i.e. observing something from several different perspectives, can improve accuracy and can provide a deeper understanding than when approaches are used in isolation (Neuman, 2006). Triangulation can extend to include both quantitative and qualitative data analysis, to enrich understanding and provide context. However, it should be noted that triangulation does not compensate for a flawed study and findings can be challenging to replicate (Jick, 1979).

The debate on which methodological perspective (as opposed to methods) is preferable is an interesting parallel to the debate on EIA theory (Cashmore, 2004). The positivist approach, on which quantitative methodology is based, is closely related to rationalist decision-making theory (Weston, 2010). As a result, quantitative methodology and rationalist decision-making theory are subject to similar criticisms, such as being reductionist and determinist. Rationalist decision-making theory in the context of EIA is therefore criticised, for example, for overestimating the ability to predict and control the environment and failing to consider the complex context of planning, such as its collective and political nature (Lawrence, 2000). In contrast, the phenomenological approach is related to more constructivist decision-making theories, such as incrementalism, in which discourse and persuasion affect outcomes and decisions build on the status quo (Lawrence, 2000; Lewis, 2003).

Like planning, EIA is both 'science' and 'art', at least when these terms are considered from the positivist perspective (Kennedy, 1988): both draw on knowledge from the natural and the social sciences (Ferreira *et al.*, 2009). There is growing consensus in the literature that decision-making within the context of EIA (e.g. scoping and screening decisions), as well as the 'science' in EIA, are not made in a purely rational context (e.g. Weston, 2000a; Cashmore *et al.*, 2008). This would seem to argue in favour of the use of qualitative methodology and data analysis. However, the benefits of triangulation (Johnson and Onwuegbuzie, 2004) suggest that quantitative data analysis can also play an important role in EIA research.

Given the benefits of being systematic, replicable and generalisable, this study intends to develop and apply quantitative methodologies, both for reviewing the quality of EcIA chapters and assessing mitigation implementation and effectiveness. This would address some of the shortcomings identified in earlier review packages (see Section 2.2) and address a research gap (see Section 2.3). However, given the benefits of triangulation, both quantitative and qualitative data analysis are used in this study, although quantitative data analysis predominates as this appears to be an area most in need of further exploration (see Sections 3.1.1 and 3.1.2).

The first half of this study (i.e. the review of EcIA chapters) uses a quantitative approach (document analysis to provide quantitative data) and quantitative data analysis to determine changes over time and identify predictors of those changes. A complementary approach, which could be the subject of further research, would have been the use of surveys or interviews of long-serving EcIA practitioners to examine the same points (e.g. Matrunola, 2007). However, in this case, the aim was to generate a large sample size to facilitate statistical analysis. This would provide insights that might be generalisable across English EcIA practice. The use of case study work would have provided greater depth of knowledge, but only for a limited number of (potentially unrepresentative) examples. There would also have been considerable difficulty in tracing the practitioners involved, and practitioners may have been wary of speaking about specific cases for fear of recrimination and/or confidentiality. In addition, practitioner recall may not accurately reflect the actual dynamics or circumstances of the case. These issues would be worth exploration in greater depth in future, potentially using qualitative case study and/or interview methods.

The second half of this study (i.e. the assessment of on-site ecological mitigation) uses both quantitative data analysis and selected qualitative illustrations from case studies. A more formal (and consequently more time-intensive) qualitative approach to this element of the research could also have been conducted: further research could include interviews with the main stakeholders (developers, consultants, planning officers, consultees and the neighbouring public) in order to identify views on the success or otherwise of ecological mitigation measures (e.g. Wood *et al.*, 2000).

Interestingly, quantitative analysis in EIA research tends to be limited to descriptive statistics, such as percentages and averages. For example, there are very few studies of ESs, and none of UK EcIA chapters, that extend quantitative data analysis to include inferential statistics. To determine whether this is a legitimate research gap, the reasons why inferential statistics tend not to be used in EIA research must first be explored.

3.1.1 Checklist-based Reviews of ESs and EcIA Chapters

The lack of inferential statistics in the literature on this topic is partly due to the subjective nature of ES research. For example, whether an ES is deemed to have met particular criteria in checklist-based reviews often depends on the reviewer (Põder and Lukki, 2011). This holds true for both checklist-based reviews of ES quality and thematic research, making changes over time difficult to establish.

Another issue applicable to both ES quality and thematic research into ESs using checklist-based reviews is that each ES is subject to a different array of constraints and contexts (such as the likely controversy of the proposed development and the development type), making comparisons between ESs and assessments of changes over time less reliable. One way to overcome this problem is to use matched pairs of ESs (i.e. each ES assigned to one time period is 'matched' to an ES in another time period by development type, development size, etc.), as demonstrated by Glasson *et al*. (1997). Another method is to ensure the sample size (i.e. the number of ESs reviewed) is large (e.g. Ryan, 2013, p. 298).

In addition to these problems, different checklist-based reviews of ES quality may have omitted or included different assessment criteria depending on their relevance to the ESs, which may not be apparent when only aggregated scores are reported (Põder and Lukki, 2011). This makes comparisons between ESs more challenging.

The use of the results of previous thematic reviews of EcIA chapters to quantitatively examine changes over time also presents several difficulties. For example, some of the assessment criteria may have been slightly different in different reviews, making comparisons difficult (see Section 5.2.1 for further detail). Finally, previous reviews may have expressed their findings as percentages of EcIA chapters. If these are expressed to one or fewer decimal places, determining the actual number of EcIA chapters may be less accurate (e.g. 14.8% of 37 EcIA chapters could be either 5 or 6 EcIA chapters, depending on the rounding method used. All of these issues make the use of inferential statistics more challenging.

However, whilst another analysis of EcIA chapters using purely descriptive statistics would be timely given the decade since the last review, it would miss an important opportunity. That opportunity is the secondary analysis of results from the earlier reviews in order to address the new question of whether there have been changes over time. There are, as described above, several issues with statistically comparing the results of previous reviews. However, whilst simple comparisons of percentages across reviews may be illustrative, a statistical analysis across reviews (whilst making attempts to minimise, and clearly stating, the limitations of such an approach) may prove more informative: “Secondary analyses of data can provide substantive and methodological anchors with the past and speedier routes to the future” (Burstein, 1978). In conclusion, with regard to checklist-based reviews of ESs and EcIA chapters, there does seem to be a legitimate research gap in the use of inferential statistics.

Detailed descriptions of the methods used in this study to review EcIA chapters can be found in Sections 4.2 , 5.2 and 6.2 .

3.1.2 The Completed Development

There have been relatively few studies of either mitigation implementation or effectiveness in EIA, let alone EcIA (see Sections 2.3.3 and 2.3.4). Yet almost all used descriptive rather than inferential statistics.

Mitigation Implementation

One of the most comprehensive studies of mitigation implementation states that “establishing causality is very difficult, especially if there are cases where several factors are intertwined” (Frost, 1997b). This is where qualitative data analysis can be particularly useful. However, quantitative data analysis can also play an important role in teasing out the relative importance of variables and even identifying unexpected relationships, which can then be explored qualitatively. In the context of EIA and the difficulty of obtaining large numbers of case studies of completed developments, as well as the difficulties of comparing results across very different sites, the use of inferential statistics should be viewed with caution. Nevertheless, it is considered by the author important to attempt this in an effort to expand the research field into potentially rich areas of enquiry.

Mitigation Effectiveness

Very few studies of mitigation effectiveness use inferential statistics. This is again likely due to the complexity of factors involved in effectiveness. The preferences or culture that individual researchers hold may also play a role. Notable exceptions are the case of compensatory wetland creation in the USA (e.g. Spieles *et al.*, 2006; Matthews and Endress, 2008). Such studies included a range of different statistical analyses, such as ANOVA to determine whether success in meeting goals was related to the status of the wetland, and linear regression to determine whether species richness was correlated with the number of species planted (Matthews and Endress, 2008). There is therefore a precedent for using inferential statistics in assessing mitigation effectiveness. However, there has as yet been no research conducted investigating the relationship between mitigation effectiveness and EIA procedural factors (e.g. ES quality and follow-up) using inferential statistics. The potential benefits of utilising quantitative methods in future EcIA research are considered to be sufficiently high to warrant this first effort.

Detailed descriptions of the methods used in this study to determine on-site ecological mitigation measure implementation and effectiveness can be found in Sections 7.2 , 8.2 and 9.2 .

3.2 Summary of Aims and Objectives

As outlined in Section 1.4, this study comprises two main strands; EcIA chapter review and on-site ecological mitigation assessment. Each of these two strands is further split into two. The EcIA chapter review comprises first a review of changes over time in EcIA chapter content using the results of previous thematic reviews, and second the identification of factors that play a role in determining EcIA chapter content and quality. The on-site ecological mitigation assessment comprises first the identification of mitigation implementation, and second the determination of mitigation effectiveness. Each of the four results chapters in this thesis has its own aims and objectives, which are stated in the relevant chapter for ease of reference. However, these aims and objectives are summarised here to provide an overview of how each chapter fits into the overarching aims and objectives (Table 8).

Table 8: Summary of thesis aims and objectives.

Chapter	Aims	Objectives
Chapter 1 (overview)	To identify the features in the planning system and EcIA process that have the potential to result in the failure of completed EIA developments to achieve no net loss of biodiversity, and how they can be modified to achieve net gain of biodiversity.	Conduct a review of EcIA chapters (Chapters 5 and 6).
		Conduct surveys of completed EIA development sites (Chapters 8 and 9).
Chapter 4	Take advantage of the benefits of two EcIA chapter checklist review systems; that of a simple checklist with thematic comparisons and that of using a checklist to derive a grade or score.	Conduct an EcIA chapter review in the style of the six previous published reviews, including thematic comparisons where possible (Chapter 5).
		Develop an aggregated grade or score, as a proxy for EcIA chapter quality to allow further analysis of the determinants of good or poor quality EcIA chapters (Chapter 6).
Chapter 5	Determine whether changes in environmental awareness, legislation, policy, and guidance since the last EcIA chapter review in 2000 have resulted in improvements in EcIA chapter thematic information provision.	Establish whether there have been improvements in EcIA chapter thematic information provision over time, by comparing the results of the current review with those found in earlier EcIA chapter reviews.
		Identify whether the recommendations made in previous studies for the improvement of EcIA chapters have been implemented.
		Discuss potential future interventions that might be required to ensure the

Chapter	Aims	Objectives
		submission of high quality EcIA chapters.
Chapter 6	Provide a scoring tool (the BAI calculation) to analyse overall EcIA chapter information content.	Identify those variables most closely associated with 'good' or 'inadequate' EcIA chapter quality scores.
		Determine whether the introduction of the EcIA Guidelines has resulted in improvements in EcIA chapter quality scores (in terms of both legal and recommended information requirements).
Chapter 7	Investigate the factors involved in successful ecological mitigation measures on case study sites.	Investigate ecological mitigation measure implementation in completed EIA developments (Chapter 8).
		Investigate ecological mitigation measure effectiveness in completed EIA developments (Chapter 9).
Chapter 8	Empirically investigate the implementation of ecological mitigation measures in completed EIA developments.	Identify the variables affecting implementation rates.
Chapter 9	Determine the effectiveness of habitat mitigation measure implementation, as well as identifying factors affecting this.	Identify whether there is a link between poor habitat mitigation effectiveness and poor EcIA chapter quality, as identified by the Guidance and Legislation BAIs.
		Identify whether there is a link between the effectiveness of ecological mitigation measures and the implementation of ecological follow-up programmes.

PART 2: ECOLOGICAL IMPACT ASSESSMENT REVIEW

CHAPTER 4: Overview

4.1 Aims and Objectives

This study aims to take advantage of the benefits of both review systems; that of a simple checklist with thematic comparisons and that of using a checklist to derive a grade or score. As a result, the main objectives of this part of the thesis are to:

- conduct an EcIA chapter review in the style of the six previous published reviews, including thematic comparisons where possible (Chapter 5); and
- develop an aggregated grade or score, as a proxy for EcIA chapter quality to allow further analysis of the determinants of good or poor quality EcIA chapters (Chapter 6).

4.2 Method

4.2.1 Ecological Impact Assessment Chapter Selection

As there is no central library of ESs, they and their attendant documentation (including the decision notice, and any appendices, supplementary documents or S106 agreements) were obtained from a variety of sources. These comprised the Oxford Brookes University Planning Department's Resources Centre, CPA websites, internet searches and environmental consultancies. This was aided by information in the Institute of Environmental Management and Assessment's (IEMA) library catalogue, which includes titles of ESs submitted by their members that could then be investigated further using the sources outlined above.

In order to ensure that only the current status of the planning system as a whole (as opposed to, for example, simply flaws in the approach used by ecological consultants) was investigated, this review was restricted to ESs for developments that were granted planning permission. ESs for developments for which appeals against refusal or non-determination were upheld were also included. In both cases, the ESs will have been reviewed by the CPA and consultees (statutory and non-statutory), and deemed as providing an acceptable level of information about the potential environmental impacts of the proposed development on which to base a decision. The decision status was determined either by consulting the CPA website, or by contacting the CPA directly where this information was not available online.

To avoid any potential for including ESs that had been analysed in the previous reviews, a submission year of 2000 was used as the earliest from which the sample could be drawn. Since 1998, devolution has created subtle differences in the legislative, policy and guidance framework for EcIA in England, Wales, Scotland and Northern Ireland, presenting difficulties in direct EcIA comparison (UKELA *et al.*, 2012). As a result, only ESs for developments within England were included. Aside from these three criteria, no further restrictions were made (see Table 9 for a summary).

Table 9. Criteria for the selection of EcIA planning applications for review.

Criterion	Restriction
Technical Chapters	Ecology
Country	England
Submission Date Range	2000-2011
Planning Decision	Permission granted*
Competent Authority Level	Any
Development Sector	Any†

* This includes applications for which appeals against refusal or non-determination were upheld.

†This includes any development listed in either Annex 1 or Annex 2 of the EIA Directive (Council of the European Union, 1985, as amended).

A total of 112 EIA planning applications matching the criteria outlined in Table 9 were obtained, together with as much of their planning documentation as possible. Several other suitable applications were identified, but where the CPA made a charge for information provision (such as the decision notice or S106 Agreement), these applications were discarded.

It is not possible to determine how representative this sample is of the ESs submitted and granted planning permission across England during that time period, due to the lack of a centralised EIA planning application database.

However, an earlier study noted that a sample size of 100 ESs was sufficient from which to draw meaningful conclusions (DETR, 1997). Given the wide variety of sources from which ESs in this study were obtained, it is assumed that a sample of 112 can be considered to be representative. Their details can be found in Appendix 5.1.

CHAPTER 5: Thematic EcIA Chapter Review

5.1 Aims and Objectives

There have been considerable changes in environmental awareness, legislation, policy, and guidance since the last EcIA chapter review in 2000 (see Table 7). The aim of this new EcIA chapter review is to determine whether these changes have resulted in improvements in EcIA chapter information provision. The objectives of this chapter are therefore to:

- establish whether there have been improvements in EcIA chapter information provision over time, by comparing the results of the current review with those found in earlier EcIA chapter reviews;
- identify whether the recommendations made in previous studies for the improvement of EcIA chapters have been implemented; and
- discuss potential future interventions that might be required to ensure the submission of high quality EcIA chapters.

5.2 Method

5.2.1 Data Collection

A literature review was conducted, which included previous published and unpublished reviews of EcIA chapters and ESs, IEEM's EcIA Guidelines (IEEM, 2006), EIA guidance documents, and EU and UK EIA legislation. From these documents, a series of questions was derived that represented a list of the information that each EcIA chapter should ideally contain. Several of the questions involved examining not only the EcIA chapter, but the front-end and concluding chapters of the ES, the EcIA chapter's technical appendices and figures, the Non-Technical Summary (NTS), the decision notice and any Section 106 Agreements.

Wherever possible, questions (and the range of possible answers to each question) were phrased such that the results would be directly comparable to those found in the earlier reviews. To aid analysis, the range of possible answers to each question in the list was identified and standardised. For example, the majority of questions could be answered from amongst the following range of possible answers; ‘Yes’, ‘No’, ‘Partly/Some’, ‘Unknown’ and ‘N/A’ (Not Applicable). Modifications were made where necessary. The inclusion of comments at intervals in the list of questions allowed qualitative information about the EcIA chapters to be gathered.

Data from each EcIA chapter were entered directly into a Microsoft Excel (2010) spreadsheet in rows. As EcIA chapters were reviewed, it became necessary to add, remove or modify questions. For additions and modifications, the EcIA chapters already reviewed were again examined for this information. In total, the spreadsheet included 459 question and comments columns.

For those questions that had been asked in previous reviews, the answers were compared to provide an indication of trends over time in the inclusion of EcIA chapter information.

5.2.2 Data Analysis

Assumptions

In the majority of the earlier studies, the reviewed ESs were not named (Treweek and Thompson, 1997; RSPB, 1995; Thompson *et al.*, 1997; Spellerberg and Minshull, 1992), and so whilst an assumption is made regarding independence in the data analysis, this may not necessarily be the case. Assumptions are also made that the current review’s restriction to English ESs, and previous reviews’ restrictions to ESs for particular development types, will not affect the analysis.

Statistical Tests

To compare EcIA chapter frequencies in certain categories (e.g. whether or not development size had been stated) across multiple studies, the Pearson chi square test was used. In order to ensure accuracy, the exact two-tailed P-value of the Pearson chi square test was calculated. This also enabled tests to be performed where expected cell counts were below five or where observed counts were zero (Mehta and Patel, 2010).

All analyses were carried out using SPSS (IBM SPSS Statistics 19). Unless otherwise stated, standard error and confidence intervals were too small to visualise and therefore omitted from charts.

5.2.3 Within Current Review Replicability Study

Commonly, existing ES review packages recommend that the ES reviews are conducted by more than one person, to reduce the effect of personal subjectivity (e.g. Lee *et al.*, 1999). However, given the length of time required for each review, several studies have involved ES review by only one person (e.g. McGrath and Bond, 1997; Canelas *et al.*, 2005), with a sample of the reviewed ESs being re-reviewed and the results compared. This approach is followed in the current review replicability study.

To determine the replicability of the current review, the first five EcIA chapters were re-reviewed using a separate spreadsheet, excluding qualitative questions, comments and questions regarding the decision notice and S106 Agreements. This resulted in each replicability analysis asking 372 of the 459 questions. Due to the questions and answers being refined over time as the review progressed, it was considered that the first EcIA chapters analysed would be the most likely to suffer from low replicability of the analysis. As a result it was these, rather than a random sample, that were chosen for the replicability study. Due to the time required for re-analysis, the study was limited to the first five EcIA chapters. Re-reviewed answers that matched the original answers for each EcIA chapter were coded as 'Same', whilst differences were coded as 'Different'. The totals for both 'Same' and 'Different' categories were calculated for each EcIA chapter. To determine whether the level of replicability was acceptable, the alternative (one-tailed) hypothesis that the proportion of 'Same' answers is greater than 95% was tested. A one-sample binomial test procedure in SPSS was conducted for each re-reviewed EcIA chapter. This non-parametric test can test a proportion against a given value, in this case the actual proportion of 'Same' answers against the hypothesised value of 95% 'Same' answers.

5.3 Results and Discussion

5.3.1 Replicability Study

A summary of the results of the repeat analysis of the first five EcIA chapters using 372 of the 459 questions can be found in Table 10 below. Detailed results can be found in Appendix 5.2.

Table 10: Summary of the replicability analysis of the first five EcIA chapters.

EcIA Chapter Number	Number of questions answered the same	Number of questions answered differently	Total number of questions	Percentage different (%)	One-sample binomial test one-tailed p-value
1	362	10	372	2.76	0.020
2	361	11	372	3.05	0.038
3	363	9	372	2.48	0.010
4	364	8	372	2.20	0.004
5	361	11	372	3.05	0.038

The null hypothesis that the proportion of 'Same' answers is equal to 95% can be rejected in favour of the alternative hypothesis that the proportion of 'Same' answers is greater than 95%. The study therefore shows high replicability of EcIA chapter analysis.

5.3.2 Summary of Changes over Time

The current study was restricted to ESs for developments that were granted planning permission (see Section 4.2.1). As a result, all of the EcIA chapters in the current study should have undergone some form of review by the CPA, and the statutory and non-statutory consultees. Any flaws identified in these EcIA chapters have therefore not been picked up by the planning system. The lack of improvement over time within many of the themes explored (e.g. baseline data collection, impact assessment, etc.) therefore reflects the deficiencies of the planning system in both identifying flaws and providing feedback to consultants. A summary of the changes over time in EcIA chapter information provision can be found in Table 11. Further detail of these results can be found in Sections 5.3.3 to 5.3.13.

Table 11: Summary of the changes observed over time in comparison with earlier EcIA chapter reviews.

Section Heading	**Section Number**	**Question**	**Comparison Study**						**Current Review: significant changes over time?**	**Current Review: direction of change**
			Spellerberg & Minshull 1992	**Treweek *et al.* 1993**	**RSPB 1995**	**Thompson *et al.* 1997**	**Treweek & Thompson 1997**	**Byron *et al.* 2000**		
General	5.3.3	Ecological consultancy involved in EcIA?	×	×	×	✓	×	×	✓	+
Baseline – Desk Study	5.3.4	Development size stated?	×	✓	×	✓	×	✓	✓	+
Baseline – Desk Study	5.3.4	Linear development length stated?	×	✓	×	✓	×	✓	✓	+
Baseline – Desk Study	5.3.4	Ecological consultation conducted?	×	×	×	✓	×	×	×	N/A
Baseline – Desk Study	5.3.4	Natural England (or equivalent) consulted?	×	×	×	✓	×	✓	✓	⁄
Baseline – Desk Study	5.3.4	Wildlife Trust consulted?	✓	×	×	✓	×	✓	✓	⁄
Baseline – Surveys	5.3.5	New ecology surveys conducted?	✓	✓	×	✓	×	✓	✓	+
Baseline – Surveys	5.3.5	Ecologists named?	×	×	×	×	×	✓	×	N/A

Section Heading	Section Number	Question	Comparison Study						Current Review: significant changes over time?	Current Review: direction of change
			Spellerberg & Minshull 1992	Treweek *et al.* 1993	RSPB 1995	Thompson *et al.* 1997	Treweek & Thompson 1997	Byron *et al.* 2000		
Baseline – Surveys	5.3.5	Provision of survey methodologies	×	×	×	×	×	✓	×	N/A
Baseline – Surveys	5.3.5	Quantitative survey results present?	×	✓	×	×	×	✓	✓	+
Baseline – Surveys	5.3.5	Surveys conducted over more than one year?	×	×	✓	×	×	×	✓	+
Baseline – Surveys	5.3.5	Fauna surveys conducted?	×	×	×	✓	×	×	✓	+
Evaluation	5.3.6	Geographic context of habitats stated?	×	×	×	×	×	✓	✓	+
Impact Assessment - Approach	5.3.7	Ecological impacts considered?	×	✓	×	×	✓	✓	✓	+
Impact Assessment - Approach	5.3.7	Assessment method stated?	×	×	✓	×	×	×	✓	+
Impact Assessment -	5.3.7	At least one impact quantified?	×	✓	×	✓	×	✓	✓	+

Section Heading	Section Number	Question	Comparison Study: Spellerberg & Minshull 1992	Treweek *et al.* 1993	RSPB 1995	Thompson *et al.* 1997	Treweek & Thompson 1997	Byron *et al.* 2000	Current Review: significant changes over time?	Current Review: direction of change
Approach										
Impact Assessment - Approach	5.3.7	Land take quantified?	×	×	×	×	×	✓	✓	-
Impact Assessment - Approach	5.3.7	Area of habitat types to be lost quantified?	×	×	×	×	×	✓	✓	+
Impact Assessment - Approach	5.3.7	Other ecological impacts quantified?	×	×	×	×	×	✓	✓	+
Impact Assessment - Approach	5.3.7	Duration of ecological impacts stated?	×	×	×	✓	×	×	✓	+
Impact Assessment -	5.3.7	Impacts stated as being direct or indirect?	×	×	×	✓	×	✓	✓	+

Section Heading	Section Number	Question	Comparison Study: Spellerberg & Minshull 1992	Treweek *et al.* 1993	RSPB 1995	Thompson *et al.* 1997	Treweek & Thompson 1997	Byron *et al.* 2000	Current Review: significant changes over time?	Current Review: direction of change
Approach										
Impact Assessment - Approach	5.3.7	'Do nothing' scenario considered?	×	×	✓	×	×	×	×	N/A
Mitigation Approach	5.3.9	Mitigation descriptions included?	×	✓	×	✓	✓	✓	✓	+
Mitigation Approach	5.3.9	Detailed mitigation descriptions provided?	×	✓	×	✓	×	✓	✓	+
Mitigation Approach	5.3.9	Likely success of mitigation measures stated?	×	✓	×	✓	✓	✓	✓	+
Mitigation Approach	5.3.9	Time required for mitigation effectiveness stated?	×	×	×	×	✓	×	✓	+
Mitigation Approach	5.3.9	Modifications for unsuccessful mitigation proposed?	×	✓	×	✓	✓	×	×	N/A

Section Heading	Section Number	Question	Comparison Study						Current Review: significant changes over time?	Current Review: direction of change
			Spellerberg & Minshull 1992	Treweek *et al*. 1993	RSPB 1995	Thompson *et al*. 1997	Treweek & Thompson 1997	Byron *et al*. 2000		
Mitigation Approach	5.3.9	Commitment to mitigation indicated?	✗	✗	✓	✗	✗	✗	✓	+
Follow-up	5.3.11	References to follow-up made?	✓	✓	✓	✓	✓	✓	✓	+
Follow-up	5.3.11	Commitment to any follow-up made?	✗	✓	✓	✓	✓	✓	✓	+
Follow-up	5.3.11	Follow-up programme provided?	✗	✓	✓	✗	✗	✗	✗	N/A
Presentation	5.3.13	Designated sites maps included?	✗	✗	✗	✗	✗	✓	✗	N/A
Presentation	5.3.13	Phase 1 habitat map included?	✗	✗	✗	✗	✗	✓	✓	+

LEGEND

✓ = yes, ✗ = no

+ = improvement over time, - = deterioration over time, / = no clear trend,

N/A = not applicable

Of the 33 direct comparisons with previous reviews, 26 (78.8%) showed significant changes over time. The lack of a significant change over time in seven of the comparisons is of concern, as it indicates that no progress has been made in these areas. These could perhaps be addressed by being given greater emphasis in the pending review of the EcIA Guidelines.

Of the 26 significant changes over time, one (4.0%) showed a significant deterioration, and two (8.0%) showed no clear trend of improvement or deterioration. The deterioration in the quantification of the overall land take required by the proposed development is of concern; without this information it is difficult to accurately assess the likely ecological impacts of the development. Again, ideally, this should be addressed in the pending revision of the EcIA Guidelines (see Section 5.3.14). Both of the comparisons showing no clear improvement or deterioration involved the consultations conducted as part of the EcIA process, with the main improvement seen in the Byron *et al*. (2000) review. Whilst no methodological details are provided in the review as to what was considered to be consultation, it is possible that consultation conducted during scoping was included in that review, resulting in higher rates of consultation than would otherwise be the case.

There have been a greater number of significant improvements over time (23) in the consideration and inclusion of information in EcIA chapters than significant deteriorations (1), significant though unclear trends (2), or no significant changes (7). This is encouraging and likely reflects a combination of the legislation, policy, and guidance changes since the last review (see Table 7). However, improvements do not necessarily equate to adequacy. The baselines established by the earlier EcIA chapter reviews in terms of information content were frequently very low, for example, the consideration of cumulative impacts. As a result, despite approximately half of the EcIA chapters in the current study failing to include cumulative impacts, this is nevertheless considered an improvement over the earlier reviews, though far from ideal.

5.3.3 General

Further information on the location of the EIA developments and the CPAs to which the applications were submitted can be found in Chapter 6.

Development Type

The earlier EcIA chapter reviews did not include complete information on the development and/or application types for the ESs they reviewed and so comparisons are not possible in all cases (for example, the Spellerberg and Minshull (1992) review did not provide information on the development sectors the ESs were drawn from). A comparison between the current review and the two reviews that considered ESs from multiple development sectors can be found in Figure 6. The categories from the Thompson *et al*. (1997) review were taken, being the broadest of the three reviews (it is easier for narrow categories to be combined into a broader category than vice versa).

Of note is the significant reduction in the percentage of ESs in the current review drawn from industrial developments, such as power stations, mineral extraction, open cast mining, landfill and waste treatment (Appendix 5.2, Pearson chi square = 4.305, df = 2, exact P = 0.035, Pearson chi square = 5.501, df = 2, exact P = 0.013, Pearson chi square = 15.811, df = 2, exact P < 0.001, Pearson chi square = 7.470, df = 2, exact P = 0.007, and Pearson chi square = 7.226, df = 2, exact P = 0.011, respectively). This contrasts with significant increases in the percentage of ESs for wind farms, mixed developments and 'other', which included residential, business parks, park and ride facilities and railways, etc. (Appendix 5.2, Pearson chi square = 7.199, df = 2, exact P = 0.006, Pearson chi square = 26.336, df = 2, exact P < 0.001, and Pearson chi square = 34.464, df = 2, exact P < 0.001, respectively).

Aside from a gradual decline in industry in the UK since the 1980s, other contributing factors are likely to include changes in policy towards mixed-use developments (e.g. University of Westminster *et al.*, 2002) and changes in energy policy encouraging renewable electricity generation (e.g. DTI, 2003). The significant increases in the 'other' category are potentially due to a greater number of less easily classified developments being proposed, such as business parks, retail developments and park and ride facilities. The role of development sector in EcIA chapter information content is explored in 5.3.3. Changes in legislation, policy and guidance will be focused on in this Chapter.

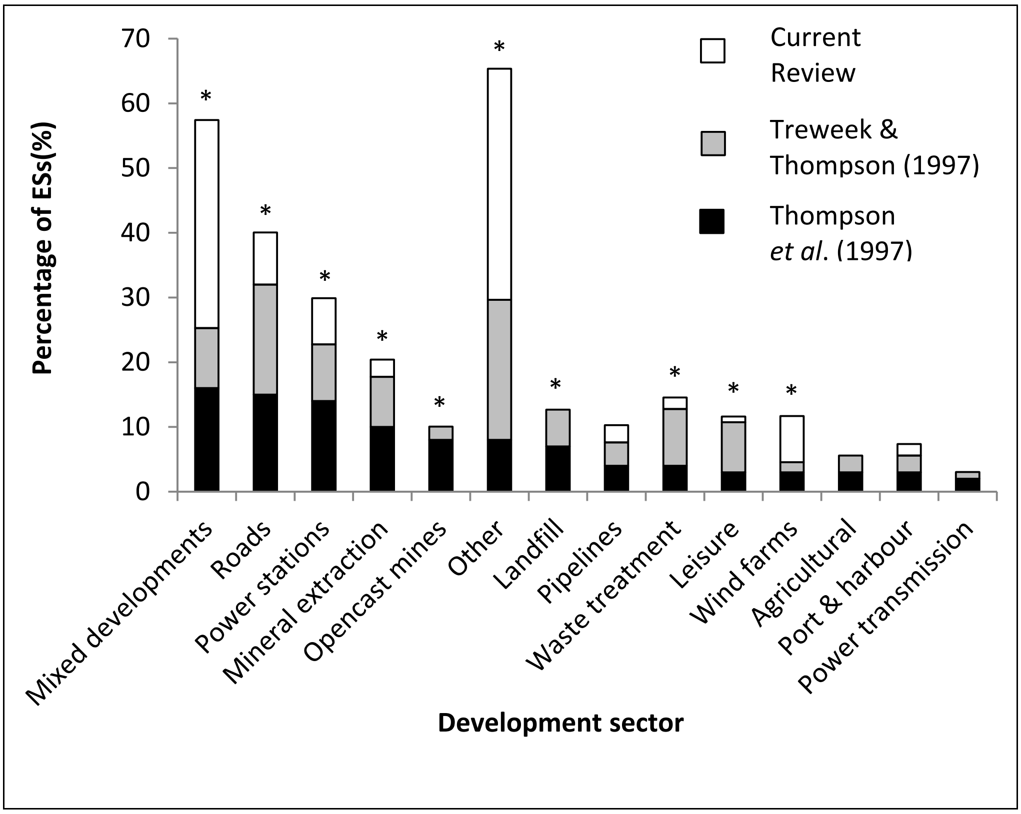


Figure 6: Change over time in the percentage of EcIA chapters in each review from different development sectors. Categories were taken from the Thompson et al. (1997) review. Columns marked with an asterisk show significant changes over time (exact P < 0.05).

Lead and Ecological Consultancies

Chapter 1 outlines the typical hierarchy of organisations involved in the preparation of ESs. The 112 ESs in the current review were co-ordinated by 61 individual lead consultancies, with each consultancy co-ordinating an average of 1.7 of the ESs. Two lead consultancies co-ordinated nine ESs each. Encouragingly, only five of the lead consultancies were directly associated with the developer (for example, the consultancy department of the county council that is proposing the development), thereby reducing the risk of bias resulting from conflicts of interest.

The 112 EcIA chapters were contributed to by a total of 79 individual ecological consultancies, either singly (in 60.8% of cases) or in collaboration, with a maximum of six ecological consultancies contributing to one EcIA chapter. In three (2.68%) cases it was not possible to determine whether ecological consultancies had been involved. Excluding these, along with EcIA chapters written by lead consultancies (unless explicitly stated that their in-house ecology team was involved in the EcIA chapter), 67.9% of the EcIA chapters were at least partially contributed to by an ecological consultancy. This is a significant improvement on the 49.0% found in the RSPB (1995) review (Appendix 5.2, Pearson chi-square = 4.407, df = 1, exact P < 0.049) and may help to explain some of the improvements in EcIA content seen over time (see Table 11 for a summary of these changes).

5.3.4 Baseline – Desk Study

Size

The size of the proposed development is the most basic and easily provided information requirement of the EIA Directive (Council of the European Union, 1985, as amended). It provides a broad-brush indication of the scale of the impacts that could arise from the proposed development; larger sites are potentially more likely to result in significant environmental impacts. Whilst not as specific as actual land take, overall development size is a useful indicator of potential biodiversity loss and should be included in all ESs.

Almost 12% (11.61%) of the 112 ESs failed to state the size of the proposed development. However, there has been a significant improvement over time in terms of specifying size, both for linear and non-linear developments (Figure 7, Appendix 5.2, Pearson chi-square = 9.166, df = 1, exact P = 0.003 and Pearson chi-square = 52.132, df = 3, exact P <0.001, respectively). The highest rates of failure to state the size of the proposed development were found in the two studies that focused on road developments (Treweek *et al.*, 1993; Byron *et al.*, 2000). This is likely due to roads being linear developments, for which it may be easier to state the length rather than the overall size. However, this does not explain the relatively high (though improved, see below) rates of linear development ESs in the current review also failing to state the length of the proposed development.

Of the linear developments, length ranged from 0.13km (for a road bridge) to 30km (for an onshore cable). Again, due to the presence of an unusually long linear development, the median of 3.0km is a more accurate reflection of average linear development length. There have been significant changes in the inclusion of linear development length in ESs over time (Appendix 5.2, Pearson chi-square = 8.451, df = 2, exact P = 0.007). However, this is largely due to the lower than expected performance of ESs in the Treweek *et al*. (1993) and larger than expected improvements in the Byron *et al*. (2000) review.

Of the ESs that did give an indication of the size of the proposed non-linear development, this ranged from 0.25ha (for an urban tower block development) to 800ha (for a wave energy installation). Due to the inclusion of a few very large developments, the median of 8.03ha is therefore the most accurate measure of the average development size. Three of the proposed developments were below the 0.5ha threshold for requiring an EIA in England and Wales (HMG, 1999, as amended; HMG, 2011), and all were located in highly urbanised areas of London, suggesting that some London CPAs are unnecessarily requesting EcIAs.

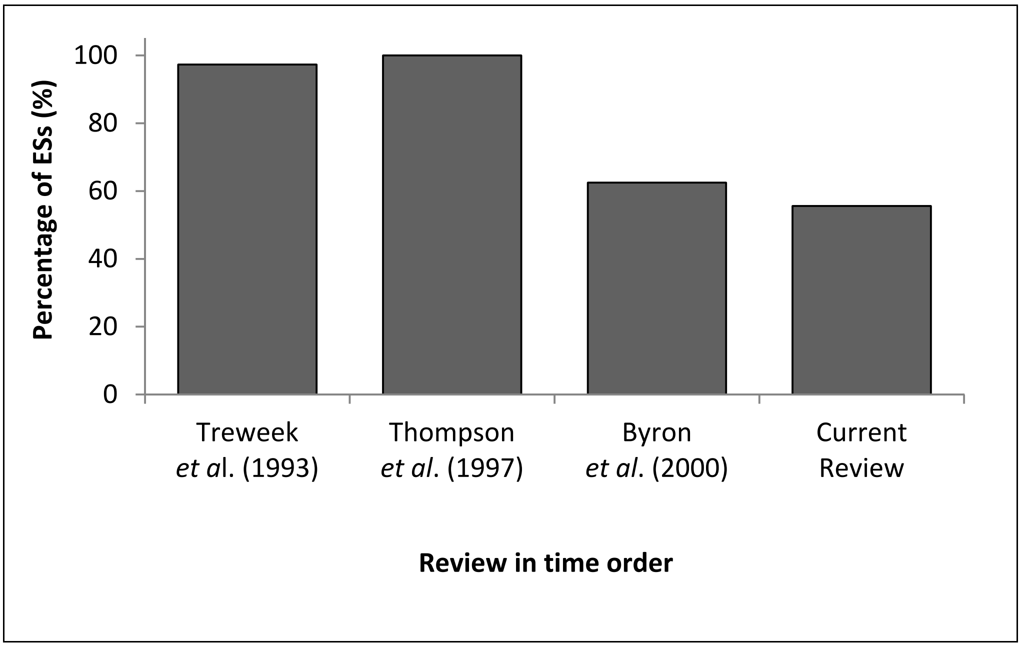


Figure 7: Percentage of ESs for linear developments in each review that failed to specify the size (i.e. area, rather than just length) of the proposed development.

Pre-Existing Land Use

The pre-existing land use of the proposed EIA development sites was classified in different categories in the previous reviews. An attempt to compare these categories has been made (Figure 8) to determine changes over time. Any given site could contain more than one category and so percentages in each review can total more than 100%.

Agricultural land use has decreased significantly over time (Appendix 5.2, Pearson chi square = 57.315, df = 3, exact $P < 0.001$), as has amenity land (Appendix 5.2, Pearson chi square = 23.931, df = 1, exact $P < 0.001$). However, urban land use has increased significantly over time (Appendix 5.2, Pearson chi square = 29.270, df = 3, exact $P < 0.001$). This likely reflects policy changes introduced to encourage the development of 'brownfield' or previously developed land, to which category urban land use belongs (ODPM, 2000). There has, however, been no significant change in the percentage of sites containing waste or derelict land (Appendix 5.2, Pearson chi square = 1.708, df = 1, exact $P = 0.216$), which is also considered as brownfield land. This may be due to the high risk of contamination and remediation costs associated with such land use.

Whilst there have been significant changes (Appendix 5.2, Pearson chi square = 85.332, df = 3, exact $P < 0.001$), the situation for suburban, residential and/or greenbelt land is complicated by the high rates of inclusion of these land use type found in the two studies that focused on road developments (Byron *et al.*, 2000; Treweek *et al.*, 1993). A repeat of this analysis with only the road developments from this review and excluding the Thompson *et al*. (1997) review (it was not possible to separate roads from other development types in their review) again revealed significant changes, but no clear trend over time (Appendix 5.2, Pearson chi square = 10.672, df = 2, exact $P = 0.002$), due to the higher than expected suburban, residential and/or greenbelt land use for new roads in the Byron *et al*. (2000) review. However, there is no significant difference in suburban, residential and/or greenbelt land use between the Treweek *et al*. (1993) review and the Byron *et al*. (2000) review, suggesting that older road developments were more likely than recent road and other developments to be associated with this land use type (Appendix 5.2, Pearson chi square = 0.148, df = 1, exact $P = 0.712$).

The reasons for this are unclear, but one potential explanation may be the road transport policy of the time. The late 1980s and early 1990s (the period from which the EcIAs were drawn for the Byron *et al*. (2000) and Treweek *et al*. (1993) reviews) were characterised by a planned £23 billion programme of road building, including over 150 bypasses (House of Commons, 1990; DoT, 1989). Bypasses will typically cut through greenbelt land in order to achieve their aim of diverting traffic around existing urban areas. Indeed, of the 37 EcIAs in the Treweek *et al*. (1993) review, almost half (48.7%) were for bypasses, and a similar proportion (47.5%) was found for the Byron *et al*. (2000) review, whilst only 11.1% of the road developments in the current review were bypasses.

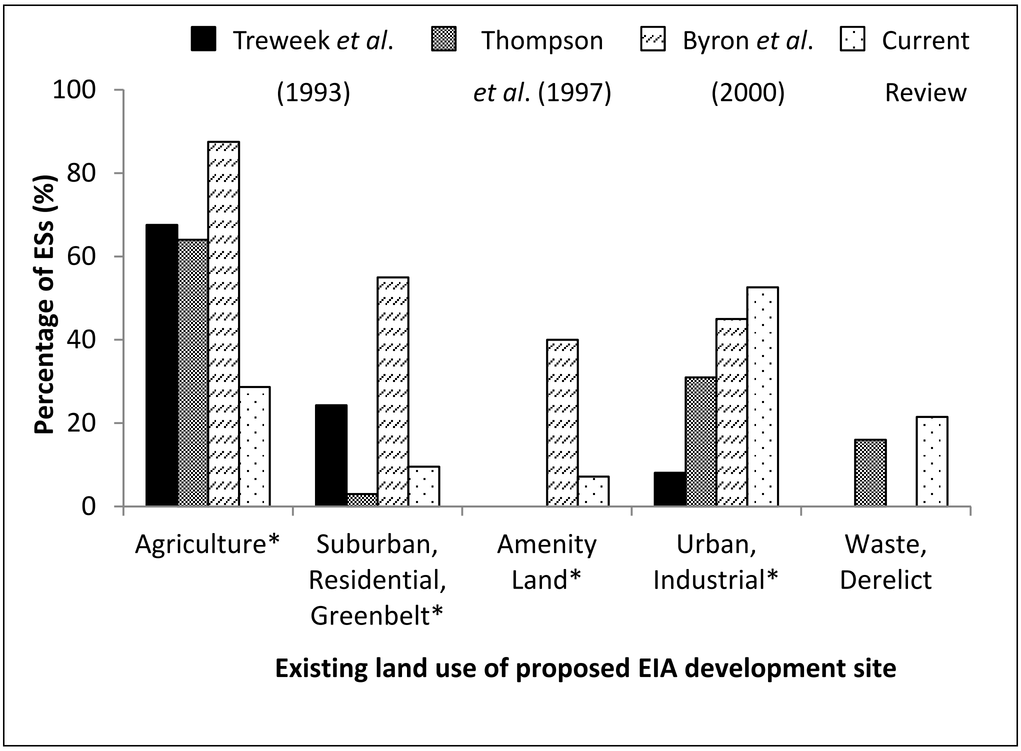


Figure 8: Changes in the pre-existing land use of proposed EIA development sites over time. Land uses marked with an asterisk show significant changes over time (exact P < 0.05). Gaps indicate that reviews have not included a land use type, rather than a zero value.

Consultation

Of the 112 ESs, 44 (39.3%) failed to include any description of consultation conducted for ecology. There is no significant difference from the findings of the

Thompson *et al*. (1997) study, where 33% of ESs failed to explicitly state that ecological consultation had been conducted (Appendix 5.2, Pearson chi-square = 1.205, df = 1, exact P = 0.314). In most cases, consultation was carried out only once at the scoping stage, with any summaries of consultation responses generally included in a 'scoping response' document. This challenges the concept of scoping and consultation being iterative processes within EIA (IEEM, 2006; Carroll and Turpin, 2009; DCLG, 2006). Descriptions of consultation within the EcIA chapter were most commonly limited to lists of the consultees contacted, with very few summaries of the results of the consultations provided. Since the adoption of the Aarhus Convention (UNECE, 1998), considerable emphasis has been placed on consultation and public participation in the EIA process and so the lack of general improvement over time is of concern. It is likely, however, that consultation was conducted but descriptions omitted from the final documents (Thompson *et al.*, 1997; Byron *et al.*, 2000). To ensure transparency, the EcIA Guidelines should place greater emphasis on the importance of conducting consultation throughout the EcIA process and on reporting the outcomes of consultation.

More than half of the EcIA chapters (51.8%) failed to state consultation with all of the relevant statutory consultees, i.e. English Nature (now Natural England, NE), the Environment Agency (EA) and the CPA. Despite this, there have been significant changes over time in the rate of consultation with the statutory body for nature conservation, NE (Appendix 5.2, Pearson chi-square = 20.581, df = 2, exact P <0.001). The main improvement, however, is seen in the Byron *et al*. (2000) review, where 87.5% of ESs consulted NE (or its equivalent in Scotland and Wales). This may be due to public resistance to high profile road developments in the 1990s at least partly on environmental grounds, such as the Newbury Bypass (Dudley, 2007).

Forty-five (40.2%) of the 112 EcIA chapters stated at least some consultation with non-statutory bodies, such as the RSPB, with thirty-six (32.1%) EcIAs stating consultation with the relevant wildlife trust. There have been significant changes in the consultation of wildlife trusts over time since the RSPB (1995) review (Appendix 5.2, Pearson chi-square = 36.438, df = 3, exact P <0.001), but again the main improvement is in the Byron *et al*. (2000) review, with a poorer than expected performance in the current review.

The lack of a clear trend of improvement over time, with the peak consultations with NE (or its equivalent) and the local wildlife trust seen in the Byron *et al*. (2000) review, is of concern. A potential reason for the improvement in road ESs in comparison with early ESs for a wide range of development types may be the provision of guidance (Byron *et al.*, 2000). However, this does not explain the lack of further improvement in the ESs analysed in this study, as the EcIA Guidelines were available, although these are not sector-specific.

5.3.5 Baseline – Surveys

All Ecological Surveys

Three (2.68%) EcIA chapters failed to include any new ecology surveys for flora or fauna; all were for proposed urban infrastructure developments in central London, drawing into question the need for full EcIA for such developments. However, there have been changes over time in the proportion of EcIA chapters including new ecology surveys, with significant improvements in the current review (Appendix 5.2, Pearson chi square = 115.345, df = 4, exact $P < 0.001$). This is important as baseline desk study data is often incomplete; site visits and taxon-specific surveys are required to gain an informed view of the ecological importance of the proposed development site. The improvement potentially reflects growing awareness amongst CPAs and developers of the importance of ecology, partially as a result of case law (e.g., R v Cornwall County Council, ex parte Hardy, 2001).

Seventy-six (67.9%) EcIA chapters failed to include the names of any of the ecological surveyors involved in the assessment, which is not significantly different from the results of the Byron *et al*. (2000) review (Appendix 5.2, Pearson chi-square = 4.039, df = 1, exact $P = 0.056$). In addition, 73 (65.2%) EcIAs failed to state any of the surveyors' qualifications, such as IEEM membership and European Protected Species (EPS) survey licence number. This means that questions regarding, for example, the survey methodology by the CPA cannot be targeted to the appropriate surveyor. The resultant lack of accountability reduces the pressure for consultants to conduct a robust EcIA and to write the chapter clearly.

The Treweek *et al*. (1993) review noted that "In the majority of cases the ES did not include any information on survey methodologies". Without this information the reliability of the survey findings, and any conclusions based on them, must be called into question. There has been no significant improvement in the provision of survey methodologies since the Byron *et al*. (2000) review, which found that of those EcIA chapters that included new ecological surveys, 82.9% gave an indication of the methodologies used (Appendix 5.2, Pearson chi square = 2.242, df = 1, exact P = 0.199). In this instance, 91.7% gave an indication for all or some of the surveys conducted. Whilst the provision of survey methodologies is relatively good, improvements can yet be made in consistency. For example, 63.3% of EcIAs failed to provide the methodologies for all of the surveys conducted, which reflects poorly on the EcIA chapter as a whole.

Despite repeated calls for quantitative ecological survey data on which to base quantitative impact predictions (e.g. Beanlands and Duinker, 1983), this has historically been omitted. However, there has been a significant improvement in the use of quantitative data over time, with 31 (28.4%) of EcIA chapters conducting surveys failing to provide quantitative data for any surveys (Appendix 5.2, Pearson chi square = 17.833, df = 2, exact P < 0.001). Without quantitative survey data, quantitative impact predictions cannot be reliably made, tested and the results disseminated to the wider ecological community, leading to a paucity of data available on the impacts of built development on ecology.

To ensure robustness and consistency, it may be necessary to conduct surveys for more than one year (e.g. for sites supporting important populations of notable or protected species). In an early review, the RSPB (1995) found that 94.6% of EcIA chapters failed to conduct surveys over more than one year. This situation has been significantly improved over time, with 69.7% of EcIA chapters failing to conduct surveys over more than year, but there is still considerable scope for progress (Appendix 5.2, Pearson chi square = 48.990, df = 1, exact P < 0.001).

Realistically, there will be occasions when surveys have to be conducted under sub-optimal conditions or during sub-optimal times of year. However, these and other limitations need to be stated to ensure that confidence can be correctly assigned to the results. However, of those EcIA chapters that conducted surveys, 43 (39.4%) failed to state any limitations or explain why there were no limitations. Whilst not directly comparable, the RSPB (1995) review found that 50% of EcIA chapters failed to state baseline data limitations. This is an area requiring improvement, as a precautionary approach should be taken where limitations and 'reasonable doubt' are present (IEEM, 2006). For example, if a reptile survey were undertaken under suboptimal weather conditions, this should be stated and considered within the impact assessment, as reptile counts would likely be lower than would be the case under optimal weather conditions.

Phase II Flora and Fauna Surveys

Phase II vegetation surveys were conducted for 49 EcIA chapters (43.75%) and included National Vegetation Classification (NVC), river corridor, bryophyte & lichen, hedgerow and other specific habitat surveys. Ninety (80.4%) EcIA chapters included fauna surveys, which is a significant improvement on the Thompson *et al*. (1997) review finding of 20% (Appendix 5.2, Pearson chi-square = 103.947, df = 1, exact $P < 0.001$).

Comparison with the Byron *et al*. (2000) review reveals some interesting changes over time in the percentage of EcIA chapters including certain survey types (Figure 9). Surveys of the majority of vertebrates have increased, with the increases being significant for bats (Appendix 5.2, Pearson chi square = 27.934, df = 1, exact $P < 0.001$), amphibians (Appendix 5.2, Pearson chi square = 8.116, df = 1, exact $P = 0.005$) and birds (Appendix 5.2, Pearson chi square = 13.482, df = 1, exact $P < 0.001$). Surveys also increased for aquatic invertebrates such as white-clawed crayfish (*Austropotamobius pallipes*). This is likely to reflect the fact that each of these groups contains species protected by EU legislation and that they are relatively straightforward to survey, with good survey and identification guides available (e.g. Bat Conservation Trust, 2007). The remaining groups appear to be characterised by a lack of European legislative protection and/or by a lack of widely available survey guidance (e.g. for fungi), potentially explaining the reduction in surveys over time (Treweek, 1995).

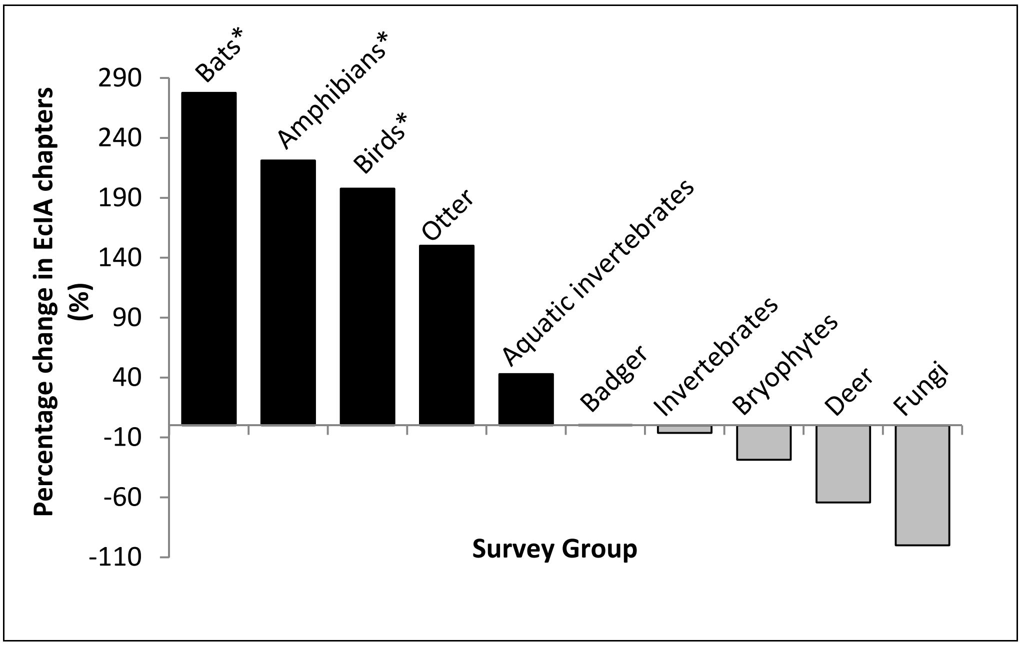


Figure 9: Percentage change since the Byron et al. (2000) review in the proportion of EcIA chapters including surveys of different groups of organisms. Black bars indicate an increase over time, whilst grey bars indicate a decrease over time. Survey groups marked with an asterisk have changed significantly over time (exact P < 0.05).

5.3.6 Evaluation

Geographic Context

Species or habitats with national importance may assume a still greater importance in a local context (IEEM, 2006). For example, just 0.1% of the UK BAP priority habitat acid grassland is located in Cambridgeshire (Cambridgeshire and Peterborough Biodiversity Partnership, 2008). As a result, it is important to identify the geographic context of ecological receptors. However, this was not stated for any of the habitats in 21 (18.8%) EcIA chapters or for any of the species in 20 (17.9%) EcIA chapters. Nevertheless, this is a significant improvement since the Byron *et al*. (2000) review, which found 75% of EcIA chapters failed to state the geographic context of habitats (Appendix 5.2, Pearson chi square = 41.829, df = 1, exact P < 0.001). Those EcIA chapters that failed to state the geographic context for species were significantly more likely to fail to state the geographic context for habitats (Appendix 5.2, Fisher's exact test, two-tailed, exact $P < 0.001$). This indicates that EcIA training courses may be required to rectify this.

5.3.7 Impact Assessment - Approach

Ecological Impacts Considered

Earlier reviews identified up to a fifth of ESs failing to consider ecological impacts (Treweek *et al.*, 1993; Treweek and Thompson, 1997). However, this has improved significantly over time, with 100% of ESs considering ecological impacts (Appendix 5.2, Pearson chi square = 35.065, df = 3, exact $P <0.001$). In some instances, however, it may be questioned whether an EcIA was required. CPAs should therefore be clear about when EcIA is required, given the context of the proposed development and the site location.

Assessment Method

Different guidance documents provide different methods for assessing the ecological impacts of proposed developments. For example, the DMRB Volume 11 (Highways Agency, 1992, as amended) promotes the use of a 'matrix method' of impact assessment, whilst the EcIA Guidelines specifically move away from such an approach as being unreliable. Without stating the guidance used, ambiguity is generated in terms of definitions and assessment approach. Interestingly, of the 69 EcIA chapters submitted from 2007 onwards (i.e. when the EcIA Guidelines were readily available), ten (14.5%) EcIAs failed to state their use and seven stated the use of alternative methods. No explanations were provided for this, which is of concern and needs addressing by IEEM.

Of the 112 EcIA chapters, 14 (12.5%) failed to state the method used for assessing the proposed development's potential impacts on ecological receptors. This is, however, a significant improvement on the results of the RSPB (1995) review, which found that 86.5% of EcIA chapters failed to state the assessment method used (Appendix 5.2, Pearson chi square = 78.808, df = 1, exact $P < 0.001$). Of the 81 EcIA chapters that stated the use of a draft, or the final edition, of the EcIA Guidelines, 50 (62.5%) also stated the use of another guidance document. Such guidance ranged from various editions of the "Design Manual for Roads and Bridges Volume 11", or DMRB Vol. 11 (Highways Agency) to editions of the "Guidelines for Environmental Impact Assessment" (IEMA, 2004). However, few EcIA chapters identified which documents were used in different parts of the assessment process, potentially leading to confusion.

Quantification

Quantifying impact predictions enables follow-up and testing to be conducted, the results of which can further scientific knowledge and inform future EcIAs. Historically, impact quantification has been poor (Treweek *et al.*, 1993; Thompson *et al.*, 1997) but there have been significant improvements over time (Appendix 5.2, Pearson chi square = 120.772, df = 3, exact $P < 0.001$). Byron *et al*. (2000) noted that the improvement found in their study was primarily due to a higher percentage of EcIA chapters quantifying land take (77.5% of EcIAs), which is significantly higher than in the current review (Appendix 5.2, Pearson chi square = 21.609, df = 1, exact $P < 0.001$). The improvement seen in the current review in impact quantification over time is due to significant progress in the quantification of habitat type loss (Appendix 5.2, Pearson chi square = 7.383, df = 1, exact $P = 0.010$) and the quantification of other impacts (Appendix 5.2, Pearson chi square = 4.538, df = 1, exact $P = 0.043$).

Whilst such an improvement in habitat type loss and other ecological impacts is welcome, it should not have come at the expense of quantifying overall land take. Relatively few (17, 15.2%) EcIA chapters quantified all of the habitat type loss expected to occur as a result of the proposed development, with 26 (23.2%) focusing instead on important or notable habitat types. Global Positioning System (GPS) devices (particularly smartphones and tablets) are now available at commercially viable prices and there is a greater choice of commercially available habitat mapping software. As a result, quantifying habitat type areas within a standard habitat survey visit is made cost-effective, rapid and more accurate. Habitat maps based on GPS data should therefore be the norm, rather than the exception (see Section 5.3.13).

Significance

The concept of significance remains poorly understood (Lawrence, 2007) and in practice has changed considerably over time, even within EcIA. For example, prior to the EcIA Guidelines' publication, significance tended to be described on a scale of negligible to major. An earlier study noted that "Many of the EISs referred to `significant' impacts or classified impacts as minor, moderate, serious, etc. without providing any definition of these terms" (Byron *et al.*, 2000). Without such a definition, all of the subsequent impact assessment is rendered meaningless as there is no reference point from which to make a judgement about the significance of a potential impact.

However, the EcIA Guidelines have since provided a framework that helps to reduce subjectivity (Briggs and Hudson, 2013). Yet of the 112 EcIA chapters, 25 (22.3%) failed to provide a definition of what constituted a significant impact and 12 (10.7%) failed to provide a full definition. Merely stating the use of the EcIA Guidelines is not sufficient evidence that IEEM's definition of significance has been utilised in the EcIA chapter.

Impact Characteristics

Ecological impact significance depends not only on the value of the receptor but also on the characteristics of the impact. These comprise impact magnitude, physical extent, duration, timing/frequency and reversibility. For a given ecological receptor, for example, an impact of greater magnitude and/or physical extent will be of greater significance. Some characteristics provide enhanced explanatory power, such as whether the impact is direct or indirect, positive or negative. Further details on these impact characteristics and how they can affect ecological receptors are provided in the EcIA Guidelines.

Previous reviews examined only impact duration and whether an impact is direct or indirect. There has been a significant improvement in the inclusion of impact duration in EcIA chapters since the Thompson *et al*. (1997) review (Appendix 5.2, Pearson chi square = 59.187, df = 1, exact $P < 0.001$). However, this remains the least stated impact characteristic (Figure 10) with almost two-thirds (63.4%) of EcIA chapters failing to estimate impact duration. There has also been a significant improvement over time in EcIA chapters explicitly stating whether impacts are direct or indirect (Appendix 5.2, Pearson chi square = 138.256, df = 2, exact P < 0.001). Whilst the improvements are encouraging, the overall poor characterisation of ecological impacts impairs the entire EcIA chapter. Without knowing the duration of an impact, effective mitigation cannot be proposed, and by not stating whether an impact is direct or indirect, less confidence can be placed in the consultant/s having considered all potentially significant impacts.

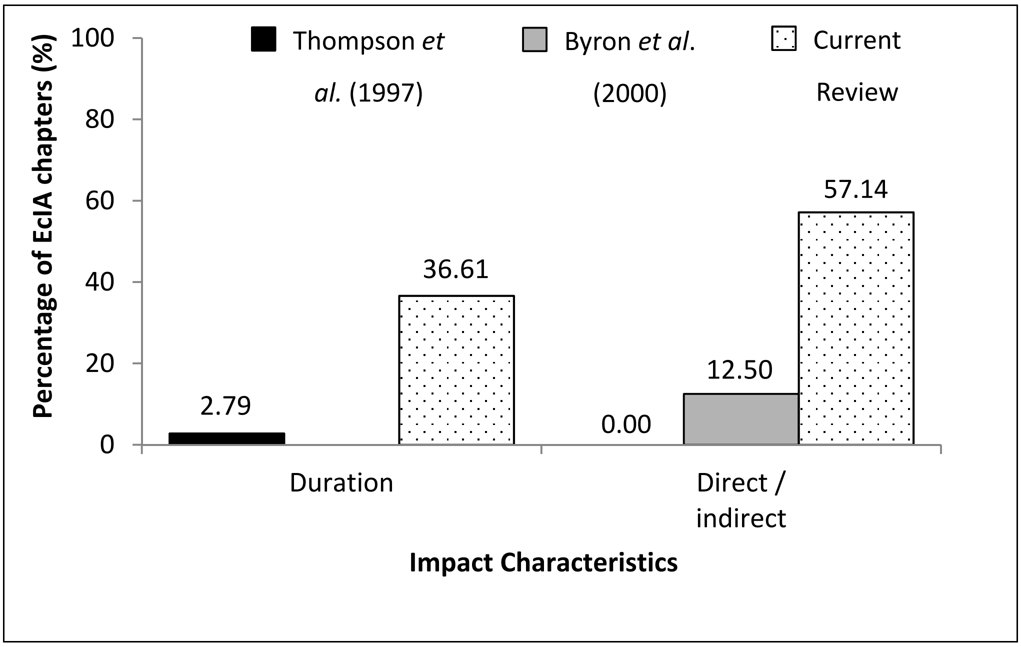


Figure 10: Change over time in the percentage of EcIA chapters including duration and direct/indirect impact characteristics for any ecological impacts. Gaps indicate that reviews have not included a habitat type, whilst zero values are represented with a 0.

'Do Nothing' Scenario

As proposed EIA developments are likely to be constructed several years after submission of the EcIA chapter, its impacts should not be assessed against the existing baseline as identified through site survey. Instead, the predicted baseline at the likely time of construction, should the development not proceed, should be used, i.e. the 'do nothing' scenario (note that this is not a consideration of alternatives). This scenario should also include the built developments likely to be constructed within the zone of influence (ZoI) of the development, thereby accounting for cumulative impacts (IEEM, 2006, p30). The RSPB (1995) review found that 35.0% of EcIA chapters included the ‘do nothing’ scenario and there has been no significant change since that study, with 31.3% of EcIA chapters including the ‘do nothing’ scenario (Appendix 5.2, Pearson chi square = 0.192, df = 1, exact P = 0.688).

Type of Ecological Impact

Despite habitat impacts (particularly loss and fragmentation) being the most obvious impacts to characterise and include in EcIA chapters, these were poorly addressed in the past (e.g. Treweek *et al.*, 1993). However, the Byron *et al*. (2000) review found a significant improvement in the inclusion of habitat loss as a potential ecological impact (Appendix 5.2, Pearson chi square = 21.043, df = 4, exact P < 0.001, Figure 11). This may reflect the additional guidance available for road developments in the form of the DMRB Vol. 11 and is reflected in 100% of the road developments in the current study also identifying habitat loss as an ecological impact. This suggests that other development sectors (particularly urban infrastructure development) may benefit from their own, sector-specific, guidance for EcIA (although see Section 0).

The inclusion of habitat fragmentation as a potential ecological impact has improved significantly over time (Appendix 5.2, Pearson chi square = 60.390, df = 4, exact P < 0.001). However, habitat fragmentation is less frequently considered than habitat loss and remains an area requiring improvement.

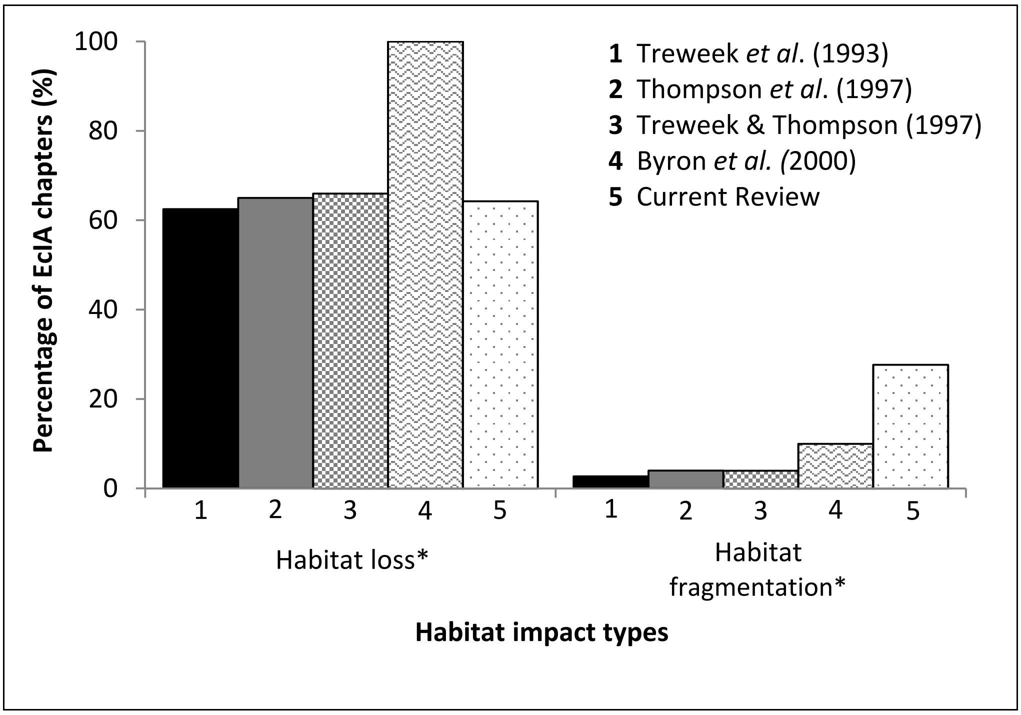


Figure 11: Change over time in the percentage of EcIA chapters including different habitat impact types. Habitat impact types marked with an asterisk show significant changes over time (exact P < 0.05).

One of the criticisms aimed at EcIA chapter impact assessment descriptions was their restriction to obvious impacts, such as habitat loss (Treweek *et al.*, 1993). As can be seen in Figure 12, this has improved significantly over time, with light pollution impacts showing the greatest percentage increase in inclusion within EcIA chapters (Appendix 5.2, Pearson chi square = 45.476, df = 1, exact $P < 0.001$). Contributing factors may be light pollution being included in planning policy documents (e.g. ODPM, 2005b), as well as increasing recognition of and guidance on the impacts lighting can have on protected wildlife, such as bats (e.g. Kerr, 2002; BCT and ILE, 2008). However, improvement is still necessary, as less than a fifth of EcIAs considered lighting or dust as potential (pre-mitigation) ecological impacts of their proposed developments (23.21 and 24.11%, respectively).

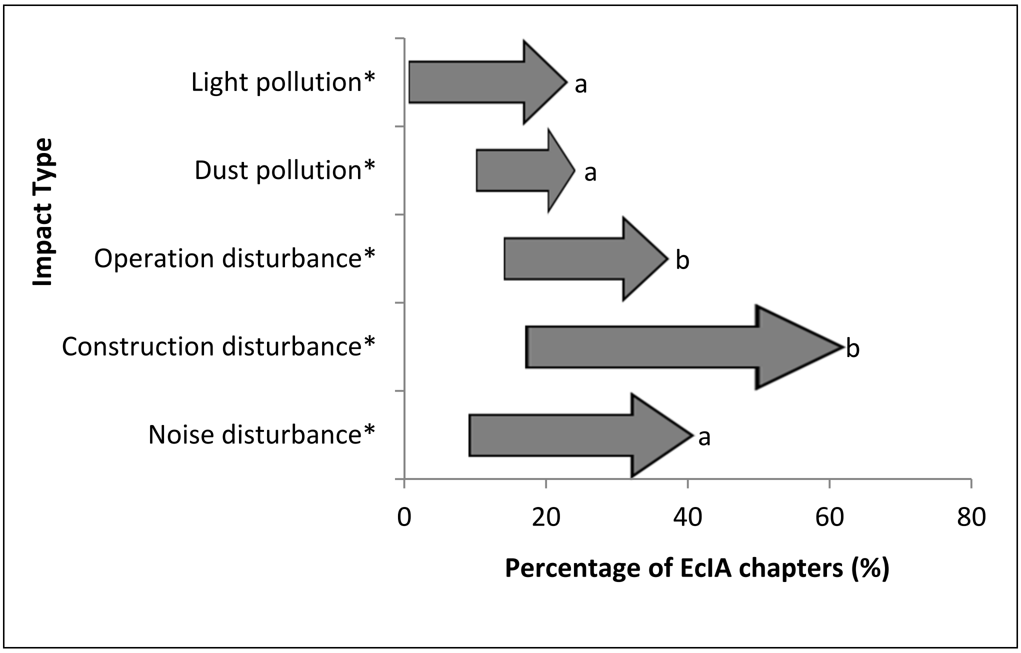


Figure 12: Increase over time in the percentage of EcIA chapters including different potential impact types over time. Arrows marked with 'a' show the increase since the Treweek and Thompson (1997) review, whilst those marked with 'b' show the increase since the Thompson et al. (1997) review. Impacts marked with an asterisk show significant improvements in their consideration in EcIA chapters over time (exact P < 0.05).

5.3.8 Impact Assessment – Significantly Affected Receptors

EcIA chapters should note the likely significance of both pre- and post-mitigation impacts. The latter are known as residual impacts (see 1.1.4). Importantly, mitigation proposals within EcIA chapters are not legally binding unless included within the decision notice or S106 Agreement. To ensure that the CPA has a clear idea of which mitigation measures are critical to reduce the impacts of a proposed development on ecology, the pre-mitigation impacts should therefore be stated. Despite this, 19 (17.0%) EcIA chapters failed to state pre-mitigation impacts.

Of the remaining 93 EcIA chapters, five (5.37%) stated that there would be no significant pre-mitigation ecological impacts as a result of the proposed development. This is of note, given that EIA developments are, by definition, "likely to have significant effects on the environment" (Council of the European Union, 1985, as amended). Of these five EcIA chapters, three were located within heavily urbanised areas of London and it can be questioned whether EcIA was in fact required for these developments. The remaining two developments were a 24ha wind farm and a 6.7km pipeline. Developments of this size on greenfield land have the potential to have significant pre-mitigation ecological impacts and it is of interest that this was not recognised within these two EcIA chapters.

The previous reviews did not include definitions of “potential impacts”, “potentially affected” or “potential effects” (Treweek *et al.*, 1993; Thompson *et al.*, 1997; Treweek and Thompson, 1997; Byron *et al.*, 2000). As a result, this review has assumed that these terms are equivalent to significant pre-mitigation impacts.

Significant Impacts on Species

The Byron *et al*. (2000) review considered only a limited selection of protected species and since then, there have been decreases in the inclusion of protected species impacts (Figure 13), which are significant for badger (Appendix 5.2, Pearson chi square = 26.057, df = 1, exact $P < 0.001$) and otter (Appendix 5.2, Pearson chi square = 4.247, df = 1, exact $P = 0.047$). These decreases likely reflect the changes in land use policy in favour of the redevelopment of brownfield land (see Section 5.3.4). Such land is less likely to support otter or badger but urban and/or derelict buildings may support bats, potentially explaining the lack of a significant reduction in impacts for this group.

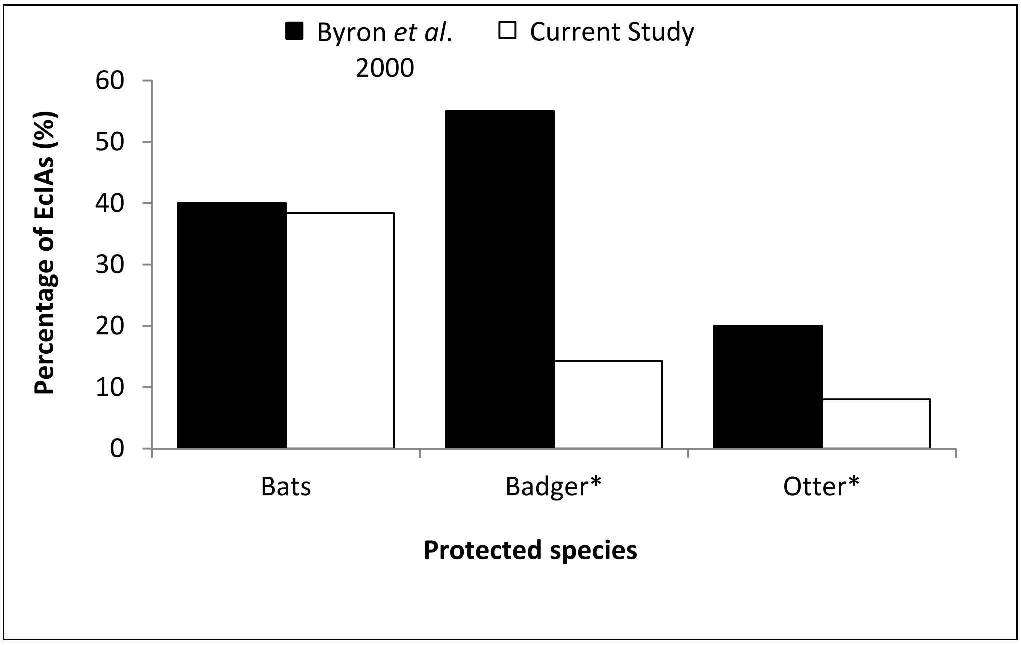


Figure 13: Change in the percentage of EcIA chapters identifying significant pre-mitigation impacts on protected species since the Byron et al. (2000) review. Species marked with an asterisk show significant changes over time (P < 0.05).

Significant Impacts on Habitats

There have been significant changes over time in the percentage of EcIA chapters describing potentially significant impacts on various habitat types, both terrestrial and aquatic/marine (Figure 14, Appendix 5.2).

Whilst there have been significant changes in terms of potential impacts on terrestrial habitats, they do not show a clear trend over time, mainly as a result of the high percentages of habitat impacts found in the Byron *et al*. (2000) review. These high percentages may be due to the use of a slightly different definition of "potentially affected" or due to a sample of particularly large and/or damaging EIA developments. However, there appears to have been a decrease over time in the percentage of EcIA chapters stating potential impacts on terrestrial habitat types. This may be linked with the changes in planning policy in favour of brownfield redevelopment, resulting in proposed developments avoiding typically 'greenfield' (previously undeveloped) habitats, such as woodland and heathland.

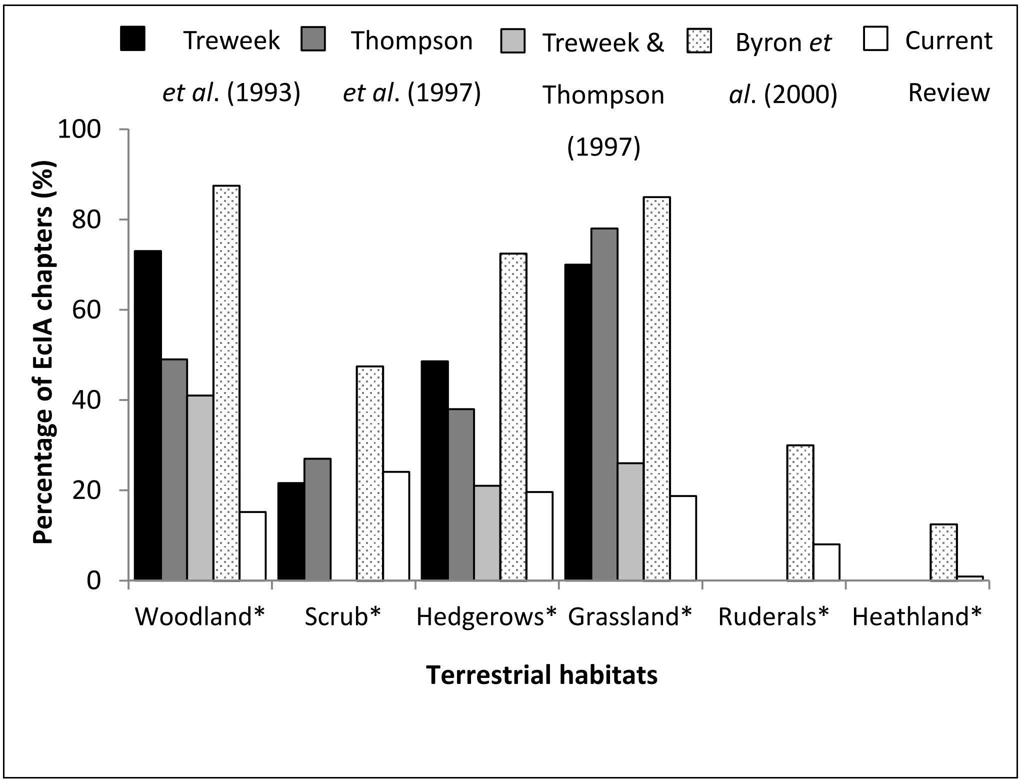


Figure 14: Change over time in the percentage of EcIA chapters identifying significant pre-mitigation terrestrial habitat impacts. Habitats marked with an asterisk show significant changes over time. EcIA chapters may have included more than one habitat type and so percentages across reviews may total more than 100%. Gaps indicate that reviews have not included a habitat type, rather than a zero value.

In terms of aquatic habitats, there have not been significant changes for coastal (saltmarsh/intertidal and estuarine) habitat impacts over time (Figure 15). This is likely due to there being no lessening of demand for large coastal infrastructure projects, such as ports and harbours (see Section 5.3.3). Such developments tend to have very specific siting requirements (both terrestrial and marine) and therefore fewer options than entirely terrestrial developments for avoiding habitat impacts.

For the remaining aquatic habitats, there is again no clear trend over time due to the high percentages of habitat impacts found in the Byron *et al*. (2000) review (Figure 15). However, the general trend appears to be for decreasing habitat impacts over time, particularly for flowing water, such as rivers, canals and ditches. One potential explanation for this may be the influence of the

Environment Agency (EA), following its creation in 1996 from three previously existing bodies, in its role as a statutory consultee for planning applications. One of the EA's roles is "protecting floodplains from inappropriate development" (Environment Agency, 2012).

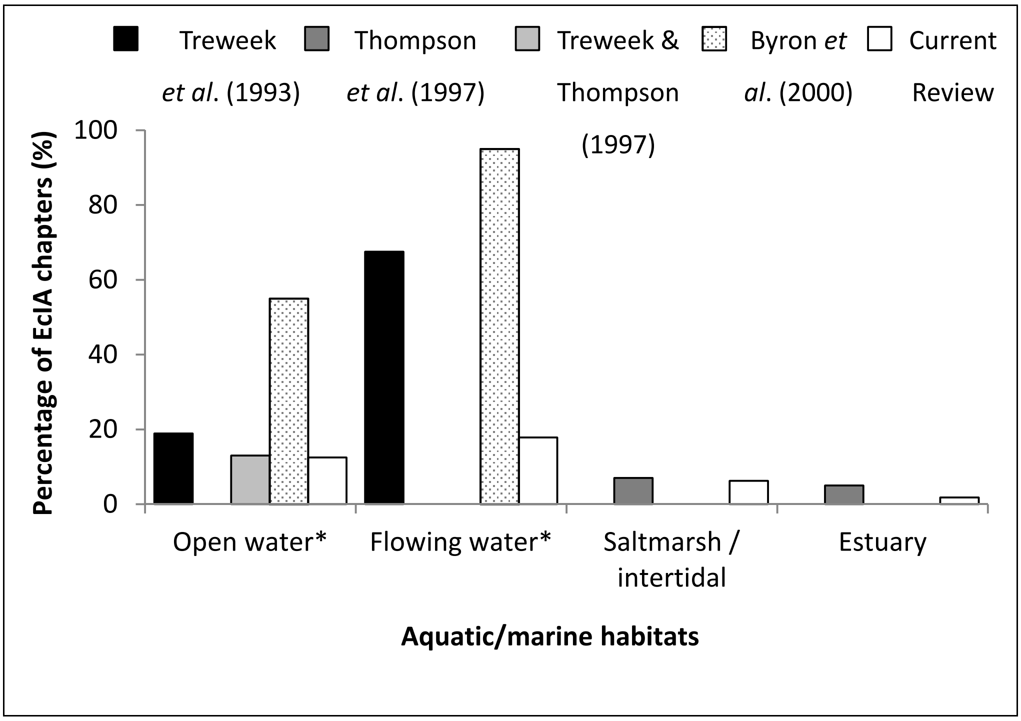


Figure 15: Change over time in the percentage of EcIA chapters identifying significant pre-mitigation aquatic/marine habitat impacts. Habitats marked with an asterisk show significant changes over time. EcIA chapters may have included more than one habitat type and so percentages across reviews may total more than 100%. Gaps indicate that reviews have not included a habitat type, rather than a zero value.

Significant Impacts on Designated Sites

It is encouraging that there have been significant decreases in the percentage of EcIA chapters identifying significant pre-mitigation potential impacts to SSSIs and Local Wildlife Trust (LWT) reserves and that the percentage of EcIA chapters identifying impacts to sites of international (Ramsar sites) and European (Special Protection Areas, or SPAs) importance is relatively low (Figure 16). However, the lack of significant change in the relatively high percentage of EcIA chapters identifying impacts on SINCs or their equivalent is of concern, particularly as SINCs are not protected by law.

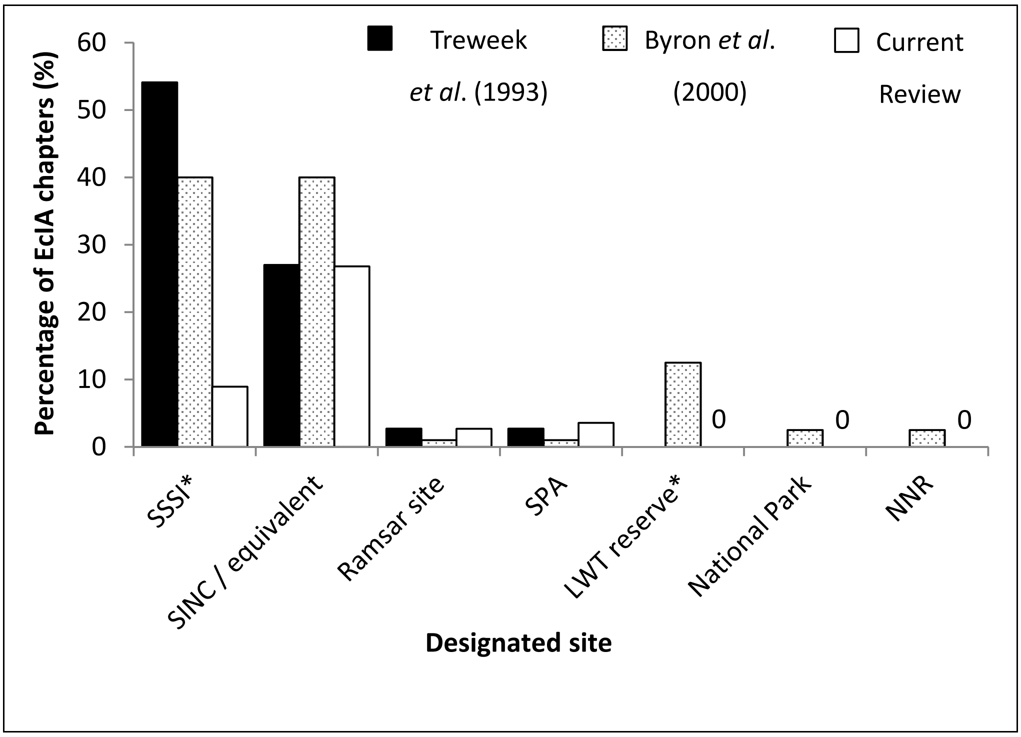


Figure 16: Change over time in the percentage of EcIA chapters identifying significant pre-mitigation designated sites impacts. Designated sites marked with an asterisk show significant changes over time. EcIA chapters may have included more than one designated site and so percentages across reviews may total more than 100%. Gaps indicate that reviews have not included a designated site, whilst zero values are represented by a 0.

5.3.9 Mitigation Approach

Mitigation Description

There have been significant improvements in the inclusion of mitigation descriptions in EcIA chapters over time (Figure 17, Appendix 5.2, Pearson chi square = 141.416, df = 4, exact P <0.001). Interestingly, mitigation proposals were included for all five (4.46%) of those EcIA chapters that stated there would be no significant pre-mitigation impacts. This is a significant reduction on the 13.0% found in the Treweek and Thompson (Treweek and Thompson, 1997) review (Appendix 5.2, Pearson chi square = 5.696, df = 1, exact P = 0.027). This either calls into question the impact assessment for these EcIA chapters, or the terminology used for the mitigation, as without an impact the mitigation should instead be referred to as an enhancement.

The one EcIA chapter that did not include any mitigation measures was for a contaminated land site that required remediation before being developed under a separate planning application, within which mitigation for the remediation work impacts would be included.

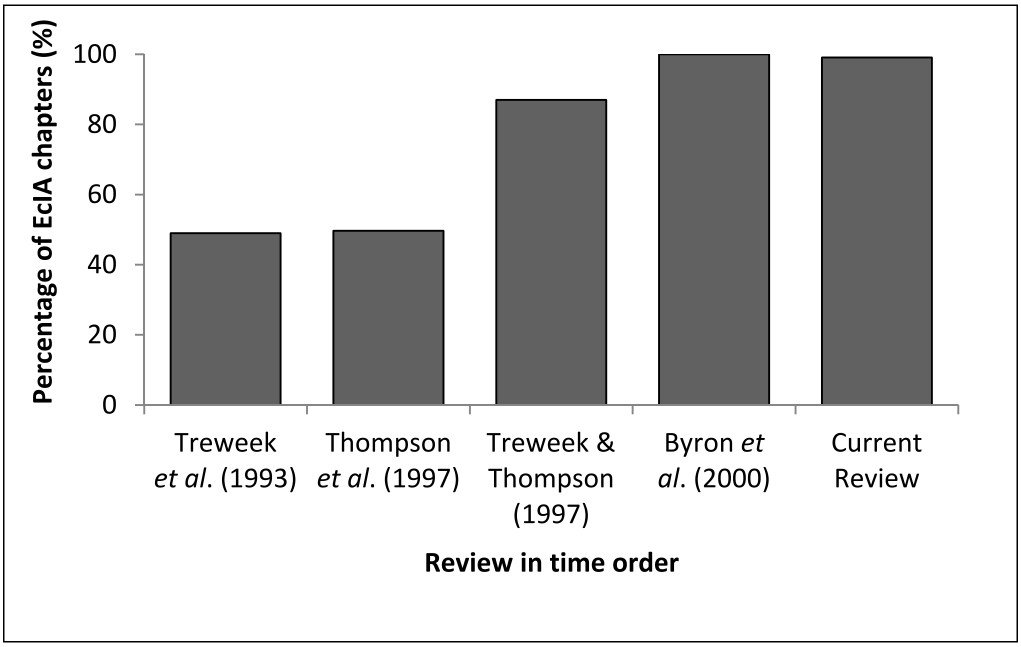


Figure 17: Change over time in the percentage of EcIA chapters including descriptions of proposed mitigation.

Mitigation descriptions are useful but can introduce uncertainty unless clear and with sufficient methodological detail to allow them to be conditioned, obligated and/or included within an Ecological Management Plan (EcMP). There has been a significant improvement over time in the percentage of EcIA chapters including at least one detailed mitigation description (Appendix 5.2, Pearson chi square = 9.599, df = 3, exact $P = 0.004$). However, less than a fifth (21, 18.75%) of EcIA chapters included any detailed mitigation descriptions (Figure 18). Whilst some flexibility in the implementation of some mitigation measures is useful (e.g. either halting construction during the breeding bird season or conducting a breeding bird survey prior to construction to ensure absence), for many measures an indication of the methodology is important (for example details of green roof planting). Without such detail, the likely residual impact on ecological receptors cannot be assessed with sufficient confidence, with possible consequent impacts on the biodiversity of the proposed development site.

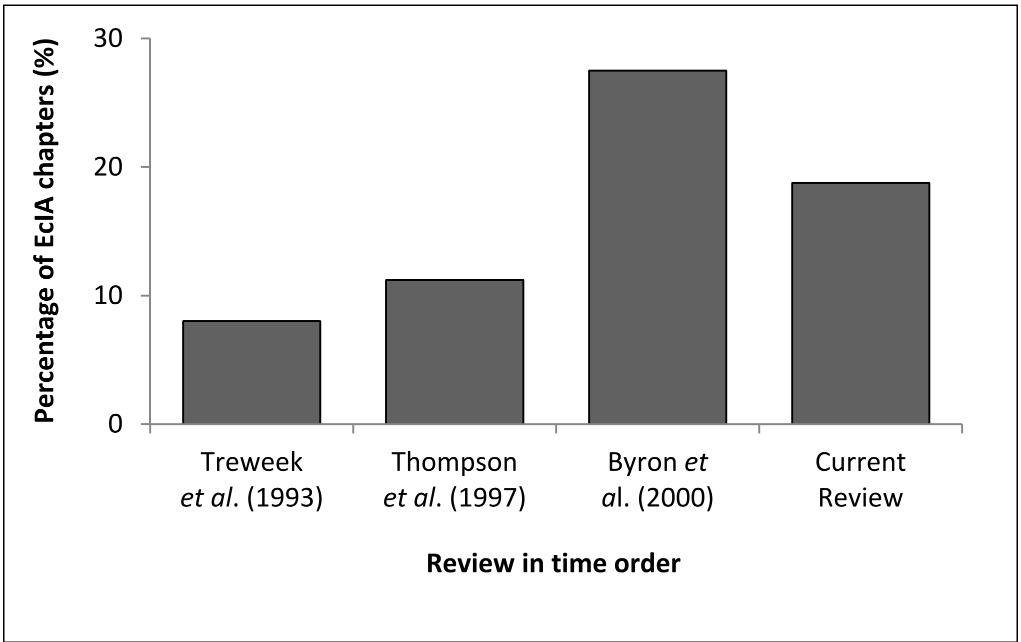


Figure 18: Change over time in the percentage of EcIA chapters including detailed mitigation descriptions for at least one mitigation measure.

Mitigation Effectiveness

In the absence of readily available detailed ecological follow-up studies, the success of mitigation measures in meeting their impact reduction or avoidance targets is uncertain. As a result, the likely success of the proposed mitigation measures should be stated. There have been significant improvements over time in the percentage of EcIA chapters indicating the likely success of their proposed mitigation measures (Appendix 5.2, Pearson chi square = 11.176, df = 4, exact P = 0.003). However, rates of inclusion remain very low and of the seven EcIAs that indicated likely success, only one included this for every proposed mitigation measure (Figure 19).

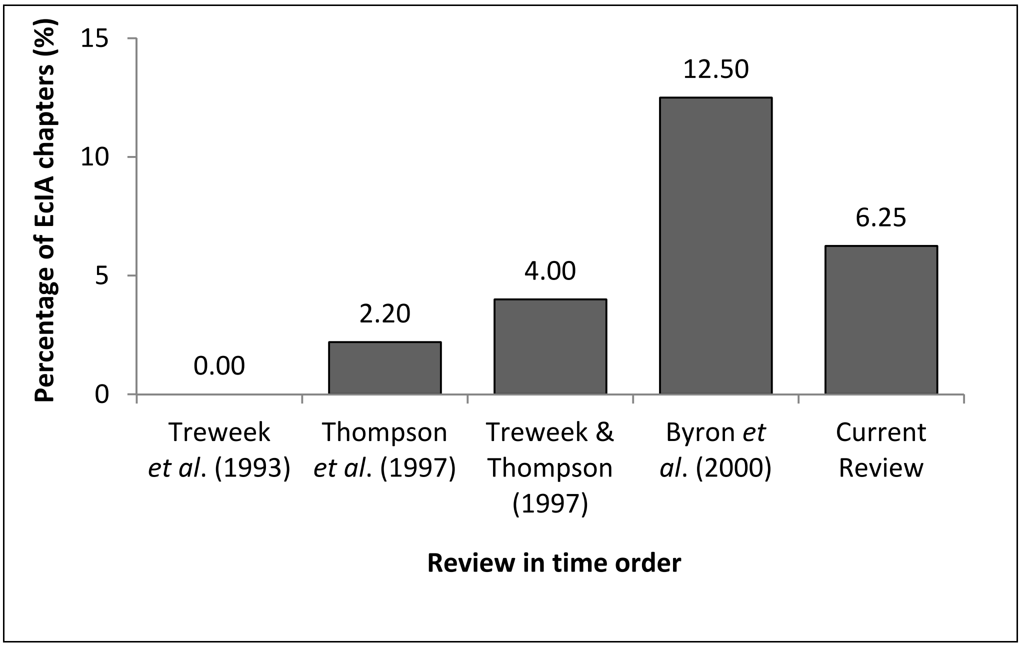


Figure 19: Change over time in the percentage of EcIA chapters indicating the likely success of any of the proposed mitigation measures.

For many mitigation measures, particularly habitat creation or improvement measures, there is a time lag between measure implementation and its effectiveness. For some measures this can be significant; for example, woodland requires many decades to mature. As a result, the length of time required for mitigation to become effective should be stated. There has been a significant improvement since the Treweek and Thompson (1997) review in the percentage of EcIA chapters providing indications of the time required for mitigation measures to become effective (Appendix 5.2, Pearson chi square = 43.077, df = 1, exact $P < 0.001$). However, rates of inclusion remain relatively low at less than a quarter of EcIA chapters (23, 20.54%). Without acknowledgement or estimation of the time lag between mitigation implementation and effectiveness, less confidence can be placed in the residual impact assessment.

An alternative to providing an indication of the likely success of mitigation is to propose modifications for mitigation that does not achieve its impact avoidance or reduction targets. Three EcIA chapters proposed modifications for at least one of their proposed mitigation measures in the event of their being unsuccessful and there has been no significant change in this over time (Figure 20, Appendix 5.2, Pearson chi square = 5.595, df = 3, exact $P = 0.056$).

Without indications of the likely success of proposed mitigation measures, or proposals for the modification of unsuccessful mitigation measures, confidence in the accuracy and reliability of the residual impact assessment must necessarily be low. Given the high percentages of EcIA chapters failing to include this information and failing to caveat residual impact assessments in light of this, EcIA chapters are on the whole failing to provide CPAs with adequate information on which to base their decisions. Yet this does not seem to be recognised by statutory consultees or CPAs, as all of these EcIA chapters were granted planning permission.

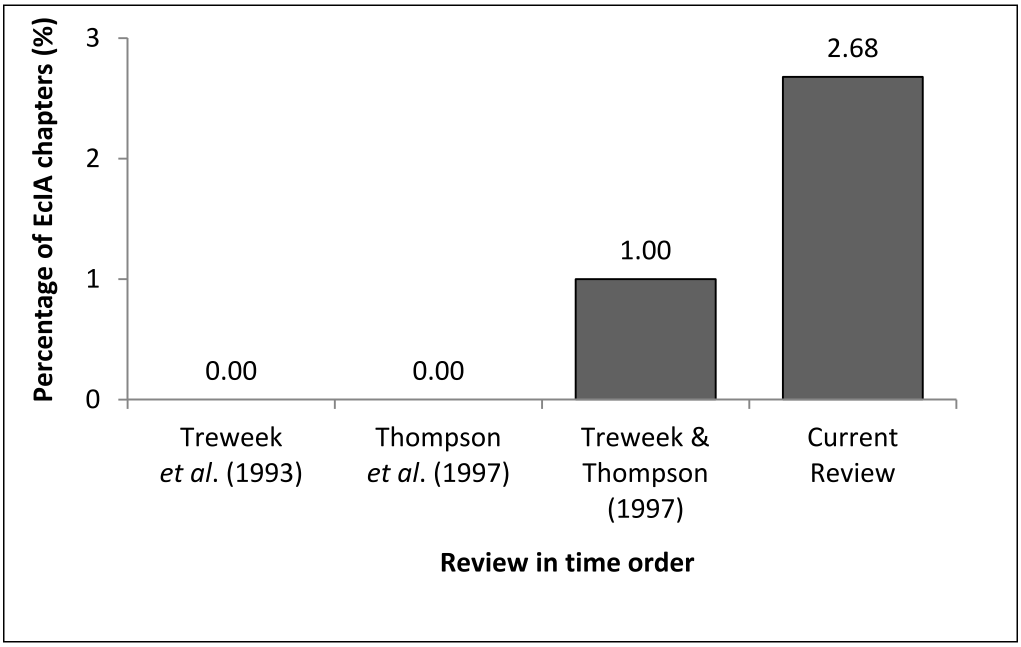


Figure 20: Change over time in the percentage of EcIA chapters that include proposals for the modification of unsuccessful mitigation measures.

Commitment to Mitigation

In the absence of definitions in the RSPB (1995) review that examined this issue, this review assumed that use of the word ‘will’, rather than ‘should’ and ‘could’, evidenced developer commitment. Whilst by no means the only indicator, this was identified as the least time-consuming and objective method of identifying developer commitment. Since the RSPB (1995) review there has been a significant improvement over time in the inclusion of developer commitment to mitigation measures in EcIA chapters from 11% to 77.68% (Appendix 5.2, Pearson chi square

= 52.308, df = 1, exact P < 0.001). However, of the 112 EcIA chapters, 25 (22.32%) failed to provide any indication of developer commitment to mitigation measure implementation and over half (52.68%) failed to indicate commitment to all of the proposed mitigation measures. Given that EcIA chapter mitigation measures are not legally binding unless included within decision notice conditions or S106 Agreement obligations, lack of evidence of commitment on the part of the developer suggests that those mitigation measures not included in conditions or obligations will be less likely to be implemented.

5.3.10 Mitigation Proposed

Within the six published EcIA chapter reviews, there was little agreement as to the classification used for the mitigation proposed. For example, some included habitat creation and restoration within the same category (Thompson *et al.*, 1997) whilst others separated them (Treweek *et al.*, 1993). As a result, there are few proposed mitigation measures that can be compared across multiple studies; these are outlined below.

Landscaping

Landscaping can serve multiple purposes in an EIA development if planned carefully. Not only is it visually appealing, but it can provide valuable wildlife habitat, reduce flooding (e.g. reedbeds) and mitigate noise and air pollution impacts. However, its use as an ecological mitigation measure in EcIA chapters is only valid if the landscaping has been specifically designed with biodiversity in mind (Thompson *et al.*, 1997).

There have been significant increases in the use of landscaping as an ecological mitigation measure over time, with over two-thirds (64.29%) of EcIAs including it (Figure 21, Appendix 5.2, Pearson chi square = 158.314, df = 4, exact P < 0.001). Whilst it is encouraging that landscaping and ecological mitigation are apparently being integrated, caution must be exercised as the lack of mitigation measure detail provided in more than four-fifths of EcIAs (see Section 5.3.9) could mean that landscaping inappropriate for ecological mitigation is being implemented.

Ideally, all landscaping proposals for ecological mitigation should be accompanied with a detailed planting list and quantification of the areas to be landscaped.

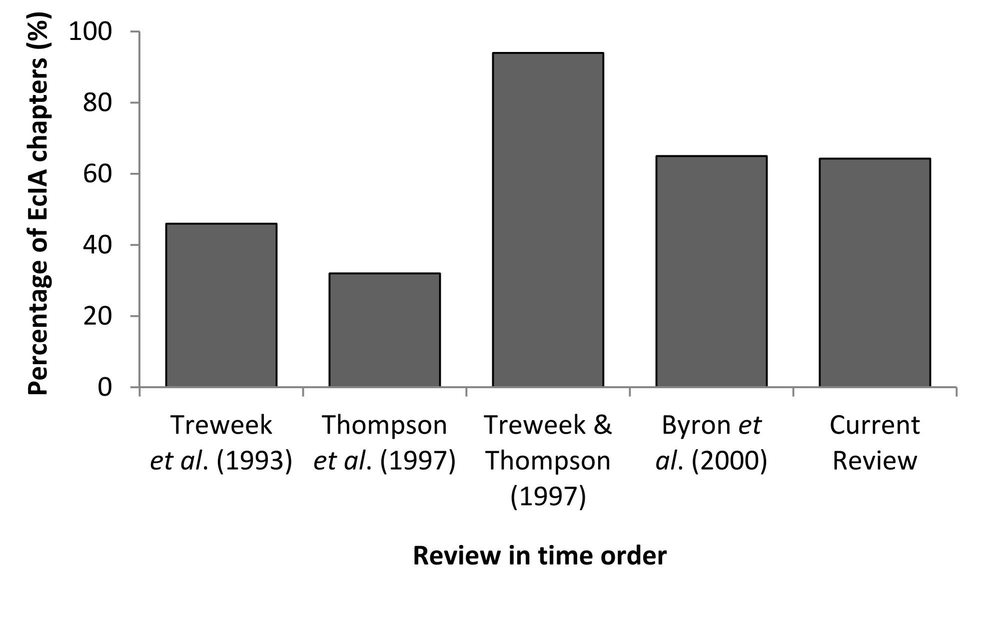


Figure 21: Change over time in the percentage of EcIA chapters including landscaping as an ecological mitigation measure.

Translocation and Relocation

Translocation and relocation of individual species (flora and fauna) and habitats are subject to large uncertainties and require detailed specialist knowledge to improve their chances of success (Treweek and Thompson, 1997). As a result, they should only be recommended as ecological mitigation measures if absolutely necessary. Yet there has been a significant increase in the use of translocation and relocation as ecological mitigation measures over time (Appendix 5.2, Pearson chi square = 23.348, df = 2, exact $P < 0.001$), with almost a third (32.14%) of EcIA chapters proposing them (Figure 22). One explanation for the increase might be that CPAs are becoming more aware over time of issues surrounding EPS (partially as a result of case law (e.g., R v Cornwall County Council, ex parte Hardy, 2001), combined with ecologists frequently not being brought in early enough in the design phase of the development to be able to avoid translocation and/or relocation being necessary. This is where CPA and developer-specific EcIA literature would be useful, which IEEM could develop and distribute (see Table 12).

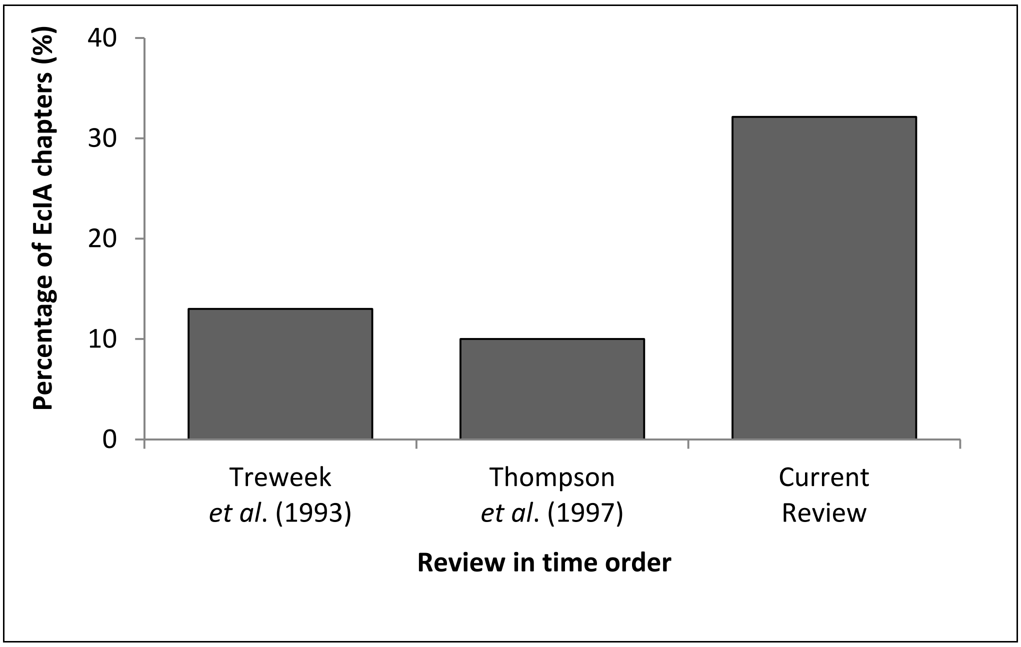


Figure 22: Change over time in the percentage of EcIA chapters including translocation or relocation as ecological mitigation measures.

5.3.11 Follow-up

Further information on the context and importance of follow-up in the EcIA process can be found in Chapters 8 and 9.

References to Follow-up

There have been significant changes over time in the inclusion of references to follow-up in EcIA chapters (Appendix 5.2, Pearson chi square = 138.973, df = 6, exact $P < 0.001$). With the exception of the RSPB (1995) review, the previous reviews have found very low percentages of EcIA chapters including references to, or recommendations for, follow-up (Figure 23). Despite follow-up being considered “good practice” in the EcIA Guidelines (IEEM, 2006 p. 48), 60.71% of EcIA chapters still do not include any mention of follow-up. In general, however, there has been a trend of increasing percentages of EcIA chapters including references to follow-up. The RSPB (1995) review reviewed 37 ESs, half of which were drawn from the IEMA library, and half of which were selected by RSPB staff as representative of the cases in which the RSPB were involved. It is therefore possible that early consultation with the RSPB for the latter ESs resulted in the inclusion of follow-up recommendations, which would not perhaps have otherwise been included. If this is indeed the case, this demonstrates the importance of non-statutory consultees in improving EcIA chapters.

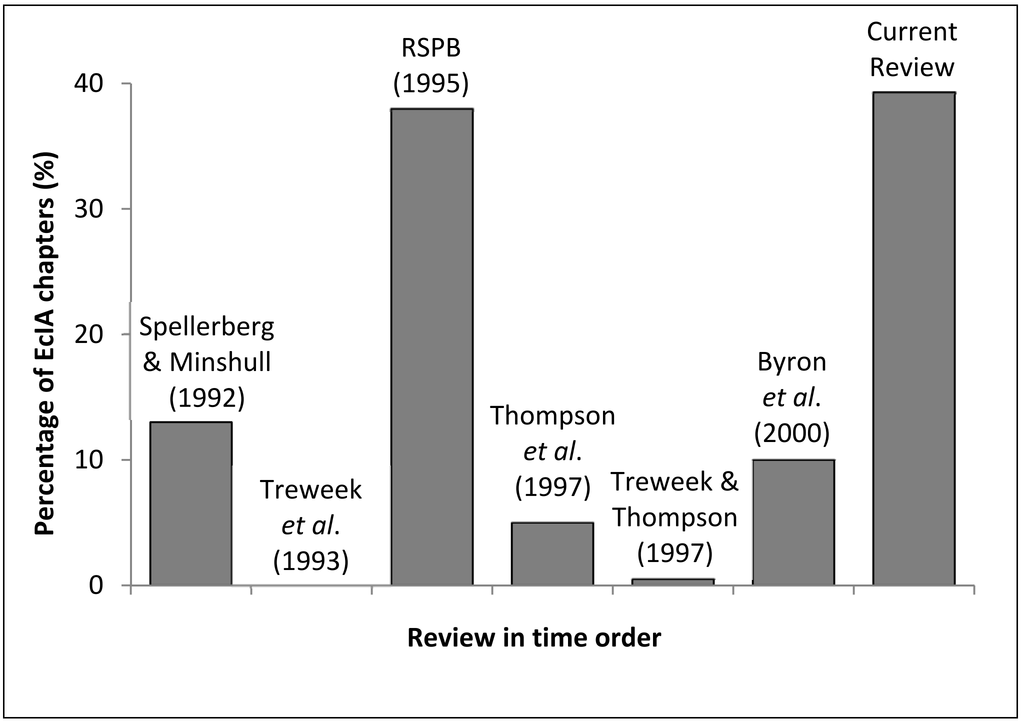


Figure 23: Change over time in the percentage of EcIA chapters including a reference to post-construction follow-up.

Commitment to Follow-up

Over time there has been a significant improvement in stating a commitment to follow-up in EcIA chapters (Appendix 5.2, Pearson chi square = 77.566, df = 5, exact $P < 0.001$, Figure 24). However, of those EcIA chapters including a reference to follow-up, over half (25) failed to provide any indications of commitment to any follow-up proposals. This has far-reaching implications, as without follow-up, there can be no on-site management of failing mitigation and no improvement in impact predictions or mitigation proposals in future EcIA chapters. As a result, there will be no reduction in the rate of biodiversity loss due to EIA developments, unless the rate of submission and/or planning permission for such developments decreases over time.

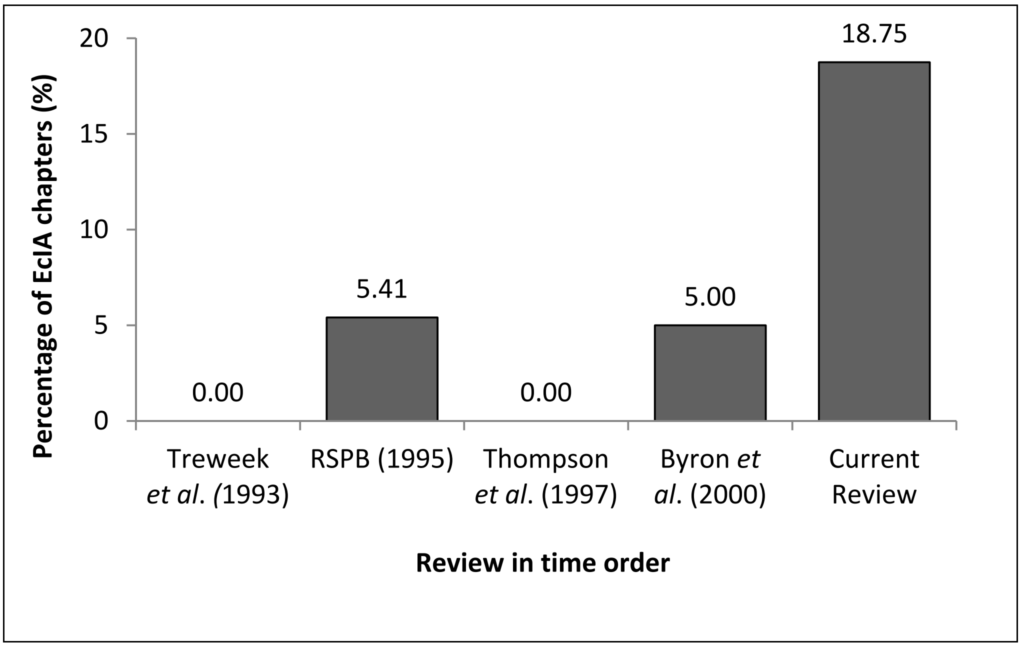


Figure 24: Change over time in the percentage of EcIA chapters including commitment to follow-up recommendations.

Follow-up Programme Provision

There have been no significant changes in the provision of follow-up programmes in EcIA chapters over time (Appendix 5.2, Pearson chi square = 0.065, df = 1, exact P = 1.000, Figure 25) and the rate of provision remains very low (3.57% of EcIAs mentioning follow-up). It is possible that developers are unwilling to commission complete follow-up programme documents from consultants in the event that the project does not receive planning permission. However, such documents could easily be referenced within the EcIA chapter as requiring a planning condition to secure their creation and implementation. This would incur no immediate cost to the developer and so does not explain why rates of follow-up programme provision remain so low. It may be, therefore, that consultants are unwilling to mention monitoring programmes in EcIA chapters in order to avoid incurring later costs to developers once planning permission has been granted. Yet this is not borne out by the increasing rate of references to follow-up and follow-up commitment being made in EcIA chapters, which have the potential to be conditioned as part of the planning permission. It is most likely, therefore, that consultants are unaware that follow-up programmes can be provided within the context of EcIA chapters, or at least referenced within them as requiring a planning condition. This can be rectified through appropriate training, possibly via IEEM or another relevant statutory or non-statutory body.

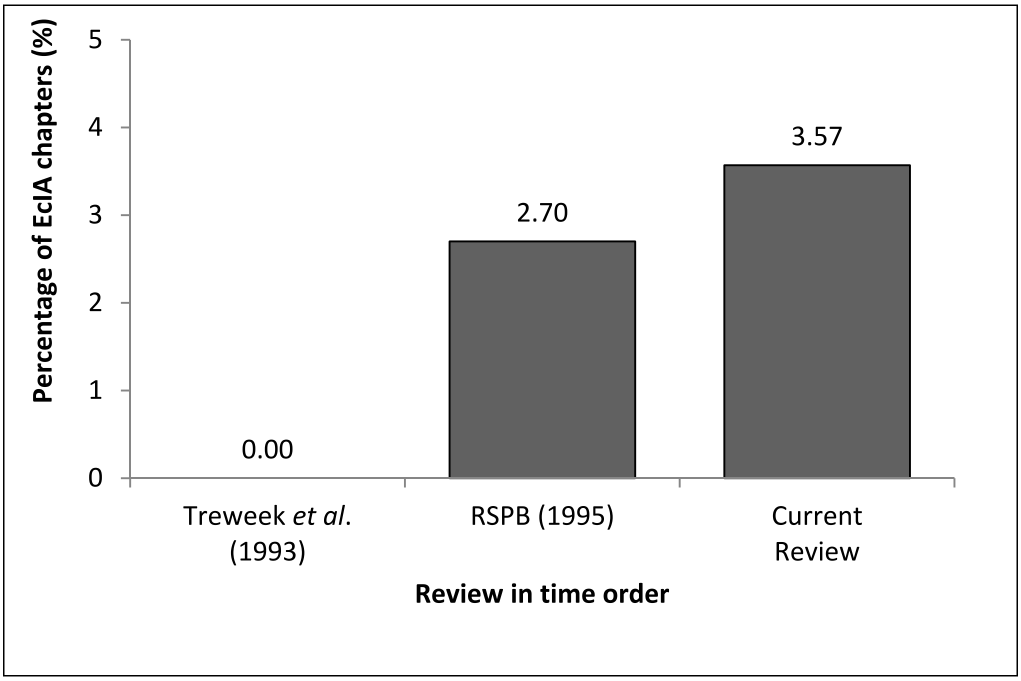


Figure 25: Change over time in the percentage of EcIA chapters including a follow-up programme.

5.3.12 Residuals & Cumulative Impact Assessment

Residual Impacts

None of the earlier published EcIA chapter reviews assessed whether residual (i.e. post-mitigation) impacts had been assessed. However, a recent unpublished work investigating ecological mitigation measures found that 77.50% of the 40 EcIAs examined included some assessment of residual impacts (Matrunola, 2007). There has been no significant change over time since 2007, with almost 85% (95, 84.82%) of EcIA chapters in this review assessing the residual impacts of the proposed development (Appendix 5.2, Pearson chi square = 1.114, df = 1, exact P = 0.330). This result has not been included in the comparison summary table (Table 11) as the study was not published. However, the finding that not all EcIA chapters assess residual impacts is of note and requires addressing.

Cumulative Impacts

There have been significant changes over time in the assessment of cumulative impacts in EcIA chapters (Appendix 5.2, Pearson chi square = 90.967, df = 3, exact P <0.001). In general, there has been an improvement in the inclusion of cumulative ecological impact assessment but with almost half (48.21%) of EcIAs failing to assess cumulative impacts, there is still considerable scope for improvement (Figure 26). In addition, the majority of the EcIA chapters in this study considered cumulative impact assessment to include only an assessment of the combined impacts as a result of planned and consented developments near the proposed development site. However, the EcIA Guidelines make it clear that "environmental trends" and "completed developments" should also be considered in this assessment (IEEM, 2006). This should also include consideration of interactions between on- and off-site impacts. For example, the synergistic interaction of noise and dust could have a greater impact on ecology than either impact in isolation. Merely identifying noise and dust as separately not having significant impacts on ecology, and therefore that they cannot have a significant interactive effect on ecology, is incorrect (similar statements were frequently found in cumulative impact assessment sections of EcIA chapters).

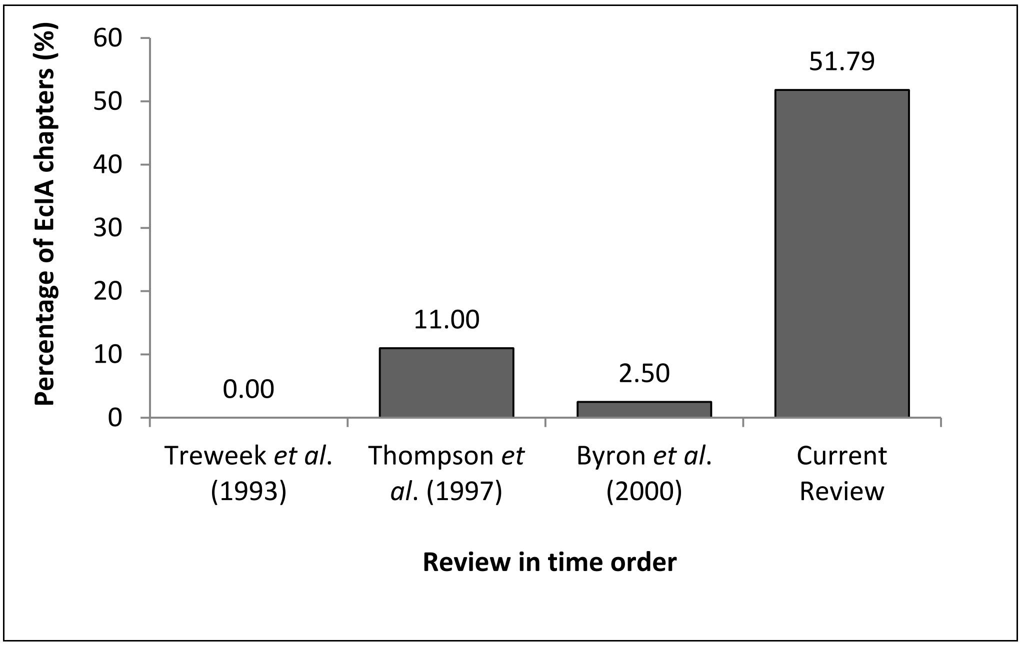


Figure 26: Change over time in the percentage of EcIA chapters considering cumulative impacts.

5.3.13 Presentation

EcIA Chapter Length

In the absence of the original length data from the Byron *et al*. (2000), a statistical comparison cannot be made between the two reviews (see Figure 27). However, the increased average percentage of the ES taken up by the EcIA chapter is a step in the right direction, particularly considering the increased maximum percentage. Despite this, a reduced minimum percentage means that improvements can still be made.

Of the 112 EcIA chapters, 19 (17.0%) comprised fewer than 10 pages, of which nine developments were situated in highly urbanised London locations (the short EcIA chapter length likely reflects the relatively low biodiversity in these areas). However, ten markedly short EcIA chapters remain for developments that were not situated in highly urban locations, which are therefore unlikely to present all relevant information. In addition to this, four (3.6%) EcIA chapters comprised more than 100 pages and would consequently be unlikely to be fully read or understood by all involved in the decision-making process (the recommended maximum length of an entire ES in the UK is 150 pages (DoE, 1995a)).

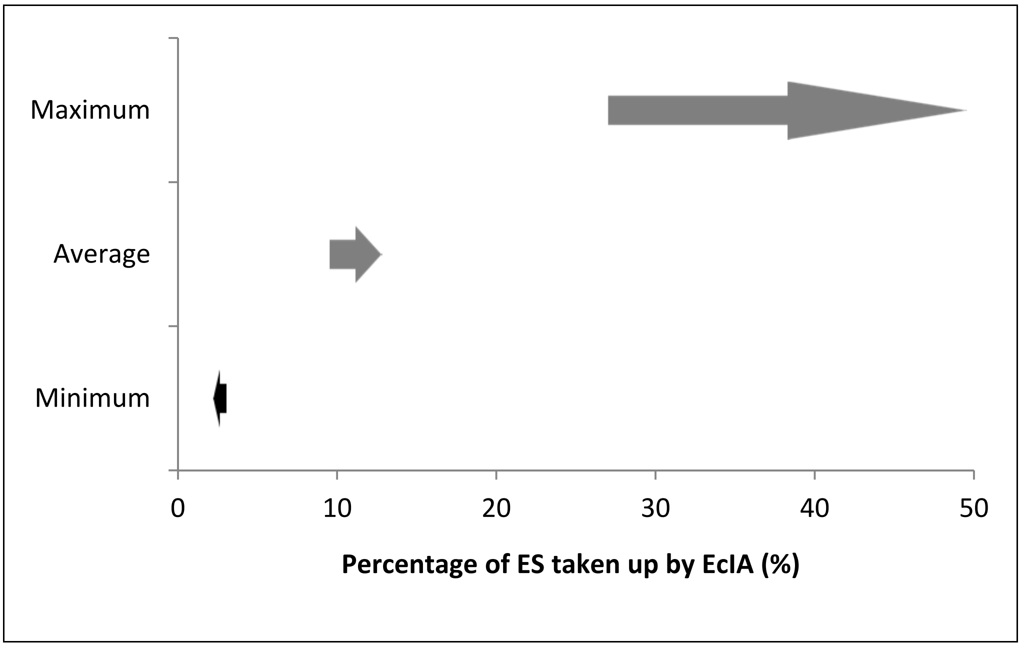


Figure 27: Change since the Byron et al. (2000) review in the percentage of the ES occupied by ecology. Grey arrows indicate an increase over time, whilst black arrows indicate a decrease over time.

Maps & Figures

Relevant maps and figures can be useful tools to support EcIA chapters, and the majority (91.1%) of EcIA chapters included them. Placing the proposed development site in the context of nearby designated sites is an important feature of EcIA chapters, yet over a third (35.7%) failed to include any maps showing designated sites. This is not significantly different from the findings of Byron *et al*. (2000), where 32.5% failed to include designated sites maps (Appendix 5.2, Pearson chi square = 1.105, df = 1, exact P = 0.348). One reason for not including a designated sites map could be that there were no designated sites in the vicinity. However, a comparison of whether or not the proposed development site was at least contiguous with a designated site, with the presence or absence of a designated sites map, showed no association between the two variables (Appendix 5.2, Pearson chi square = 2.760, df = 1, exact P = 0.118). Given the presence of other maps in the EcIA chapters (indicating the availability of mapping expertise and no space restrictions), the most probable reason for designated site map is poor professional conduct on the part of the consultants. This needs to be addressed in the next version of the EcIA Guidelines, as it is not currently included as a recommendation.

However, 94 (83.9%) EcIA chapters did include a Phase 1 habitat map of the proposed development site (although some of the maps were based on old data). This is a significant improvement on the findings of Byron *et al*. (2000), where 50% of EcIA chapters failed to include an habitat map (Appendix 5.2, Pearson chi square = 18.095, df = 1, exact P < 0.001). However, over a fifth (20.2%) failed to follow JNCC or other named habitat mapping guidelines and 20 (21.3%) failed to include any indication of the site boundary.

To fulfil their function as useful visual aids, maps and figures should be clear and appropriately labelled (e.g. maps should show scales). Of the 102 EcIA chapters that provided figures and/or maps, 16 (15.7%) failed to include appropriate scales or legends, where appropriate. A direct comparison with the Byron *et al*. (2000) review is not possible as the criteria for what constituted a 'clear' map in that study are unknown, but it was found that 12.5% of those EcIA chapters that included them failed to provide clear maps. This suggests that clear and useful mapping remains an area requiring improvement.

A 'Comments' column for this section revealed examples of hand-drawn maps (two EcIA chapters) and maps created using word processing software (one EcIA chapter), maps with indistinguishable colour codes and maps missing ecological features stated as present within the text of the EcIA chapter. A picture can be worth a thousand words, but such limitations will render them meaningless.

5.3.14 Recommendations from Previous Studies

Previous EcIA studies (i.e. not only EcIA chapter reviews) have included recommendations intended to improve various aspects of the EcIA process and EcIA chapter information content. A summary of these recommendations is provided in Table 12. Whilst some of these recommendations are specific to EcIA (e.g. development of EcIA guidelines and the earlier involvement of ecologists in project design), many can be generalised and have been recommended in studies of EIA. For example, formal review procedures have been recommended by Jones *et al*. (1991) and Weston (2000b), whilst EIA development follow-up has been proposed by Culhane (1993) and Marshall (2005).

Table 12: Summary of the recommendations made in earlier EcIA studies to improve the EcIA process and EcIA content.

Category / EcIA Stage	Recommendation	Study	Implemented?	Comments
Regulation	Establish a professional society.	(Spellerberg and Minshull, 1992)	✓	IEEM was established in 1991 through collaboration between its parent bodies; the British Ecological Society (BES), Institute of Biology (IoB), Royal Geographical Society (RGS) and British Association for Nature Conservationists (BANC). IEEM now has over 4,000 members and is currently considering petitioning for Chartered Status (Goriup *et al.*, 2012).
	Develop a register of biodiversity experts.	(Bagri *et al.*, 1998)	✓	IEEM has a Professional Directory on its website, allowing developers to search for professional and qualified ecologists and environmental managers (IEEM, 2012).
Guidance	Creation of EcIA chapter information guidance.	(Spellerberg and Minshull, 1992)	✓	IEEM published its Guidelines for Ecological Impact Assessment in the United Kingdom in 2006.
	Develop EcIA guidelines.	(Bagri *et al.*, 1998)	✓	
Knowledge	Create an EcIA literature	(Spellerberg and	✗	This is something that IEEM should consider establishing, particularly with

Category / EcIA Stage	Recommendation	Study	Implemented?	Comments
Transfer	abstracting service.	Minshull, 1992)		Open Access journals and articles becoming more prevalent.
	Collect and disseminate ‘best practice’ EcIA chapters.	(Bagri *et al.*, 1998)	✗	This is something IEEM should consider; creation of a library of EcIA chapters written by its members (as practised by IEMA with ESs) would be a useful first step.
Biodiversity Awareness	Create literature to publicise the importance of ecology in EIA for developers and CPAs.	(Spellerberg and Minshull, 1992)	✓/✗	The importance of ecology in impact assessment has increasingly been emphasised in grey (non-academic) literature (e.g. IAIA, 2005; CBD Conference of Parties, 2006; Byron, 2001). There is a gap, however, for a more targeted and direct approach to CPAs and developers as existing literature tends to focus on higher level organisations, such as governments.
Design	Ecologists should be involved earlier in EIA development design and planning.	(Treweek *et al.*, 1993)	✓/✗	The situation does appear to be improving, but it is recognised within the environmental consultancy industry that there are still many cases where ecologists could and should be brought in earlier to assist with the design process (Matrunola, 2007). The statutory nature conservation bodies, as well as IEEM, have an important role to play in ensuring that qualified and experienced ecologists are consulted early in the project design process

Category / EcIA Stage	Recommendation	Study	Implemented?	Comments
				(Environment Agency *et al.*, 2012). Ideally, all ecologists involved in the EcIA process should be IEEM members.
Baseline Survey	Official guidance or legislation for standard sampling and survey methods.	(Treweek, 1996)	✓	IEEM have created a "Sources of Survey Methods" section on their website, providing references and links to published survey guidance (IEEM, 2012). This gives ecologists the flexibility to choose the most relevant survey methods, rather than a generic survey standard.
Evaluation	Research on the evaluation of ecological data and development methods.	(Treweek, 1996)	✗	The EcIA Guidelines specifically move away from the matrix method of evaluation used in, for example, the DMRB Volume 11 (Highways Agency, 1992, as amended). However, there has been no research conducted on the effects of the change in evaluation methodology.
	Introduce an 'ecosystems' perspective into impact assessment.	(Bagri *et al.*, 1998)	✓/✗	There is increasing, though relatively recent, recognition of the importance of the ecosystem approach. Several studies have investigated the approach from an environmental management perspective (e.g. Thompson and Hearn, 2012) but comparatively few have been conducted within the context of EIA. This may be due to the difficulties arising from their independent origins (Coleby *et al.*, 2011).

Category / EcIA Stage	Recommendation	Study	Implemented?	Comments
Impact Assessment	There should be minimum requirements for quantification of predicted impacts.	(Treweek, 1996)	✗	The EcIA Guidelines state that quantitative data should be provided "if possible" but provide no stipulations as to which data should be quantified. As a minimum, however, the size of the development footprint (including off-site and temporary construction compounds) should be stated, and the areas of each habitat type to be lost quantified. These could perhaps be included in the pending revision of the EcIA Guidelines.
Review	CPAs should either review, or have reviewed, EcIA chapters promptly after submission.	(RSPB, 1995)	✓/✗	Some CPAs subcontract EIA reviews to environmental consultancies. However, this is rare and with only 41% of CPAs employing a full-time ecologist (Newey, 2012) the majority of CPAs will rely on statutory and non-statutory consultees for comments.
Follow-up	Research on follow-up ecological change.	(Spellerberg and Minshull, 1992)	✓/✗	Globally, there have been increasing numbers of studies monitoring ecological change in response to, for example, deforestation, climate change, etc. However, little research has been conducted on the impacts of built development on ecology.
	Establish a national follow-	(Spellerberg and	✗	An EIA follow-up scheme that included ecology would increase our

Category / EcIA Stage	Recommendation	Study	Implemented?	Comments
	up scheme for EIA projects.	Minshull, 1992)		knowledge of, and result in improvements to, built development impact prediction and mitigation measures, thereby helping to prevent net loss of biodiversity.
	Post-project follow-up of ecology should be included for every relevant EIA development.	(RSPB, 1995)	×	
	Introduce post-development follow-up.	(Treweek, 1996)	×	
	Project impacts should be formally follow-up.	(Treweek, 1996)	×	
	Introduce field-testing of impact predictions.	(Treweek, 1996)	×	

LEGEND

× = no, ✓ = yes, ✓/× = partly

N/A = not applicable

5.4 Auto-Critique

As described in Section 3.1.1, the use of inferential statistics to determine changes in EcIA chapter content over time has several disadvantages. In this study, attempts were made to limit those disadvantages, such as by ensuring that the questions asked were as similar as possible to the questions asked in the previous reviews, by ensuring that the range of answers that could be given to each question was comparable to those of earlier reviews, and by ensuring that there was no overlap in the EcIA chapters that were analysed (by introducing the threshold of the year 2000, three years after the latest study's EcIA chapters were written). In addition, whilst a matched pairs analysis was not possible within this study (not all of the previous reviews stated which ESs their samples were drawn from), a large sample size was possible, with a minimum of 37 and maximum of 194 EcIA chapters analysed in each of the previous reviews, and 112 EcIA chapters analysed in this study. However, other limitations remain. For example, there is potential for questions to have been interpreted differently by the different reviewers and each EcIA chapter will be unique in its context and constraints, making comparisons difficult.

Whilst necessarily an imperfect analysis that should be interpreted with caution, this attempt at using inferential statistics is considered to be a useful and important start to quantitatively identifying changes in EcIA chapter content over time, and has revealed where the greatest improvements have been made and where further work is required.

5.5 Conclusions and Recommendations

There has been some progress in the implementation of the earlier reviews' recommendations to improve the practice and quality of EcIA and EcIA chapters, and also some improvement in the information content of EcIA chapters. However, many EcIA chapters still fall short of the standards set by the EcIA Guidelines and this may be at least partially explained by the lack of full implementation of the previous studies' recommendations. The formation of a professional institute for ecologists was a particularly important step that has the potential to ensure further headway is made. However, the three main areas where progress is urgently required are in knowledge transfer, review and follow-up, all of which require considerable initial investment in terms of capital, personnel and technology.

5.5.1 Role of the Institute for Ecology and Environmental Management

Having been established in 1991, IEEM is now the "leading professional membership body representing and supporting ecologists and environmental managers in the UK, Ireland and abroad" (IEEM, 2012). Given the lack of local authority and statutory consultee capacity to help drive improvements in EcIA chapter content as a result of the current government's austerity measures (e.g. Natural England, 2010b), the recommendations in this study are primarily focused towards IEEM. This has its limitations, as IEEM is a relatively young professional institute (formed in 1991), and is also relatively small with fewer than 5,000 members (in comparison with IEMA's more than 15,000 members). Nevertheless, IEEM has the potential to contribute substantially to the improvement of EcIA practice and chapter content, for example in updating its EcIA Guidelines, bringing together knowledge and aiding in its transfer, EcIA chapter review and the implementation of a follow-up programme.

EcIA Guidelines Review

IEEM have published guidance on a wide range of topics, from ecological skills to ecological report writing. Arguably their most important guidance document, however, is the EcIA Guidelines. These were first published in 2006 and have undergone no revision to date, although IEEM established a Technical Review Group in April 2011 to review the EcIA Guidelines. One month later, a consultation document was produced and circulated to IEEM's membership. However, the final reviewed Guidelines have not yet been released.

As a result, there is still a potential opportunity to amend the Guidelines in the light of the research findings of this EcIA review. These amendments include (although are not limited to) recommendations to:

- emphasise the importance of conducting, and reporting on, consultations throughout the EcIA process;

- provide the names, qualifications and experience of all ecological consultants involved in the EcIA process;
- emphasise the importance of stating survey methodologies;
- attach greater emphasis to the consideration of the 'do nothing' scenario;
- quantify the total land take of the proposed development;
- quantify the habitats to be lost to the proposed development;
- propose modifications for 'risky' or critical mitigation if unsuccessful;
- emphasise the importance of assessing residual impacts;
- provide further elaboration on the types of impacts that should be considered in the cumulative impacts assessment;
- include a designated sites map;
- use the JNCC Phase 1 habitat codes, or similar, in Phase 1 habitat maps; and
- show the site boundary on all relevant maps.

All of these recommendations would help improve the reliability of the EcIA chapter (as well as making it easier and quicker to assess), and therefore potentially the confidence that consultees and CPAs can place in it as an effective decision-making tool.

The impact of the existing EcIA Guidelines is discussed in Chapter 6, but it is clear that not all of those EcIA chapters stating the use of the Guidelines are following them. This highlights the need for an IEEM-led EcIA chapter review and enforcement process (see Section 5.5.1). Whilst there is an argument for producing sector-specific EcIA guidance (see, for example, Volume 11 of the DMRB for Environmental Assessment (Highways Agency, 1992, as amended)), the time and costs involved, when the recommendations are likely to be very similar across sectors, does not make this a viable proposition. The focus should instead be on reviewing EcIAs produced by IEEM's members and ensuring that use of the EcIA Guidelines is enforced.

Knowledge Transfer

Knowledge can be held by individuals, teams, corporations, institutions and government. Knowledge transfer can occur in many different forms and through many different methods, for example through training (formal and informal), and through conversation and reading. The bringing together of current EcIA and EIA knowledge in an accessible format to aid knowledge transfer, for example in the form of an online document repository, is perhaps the least difficult area to develop. EcIA chapters and EcIA literature can now be stored and accessed online and EcIA chapters can be 'donated' by IEEM's members. The US, for example, publishes details of submitted ESs (US EPA, 2012) and China may establish an online repository (Xin and Wencong, 2012). IEMA also holds a library of ESs contributed by its members, access to which is a benefit of membership (IEMA, 2013). The primary difficulty lies in issues of copyright and data protection (e.g. for biological records purchased by the developer, for sensitive data such as badger sett locations, and for journal articles). However, these are not insurmountable and the resultant service would provide sufficient benefit to IEEM's members (as well as CPAs, developers, EcIA and EIA researchers and the public) to justify the implementation and maintenance costs of an online and publicly accessible EcIA document repository. This is particularly the case since there are no indications that a national ES database and library will be established, despite widespread recognition of its benefits, such as increased public scrutiny (Newey, 2012).

EcIA Chapter Review

Despite numerous EIA and EcIA review studies having recommended formal review procedures since the early 1990s (see Table 12), this has still not been implemented. One major barrier is the lack of political will to support such a scheme: given the large numbers of ESs submitted each year, a review process could be prohibitively expensive. In addition, factoring in the cost of an ES review into the planning application fee would be unpopular in the current political climate, where the planning system is seen as a barrier to economic growth (Vivid Economics, 2012). A formal EIA review procedure is therefore unlikely to be implemented in the near future and so an indirect route to EcIA chapter review may be required. IEEM could play a crucial role in this, by establishing a checklist and panel of experts to review a sample of the EcIAs submitted by its members to the online repository each year (ideally the professional institutes for other technical disciplines would also conduct similar reviews). The results and main issues requiring improvement could be anonymised and published in IEEM's quarterly journal, In Practice. Severe breaches of IEEM's Guidelines within a reviewed EcIA chapter could be addressed individually by IEEM. Whilst ambitious, such a review system is not unknown. IEMA, for example, regularly conducts ES reviews and recently established an EIA Quality Mark for organisations producing ESs (IEMA, 2011). Importantly, review alone is insufficient; dissemination of results and enforcement are crucial.

Follow-up

Follow-up is a more complex area to develop, partly as there are several different types, not all of which may be appropriate in every case. A discussion of two different follow-up types (implementation audit and effectiveness monitoring) and recommendations to improve their practice can be found in Chapters 8 and 9, respectively. Follow-up has been included in the European Commission's proposals to amend the EIA Directive but there are several issues with the wording of the proposals that limit their utility (see Section 2.7.2). IEEM, potentially in collaboration with its European partner organisations, could lobby for changes to be made to the EIA Directive proposals to ensure effective follow-up in EIA.

Arguably, effective knowledge transfer should be developed first, both in order to develop a library of EcIA chapters for review and to provide a suitable repository for the documentation a monitoring programme would produce. This should, therefore, be the next priority for IEEM once it has achieved its current goal of Chartered status.

CHAPTER 6: Biodiversity Assessment Index

6.1 Aims and Objectives

The aim of the EcIA chapter scoring system in this chapter is to provide a tool to analyse EcIA chapter information content to meet the following objectives:

- to identify those variables most closely associated with 'good' or 'inadequate' EcIA chapter quality;
- to determine whether the introduction of the EcIA Guidelines has resulted in improvements in EcIA chapter information content (both legally required and recommended), hereafter referred to as EcIA chapter quality.

6.2 Method

6.2.1 Legislation and Guidance Biodiversity Assessment Indices

To maintain consistency with previous work (Atkinson *et al.*, 2000; Söderman, 2005; Khera and Kumar, 2010), the term 'biodiversity assessment index' was retained in this study: in EIA systems, 'ecology' and 'biodiversity' are often used interchangeably. Of the 459 questions included within the current review's EcIA chapter database (for details of the review methodology, see Section 5.2), 36 questions were chosen as representative of the EcIA Guidelines' best practice recommendations and 11 were chosen as representative of the information requirements under Article 5 and Annex IV of the EIA Directive (Council of the European Union, 1985, as amended). Using the formula (see Equation 1) developed by Atkinson *et al*. (2000), two aspects of EcIA chapters were assessed; namely compliance with the legislation and whether the EcIA chapter follows the best practice recommendations of the EcIA Guidelines (Vun *et al.*, 2004). The Legislation BAI was calculated from the 11 questions that were directly linked with the EIA Directive under Article 5 and Annex IV, whilst the Guidance BAI was restricted to the 36 questions linked to the EcIA Guidelines. Whilst the EcIA Guidelines include all of the legally required information, this separation into two indices with mutually exclusive criteria is intended to establish the effect of the EcIA Guidelines over and above compliance with the legislation. The questions used to calculate these two BAIs are provided in Appendix 6.1.

The index calculation produces a value between zero and one for each EcIA chapter. A score of zero indicates that none of the questions was answered in any way within an EcIA chapter, whilst a score of one indicates that every question was answered fully. The index calculation takes into account partial answers and so a score of 0.5 could indicate either that every question was partially answered, or that half of the questions were fully answered, or a mixture of the two.

Equation 1: Biodiversity assessment index equation.

Biodiversity Assessment Index = $\frac{(1.0 \times A)(0 \cdot 5 \times B)}{C}$

where

A = the number of review questions fully addressed

B = the number of review questions partially addressed

C = the total number of review questions addressed

Adapted from Atkinson *et al*. (2000).

An important modification in the current BAI calculation is that 'C' is free to vary, depending on the number of questions that are applicable to an EcIA chapter. For example, in a few cases (particularly EcIAs for developments in highly urbanised areas of London) there may have been no ecological surveys conducted and therefore no acknowledgement of survey limitations. This overcomes the problem identified by Atkinson *et al*. (2000) and Söderman (2005) of question interdependence leading to artificially low index scores.

The BAI calculation has several advantages over an existing ES review package or a simple technical chapter checklist review. First, the calculation can be made regardless of the review criteria chosen, and so can be applied to a review tailored to a particular technical chapter rather than the entire ES. Second, it provides a proxy for 'quality of content' (as opposed the quality of process that the most commonly used review packages assess). This allows easy comparison of individual EcIA chapter information, rather than showing trends in the provision of certain types of information (such as mitigation commitment) across EcIA chapters (although see Section 2.2 for a discussion of the difficulties in defining ‘quality’). This therefore also allows both easier ‘before and after’ comparisons and investigations into other variables potentially affecting EcIA chapter quality to be made. Third, the use of a formula in calculating the BAI helps to reduce (though not eliminate) the issue of inter-reviewer variability. Whilst reviewers may answer questions slightly differently, there is no subjective score aggregation process as used in the ES review packages (Põder and Lukki, 2011).

Predictors of EcIA Chapter Information Content Quality

A literature review of ES and EcIA reviews was conducted to determine which predictors were previously identified as varying with ES or EcIA information content (see Table 4 in Section 2.2.3). The two predictors relating to experience (of the developer and consultants, and of the CPA and consultees) were not directly investigated in this study due to the difficulty of obtaining this information for 112 planning applications. However, the CPA experience was estimated by identifying its tier (e.g. county, district, etc.): higher tier CPAs were anticipated to receive greater numbers of EIA applications and therefore have greater expertise in the EIA process. The relationships of the remaining predictors and the use of the EcIA Guidelines with the two different BAIs were then explored using the method outlined in Section 6.2.2.

The same method was also used for additional predictors not identified within the literature review but considered as having the potential to affect EcIA chapter quality. These were also analysed using the method outlined in Section 6.2.2 and comprise:

- the stated use of the EcIA Guidelines;
- the CPA’s involvement in the development (e.g. whether or not it proposed the development);
- whether or not the planning application was subject to public inquiry;
- the proportion of the ES occupied by the EcIA chapter; and
- the presence of designated sites on or adjacent to the proposed development site.

Due to the difficulty in obtaining accurate information, the requirement for an Appropriate Assessment as a result of the proposed development’s potential impacts on Natura 2000 sites (SACs and SPAs) was not considered in this study. It was anticipated that projects for which an Appropriate Assessment would be required would be more likely to follow the legislation information requirements and best practice requirements due to their controversial nature and the possibility of being called in for public inquiry by the Secretary of State, e.g. Dibden Bay Container Terminal, (Secretary of State for Transport, 2004), or of legal challenge by environmental groups . However, the designated sites predictor is considered to be a useful proxy for this information.

Again due to the difficulty in obtaining accurate information, the use of Regulation 19 of the EIA Regulations was not investigated. As Regulation 19 requests by the CPA for further information potentially indicate the presence of experienced planning officers and/or the use of CPA ecologists, it was anticipated that where ESs were amended as a result of Regulation 19 requests the EcIA chapter information content would be improved. In total, 14 predictor variables were selected; one continuous (year of submission) and 13 categorical (see Table 13).

6.2.2 Data Analysis

Comparison of Legislation and Guidance BAI Means

To determine whether there was a significant difference between the mean scores of the Legislation and Guidance BAIs, the paired-samples t-test was used (each pair of Legislation and Guidance BAIs was drawn from the same EcIA chapter). This analysis was carried out using SPSS (IBM SPSS Statistics 19).

As the predictor variables included both continuous and categorical variables, different statistical tests were conducted to analyse their relationship with the BAIs.

Influence of Categorical Predictor Variables

Each of the categorical predictors' relationship (including the use of the EcIA Guidelines) with the two BAIs in the current review was initially investigated using the one-way ANOVA. In order to check the assumptions of parametric tests, the Shapiro-Wilk test in combination with histograms were used to determine whether the BAI data was normally distributed according to the individual predictor variables. In the event of the data not meeting the assumption of normality, the non-parametric Kruskal-Wallis test was used, along with pairwise comparison post-hoc tests where appropriate.

Levene's statistic for homogeneity of variance was also calculated for each ANOVA test. This statistic is commonly used to assess variance equality amongst samples, which is required for parametric statistical tests, such as ANOVA. Where the assumption of homogeneity of variance was violated (Levene's test's null hypothesis of equal variances was rejected), skewness was checked and Welch's ANOVA was used, as it helps to correct for heteroscedasticity with unequal sample sizes, assuming that skewness values (the ratio between the skewness statistic and its standard error) are not greater than 2.0 (Glass *et al.*, 1972; Lix *et al.*, 1996).

Where significant differences between three or more means (for categorical variables with three or more levels) were identified with ANOVA, the Bonferroni post-hoc test was applied to determine which means were significantly different from each other. Where significant differences between three or more means were identified with Welch's ANOVA, the Tamhane T2 post-hoc test was applied (this is a conservative test used where the assumption of homogeneity of variance is not met). Using these post-hoc tests, it was possible to determine whether the number of levels for each categorical predictor variable could be reduced to avoid the issue of overfitting (Ginzburg and Jensen, 2004). For example, England is split into nine Government Office Regions, some of which could be combined with little loss of information and conforming to the principle of parsimony (e.g. Johnson and Omland, 2004). These analyses were carried out using SPSS (IBM SPSS Statistics 19).

Where influential outliers were identified from the Normal Q-Q Plots, these were removed and the removal stated in the analysis results section. For those analyses where one-way ANOVA could be conducted, the R^2 value was calculated by dividing the between groups sum of squares by the total sum of squares. R^2 is an indication of the 'goodness of fit' of the data around a regression line by estimating the variability in the data that is explained by the independent variable. Importantly, neither R^2 nor the p-value indicate causality.

Influence of Continuous Predictor Variables

The relationship of the planning application submission year with the two BAIs was investigated using linear regression. The assumption of normality for each analysis was investigated using histograms of residuals and Normal Q-Q Plots, whilst the assumption of homogeneity of variance was investigated using plots of the standardised residuals against the standardised predicted values. Where influential points (significant outliers) were identified from the residual vs. predicted value plots, these were removed and the removal stated in the analysis results section. These analyses were carried out using SPSS (IBM SPSS Statistics 19).

Predictor Variable Combination with the Greatest Explanatory Power

As not all of the predictor variables conformed to the assumptions of parametric tests, a Generalized Linear Model (Nelder and Wedderburn, 1972), rather than multiple linear regression, was used to determine which combination of predictors had the greatest influence on both BAI scores. Due to the large number of predictor variables in comparison to the sample size, interaction effects were not investigated. This analysis was conducted using Statistica (Statsoft Statistica 10).

There is general consensus in the literature that the 'true' or even an 'optimal' model to explain a given dataset does not exist (e.g. Anderson and Burnham, 2002; Whittingham *et al.*, 2006) and so this exercise is an attempt to reduce the 14 predictor variables for BAI scores to a smaller and more manageable number of predictors (principle of parsimony). As a result, backward stepwise deletion of the most non-significant predictor variables was conducted (e.g. Guernier *et al.*, 2004; Peltzer *et al.*, 2008), despite its limitations, (Whittingham *et al.*, 2006; Mundry and Nunn, 2009; Freckleton, 2011).

6.3 Results and Discussion

6.3.1 Legislation and Guidance BAI Overview

The means of both of the BAIs are less than 0.5 (see Figure 28). This is of considerable concern, as it indicates that fewer than half of the legislative information requirements and guidance recommendations are being included in EcIA chapters. It was anticipated that the mean BAI score calculated from the best practice information requirements (Guidance BAI) would be not be as high as for a BAI calculated entirely from the legally required information requirements (Legislation BAI). Indeed, the Legislation BAI has a significantly higher mean score than the Guidance BAI (Appendix 6.3, t-test for paired samples = 2.112, df = 111, P = 0.037), but there is also a significant positive correlation between the two BAI means (Appendix 6.3, Correlation = 0.563, n = 112, P = <0.001). This suggests that the information requirements of the EIA Directive, as applied to ecology, are being met more often than the guidance recommendations, but that EcIA chapters with high levels of legal compliance are also more likely to include the EcIA Guidelines' best practice recommendations.

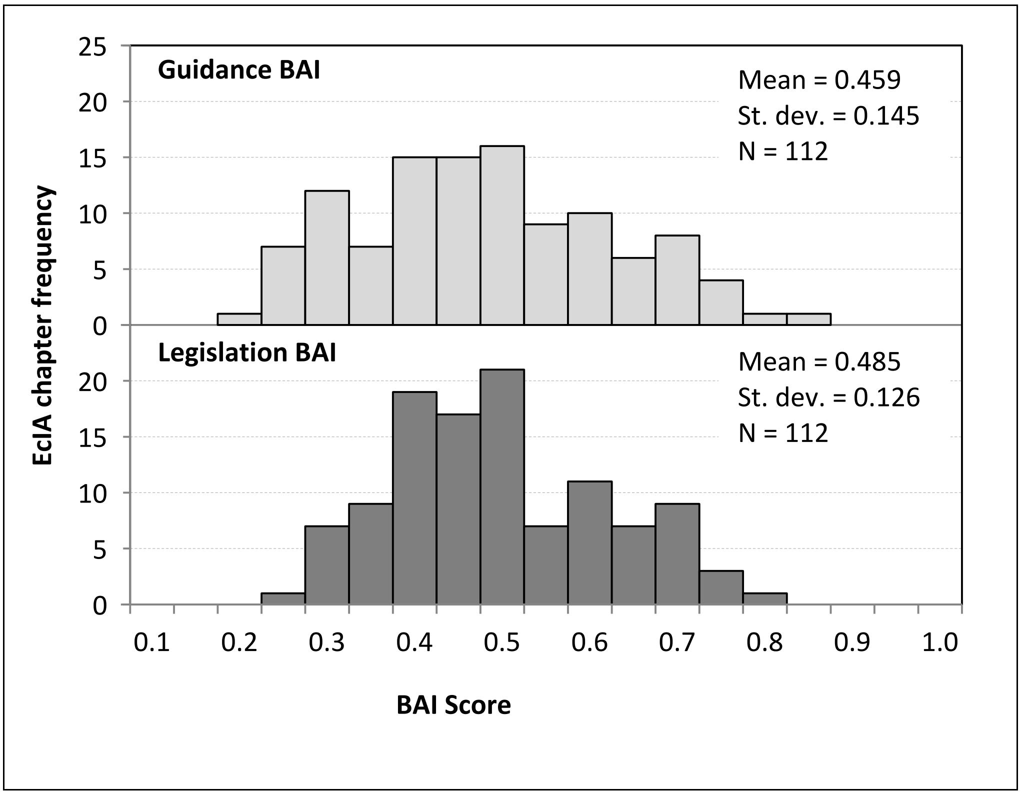
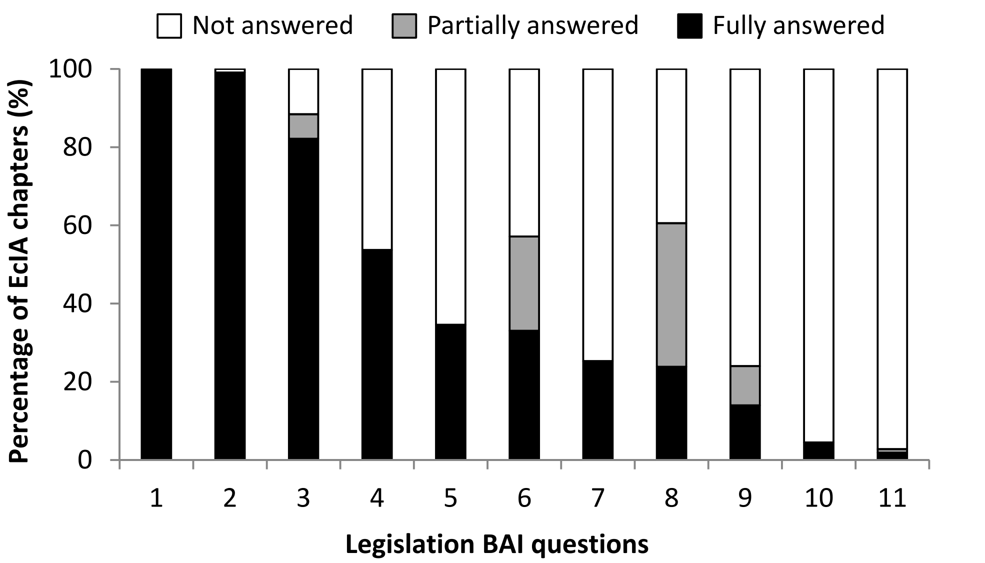


Figure 28: Frequency distributions and descriptive statistics of the two calculated Biodiversity Assessment Indices (BAIs).

Of the questions that comprised the Legislation BAI, the most frequently answered were also the most basic (see Figure 29). By virtue of including an EcIA chapter in the ES, ecological impacts were by definition considered and identified. Whilst mitigation is important, this analysis did not consider the suitability or likely effectiveness of the mitigation proposed. As a result, high rates of EcIA chapters proposing mitigation were to be expected. The consideration of social or economic impacts of biodiversity loss was not expected to be high, given that this is an area only recently gathering attention as a result of the increasingly high profile of the ecosystem services movement (e.g. Millennium Ecosystem Assessment, 2005; TEEB, 2010b). However, the lack of consideration of climate change and global warming impacts on ecology was unexpected and of concern, given that these issues have been widely publicised over the past several decades. Indeed, this issue was recognised in a 2009 report on the effectiveness of the EIA Directive (Commission of the European Communities, 2009a). Whilst it could be argued that considerations of climate change on ecology should be restricted to Strategic Environmental Assessment (SEA), it is entirely feasible for 'future-proofing' to be employed in EcIA chapter mitigation recommendations to help minimise the impact of climate change on ecology. The general lack of consideration of off-site construction areas was also of concern given that these can occupy large areas (e.g. road working corridors).

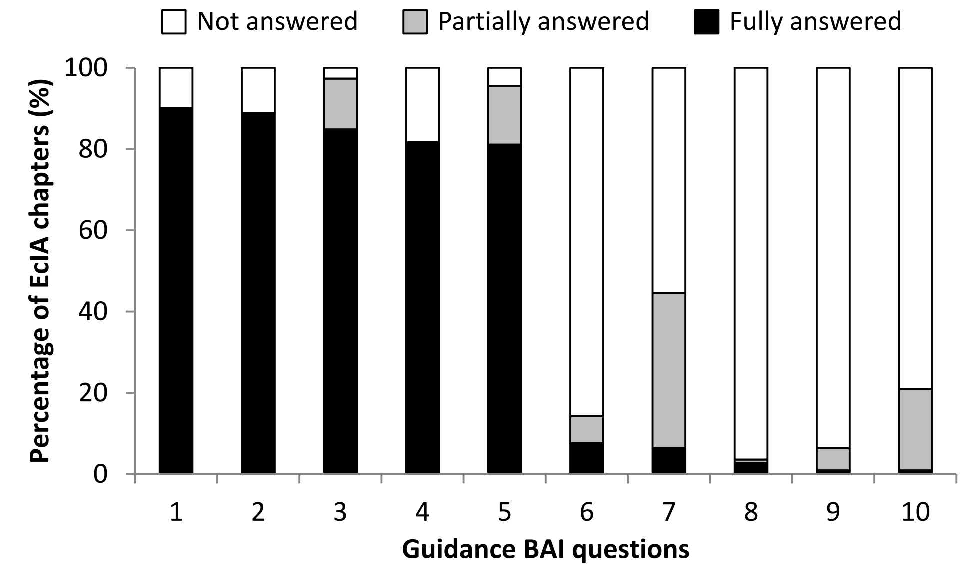


Legend

1. Are ecological impacts identified? N = 112
2. Is ecological mitigation of impacts described? N = 112
3. Is the size of the proposed development site provided? N = 112
4. Are complex / interactive / cumulative ecological impacts considered? N = 108
5. Are alternative processes / designs / methods considered for ecology? N = 110
6. Are direct versus indirect impacts explicitly identified? N = 112
7. Are alternative sites considered with reference to ecology? N =91
8. Did all surveys acknowledge limitations? N = 109
9. Is the off-site construction area ecology described? N = 50
10. Any reference made to climate change impacts on ecology? N = 111
11. Are economic / social consequences of biodiversity loss considered? N = 108

Figure 29: Best and worst answered questions from the Legislation BAI. N varies as not all questions were relevant to all EcIA chapters.

Due to the large number of questions used for calculating the Guidance BAI, only the five best and five worst answered questions are displayed in Figure 30. Two of the worst answered questions relate to mitigation measure descriptions; time to effectiveness and likely success. This is of considerable concern, as without this information it is not possible for CPAs to make informed judgements on the likely residual impacts. The lack of consideration of future decommissioning impacts is also of concern. However, now that demolition has been included in the definition of projects potentially requiring EIA (European Commission v Ireland, 2011), it is likely that this will change into the future. Whilst genetic biodiversity surveys for EIA projects are usually inappropriate, consideration should be given to the potential for population fragmentation and isolation, and the impacts this could have on genetic biodiversity. The poor consideration of the timing and frequency of ecological impacts as a result of proposed developments is unexpected, as this is relatively basic information.



Legend

1. Have records from the local records centres been obtained? N = 111
2. Was the Phase 1 habitat survey conducted using named guidelines? N = 99
3. Has the significance of all identified impacts been stated? N = 112
4. Is the proposed timescale of construction activities given? N = 109
5. Are all impacts identified as positive, neutral or negative? N = 111
6. Are decommissioning impacts explicitly identified? N = 105
7. Are the timing and frequency of all impacts given? N = 110
8. Is any mention made of genetic biodiversity? N = 112
9. Is the likely success of all mitigation measures indicated? N = 110
10. Is the time until mitigation is likely to become effective given? N = 110

Figure 30: Five best and five worst answered questions from the Guidance BAI. N varies as not all questions were relevant to all EcIA chapters.

6.3.2 Significant Predictors of the Guidance BAI

The Guidance BAI will be considered in this section, with the Legislation BAI considered in Section 6.3.3. To avoid repetition, the initial data exploration (including category combination and outlier removal) of predictor variables that significantly affect both BAIs will only be described in this section, although they will also apply to the Legislation BAI.

EcIA Guidelines

The earliest submission of an EcIA stating the use of the final EcIA Guidelines was October 2006. This was taken as the benchmark date before which submitted EcIAs are considered unlikely to have utilised the final version of the EcIA Guidelines. EcIAs submitted after this date without referencing the final EcIA Guidelines were considered to have declined the opportunity to use them. The three possible EcIA Guideline use scenarios were coded as 'Yes' (use of final EcIA Guidelines), 'No' (declined use of final EcIA Guidelines) and 'N/A' (final EcIA Guidelines were unavailable at time of writing). However, whilst an initial exploration of the use of the EcIA Guidelines (Used, Declined and Not Applicable) using Welch's ANOVA identified a significant difference between means (Appendix 6.3, $F_{2, 37.173} = 7.984$, $P = 0.001$), there was no significant difference between those EcIA chapters that declined the use of the EcIA Guidelines and those EcIA chapters written prior to the EcIA Guidelines' publication (Appendix 6.3, Tamhane post hoc: "No" and "N/A" $P = 0.969$). As a result, these two categories were combined and compared with EcIA chapters that did state the use of the EcIA Guidelines.

Welch's ANOVA revealed that those EcIA chapters that stated the use of the EcIA Guidelines had significantly higher mean Guidance BAI scores in comparison with those that did not use the EcIA Guidelines (see Figure 31), either because they were unavailable or from choice (Appendix 6.3, $F_{1, 107.279} = 19.029$, $P < 0.001$). This is an encouraging result, as it indicates that the EcIA Guidelines have had a positive effect on EcIA chapters. The publication of the EcIA Guidelines likely resulted in increased awareness amongst EcIA practitioners of the importance of information provision in EcIA chapters. In addition, by providing a framework against which EcIA chapter content could be assessed, the EcIA Guidelines likely also ensured that internal review processes could be more robust. However, this interpretation must be considered with caution, as the effects of time and the increasing experience of developers, consultants, CPAs and consultees are also likely to play important roles in the quality of EcIA chapters (see the following Sections).

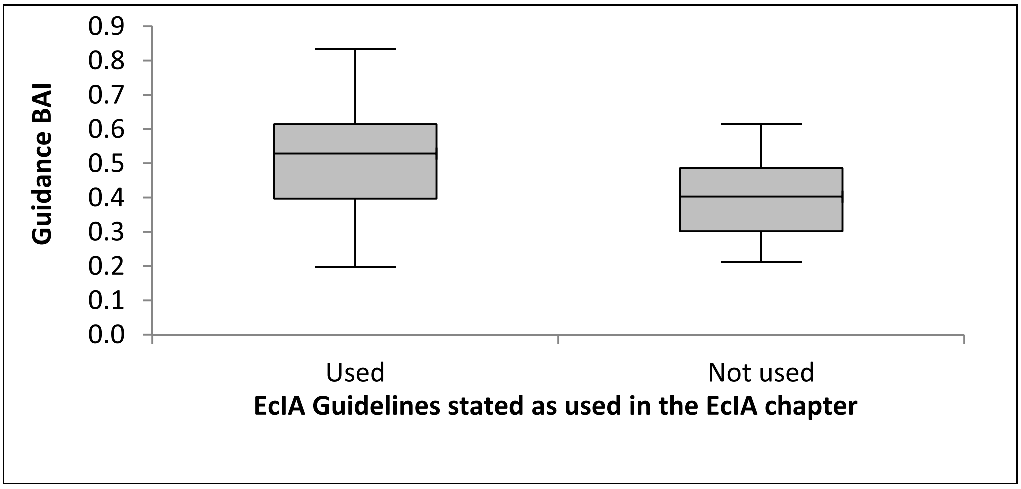


Figure 31: Change in Guidance BAI scores with the use of the EcIA Guidelines.

Year of Planning Application Submission

A linear regression analysis revealed a significant influence of planning application submission year on Guidance BAI scores (Appendix 6.3, R^2 = 0.073, n = 112, P = 0.004, see Figure 32). However, the variability in the scores explained by submission year was very small (7.3%) and so other predictor variables are likely to be important in explaining Guidance BAI scores. Whilst a small but statistically significant improvement over time was identified, this result contrasts with the "marked improvement in the proportion of satisfactory EIA" with time found in a previous study (Barker and Wood, 1999), perhaps because the learning curve for EcIA practitioners levelled off after that study was conducted.

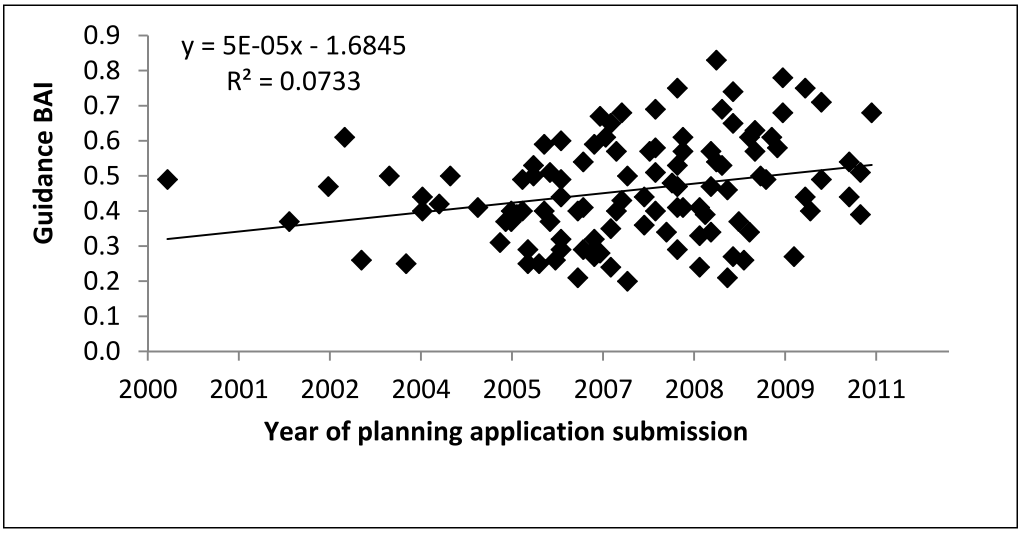


Figure 32: Change in Guidance BAI scores with year of planning application submission.

Proposed Development Size

Whilst size can be considered to be a continuous variable, the presence of a few very large proposed developments as outliers meant that categorisation into three size class categories was more appropriate for analysis. These categories were chosen to reflect small, medium and large development sizes: '<10 hectares', '10-100 hectares' and '>100 hectares'. Of the 112 ESs reviewed, 19 failed to state the proposed development size. These EcIAs were therefore removed for this analysis.

There were highly significant differences in mean Guidance BAI scores depending on the size of the proposed development (Appendix 6.3, one-way ANOVA, $F_{2, 90}$ = 8.886, P < 0.001, R^2 = 0.165, Figure 33). Proposed developments of less than 10 hectares in size had significantly lower Guidance BAI scores than those of greater than 10 hectares (Appendix 6.3, Bonferroni post hoc: '<10 hectares' and '10-100 hectares' P = 0.003, '<10 hectares' and '>100 hectares' P = 0.004). However, there was no significant difference between sites of 10 to 100 hectares and sites of greater than 100 hectares (Appendix 6.3, Bonferroni post hoc: '10-100 hectares' and '>100 hectares' P = 0.784).

This echoes the findings from previous studies that ESs and EcIA chapters for smaller developments tended to be of lower quality (Lee and Colley, 1992; Oxford

Brookes University Impact Assessment Unit, 1996; Barker and Wood, 1999). This may reflect their reduced potential for significant ecological impacts in comparison to larger developments. This may result in a reduced concern by all those involved in the EcIA process (including CPAs and consultees) to ensure that the EcIA chapter complies with the EcIA Guidelines' best practice information recommendations. However, whilst smaller developments are less likely to result in significant environmental impacts than larger developments, this is not always the case. Even if the inclusion of an EcIA chapter within an ES is simply part of a box-ticking exercise to avoid legal challenge, the size of the development should not affect the quality of the information content within the EcIA chapter: where information is to be omitted, the reasoning should be made clear.

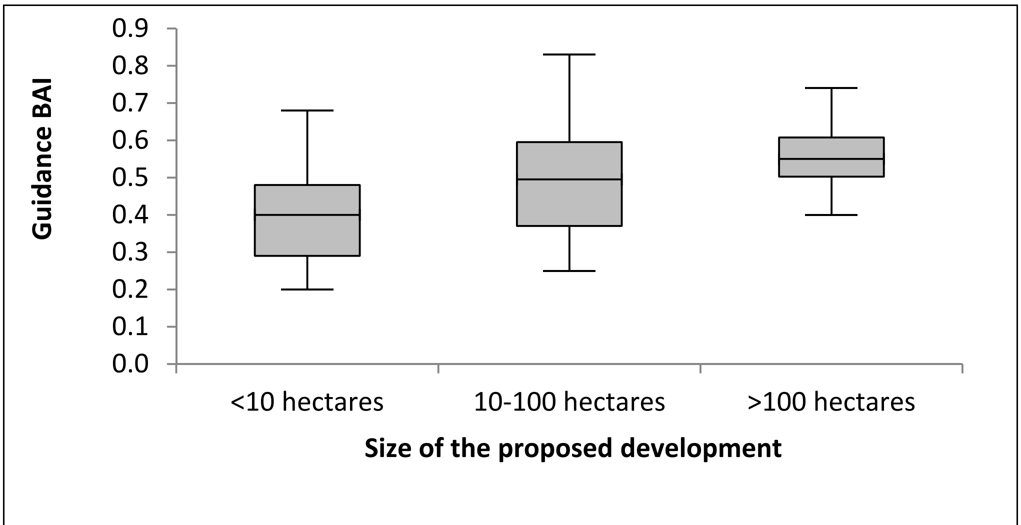


Figure 33: Change in Guidance BAI scores with increasing size of the proposed development.

Location of the Proposed Development

Initial exploration of the nine English Government Office Region, or GOR, data (ONS, 2010) identified a significant relationship between region and the Guidance BAI (Appendix 6.3 , one-way ANOVA, $F_{8, 101}$ = 2.988, P = 0.005, R^2 = 0.191), but only for the North West and London (Appendix 6.3, Bonferroni post hoc: London and North West P = 0.004). As a result, it was considered appropriate to combine the London, South West and South East GORs into one 'South' category, with the remaining GORs combined into one 'North' category.

Further data exploration identified two cases (EcIA chapters) as influential outliers, having higher than expected BAI scores. One was likely due to the controversial London site having been the subject of multiple planning applications over a relatively short time period, potentially resulting in EcIA chapter improvements over time as surveys were repeated and consultants changed. The second was likely due to the road development having a high likelihood of requiring public inquiry. Both EcIA chapters were removed from further analysis.

There was a significant difference between the mean Guidance BAI scores for proposed developments in the North and South of England (Appendix 6.3, one-way ANOVA, $F_{1, 108} = 17.660$, $P < 0.001$, $R^2 = 0.141$). Whilst there was a small loss in the variability explained in this combined model (14% compared to 19%), the reduction in the number of categories and the subsequent ease of interpretation was sufficiently useful to compensate for this.

EcIA chapters for proposed developments located in northern England had higher mean scores than those for developments in southern England (see Figure 34). The reasons for the higher quality of northern EcIA chapters are unclear. Northern CPAs, which tend to be more economically deprived than southern CPAs (Anyadike-Danes, 2004), would perhaps be expected to encourage built developments bringing employment and therefore be less stringent in their review processes. It may be that with fewer EIA developments in northern England, CPAs take a more cautious approach to EcIA chapter assessment as a result of lack of experience in comparison with CPAs in southern England.

Figure 34: Change in Guidance BAI scores with proposed development location.

Designated Sites

It was anticipated that the presence of designated sites (whether statutory or non-statutory) on or adjacent to the proposed development site would increase its visibility, both to the public but also to the CPA and statutory nature conservation consultees. As a result, it was considered that a more thorough approach to the EcIA would be taken, with a corresponding improvement in the BAI scores. This was indeed found to be the case for the Guidance BAI scores of the 107 EcIA chapters that stated whether or not designated sites were located on or adjacent to the proposed development site (Appendix 6.3, one-way ANOVA, $F_{1, 105} = 5.892$, $P = 0.017$, $R^2 = 0.053$, see Figure 35). However, only 5% of the data's variability was explained by the presence of designated sites and so this does not appear to be a strong predictor of Guidance BAI scores.

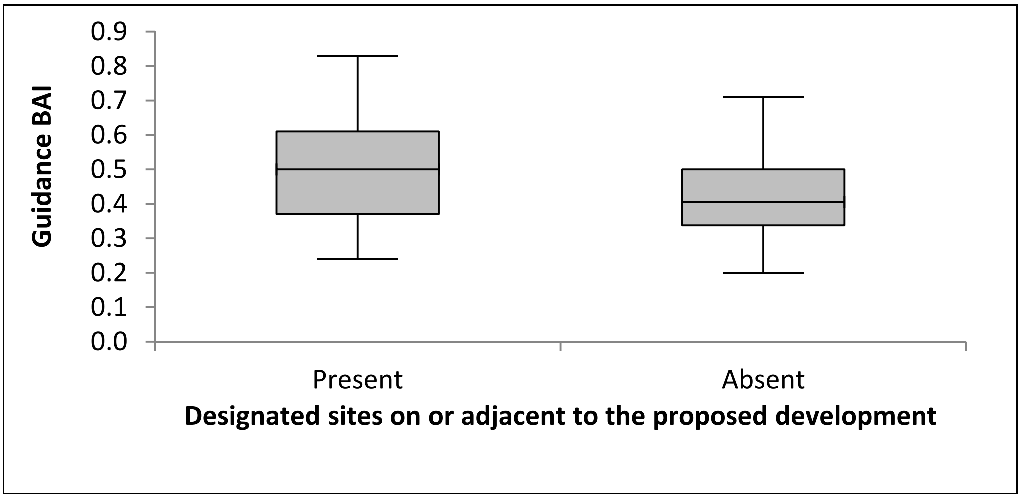


Figure 35: Change in Guidance BAI scores with presence or absence of designated sites (statutory and/or non-statutory) on or adjacent to the proposed development site.

CPA Involvement in the Proposed Development

The CPA was involved in 33 (29.5%) of the 112 proposed developments, most frequently proposing the development, and with the CPA owning three of the proposed development sites. It was anticipated that CPA involvement could result in EcIA chapters of slightly lower quality: increased familiarity between the CPA and the consultants could result in unintentional under-reporting of information within the EcIA chapter. However, the opposite was found to be the case for the Guidance BAI scores (Appendix 6.3, one-way ANOVA, $F_{1,110} = 4.947$, $P = 0.028$, $R^2 = 0.043$, see Figure 36). This may have been to help ensure that no accusations of bias, or a potential High Court challenge, could be made by the public.

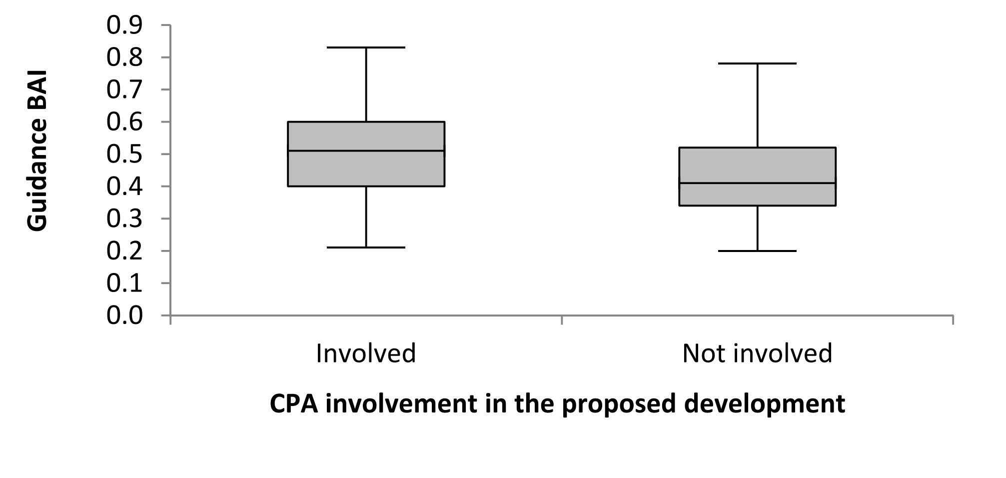


Figure 36: Change in Guidance BAI scores with CPA involvement in the proposed development.

CPA Tier to which the Planning Application was Submitted

During the initial data exploration, one influential outlier was identified and removed. This was a London development with a higher than expected BAI score, likely a result of the multiple planning applications that had been submitted for the iconic site over a short period of time.

It was anticipated that higher tier CPAs will have had the greatest number of EIA planning applications and therefore the greatest experience in assessing EIA planning applications, including ESs. It was considered that greater experience would result in greater demands in terms of information content and therefore higher BAI scores. Indeed, a one-way ANOVA identified a significant relationship between CPA tier and mean Guidance BAI score (Appendix 6.3, $F_{5, 105} = 3.926$, P = 0.003, $R^2 = 0.158$). However, the only significant differences were between London borough councils and district councils, and between London borough councils and other CPA tiers, such as the Forestry Commission (Appendix 6.3, Bonferroni post hoc: London Borough and District P = 0.022, London Borough and Other P = 0.016). In both cases, the EcIA chapters submitted to London borough councils were of lower quality according to the Guidance BAI score than those submitted to district councils or other CPA tiers (see Figure 37).

Several of the EcIA chapters submitted to London borough councils were for small (less than one hectare) proposed developments in heavily urbanised sites, which were highly unlikely to have significant ecological impacts. Whilst consideration of ecology is commendable and to be encouraged, an EcIA chapter in these cases was not strictly required. This may explain why many of the best practice recommendations were not included within these EcIA chapters: it was likely not considered necessary by the consultants to do so, given the lack of ecological receptors.

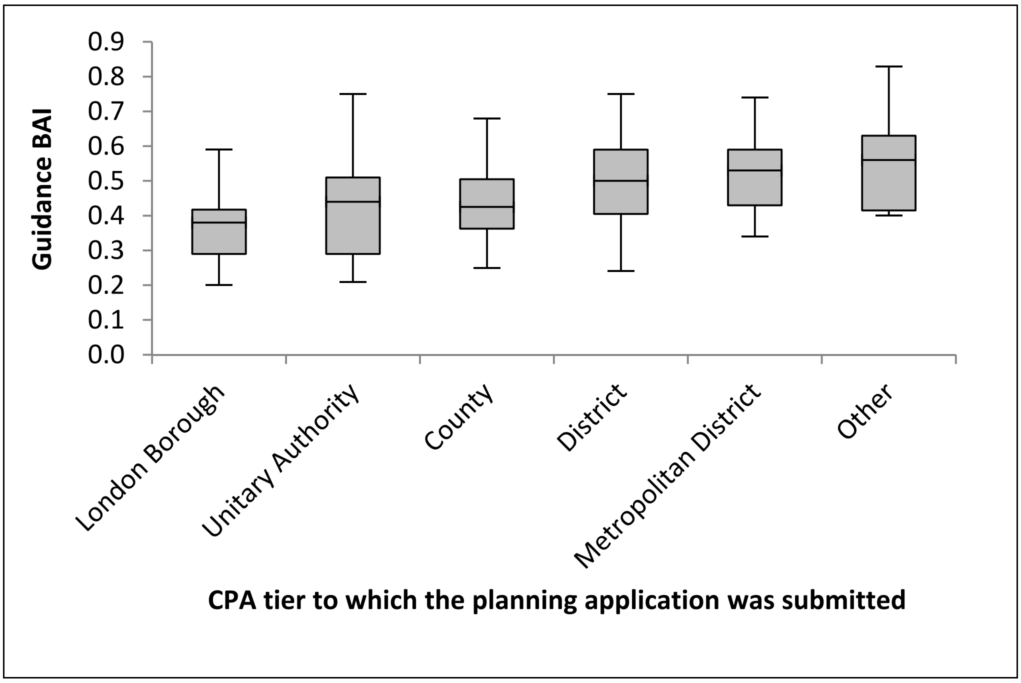


Figure 37: Change in Guidance BAI scores with the CPA tier to which the planning application was submitted.

Ecological Consultancy Type

The majority of EcIA chapters were written and co-ordinated by the ecology team of a multidisciplinary environmental consultancy (79.6% of the 108 EcIA chapters for which the authors could be determined). Many of these chapters included input from specialist independent ecological consultancies, and these were themselves the lead authors of 20.4% of EcIA chapters. Whilst it could be theorised that specialist independent ecological consultancies would write more comprehensive EcIA chapters, this was not found to be the case for the Guidance BAI (Appendix 6.3, one-way ANOVA, $F_{1,106} = 4.956$, $P = 0.028$, $R^2 = 0.045$, see Figure 38).

This is considered unlikely to be due to a relative lack of EcIA experience: as was pointed out in an earlier study, "New consultancies may employ experienced practitioners" (Oxford Brookes University Impact Assessment Unit, 1996). This is particularly relevant now that there is a large body of experienced EIA and EcIA practitioners in the UK, many of whom move from multidisciplinary consultancies to establish their own specialist independent consultancies (this trend has been exacerbated amongst EcIA practitioners in recent years by the economic crisis, partly because ecology is a seasonal discipline). In multidisciplinary consultancies, each chapter is not only reviewed by senior members of the technical team but also by the ES co-ordinator. In small, specialist independent consultancies, however, the opportunities for such internal review are reduced, potentially resulting in information gaps being missed.

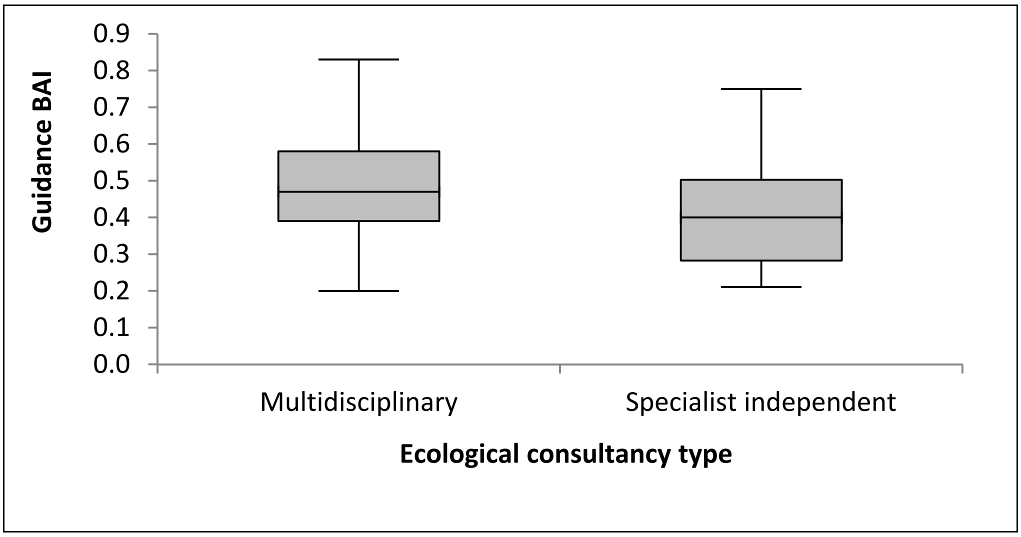


Figure 38: Change in Guidance BAI scores with the type of ecological consultancy that authored the majority of the EcIA chapter.

EcIA Chapter Length

During the initial data exploration, an influential outlier was identified. The EcIA chapter was over 500 pages in length and had higher than expected BAI scores. This large, partially publicly funded bridge project had the potential to cause major ecological impacts. It therefore required considerable consultation with the public and statutory and non-statutory consultees, which may have resulted in information gaps being identified and rectified. To reduce the impact of outliers without reducing the dataset, this continuous variable was therefore split into three categories: less than 20 pages, between 20 and 40 pages, and greater than 40 pages.

EcIA chapters were found to range in length from four to 134 pages, with an average of 30.5 pages (excluding the 514 page EcIA chapter). It was anticipated that short EcIA chapters would have lower Guidance BAI scores than longer EcIA chapters. This was indeed found to be the case (Appendix 6.3, one-way ANOVA, $F_{2, 109} = 34.810$, $P < 0.001$, $R^2 = 0.390$, see Figure 39). Short EcIA chapters have a greater likelihood of information gaps simply by virtue of their length. However, the longest chapters were not necessarily the best in terms of addressing information gaps (Lee and Colley, 1992; Oxford Brookes University Impact Assessment Unit, 1996; Barker and Wood, 1999). For example, of the five EcIA chapters longer than 75 pages, three scored less than 0.70 on the Guidance BAI.

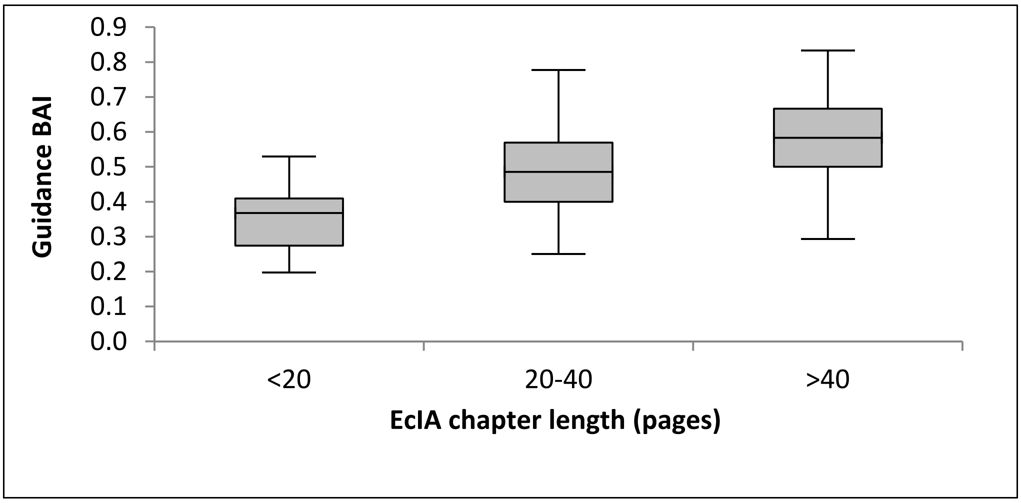


Figure 39: Change in Guidance BAI scores with EcIA chapter page length.

Proportion of the ES Occupied by the EcIA Chapter

Whilst EcIA chapter length was considered to be an important predictor of quality, it was possible that the emphasis given to ecology within the ES itself could be an indication of EcIA quality. It was anticipated that the greater the proportion of the ES occupied by the EcIA chapter, the higher the EcIA chapter's quality was likely to be. During initial data exploration, one influential outlier was identified and removed from this analysis. This EcIA chapter (for a proposed business park) was found to comprise almost 50% of the entire ES, which unusually included only three technical chapters, including ecology. From a sample of 25 of the 112 EcIA chapters reviewed, the average number of technical chapters in the ES was 11.

A one-way ANOVA identified a significant positive relationship between the proportion of an ES occupied by the EcIA chapter and the Guidance BAI (Appendix 6.3, $F_{2,109} = 12.926$, $P < 0.001$, $R^2 = 0.192$, see Figure 40). Whilst important, this appears to be a less explanatory predictor of EcIA quality than EcIA chapter length, as only 19% of the variability in the data is explained, compared to 39% for the EcIA chapter length. This may be because ESs for large developments (which have been shown to have significantly higher Guidance BAI scores) may contain up to 20 technical chapters, potentially (although not necessarily) reducing the proportion of the ES that can be occupied by ecology.

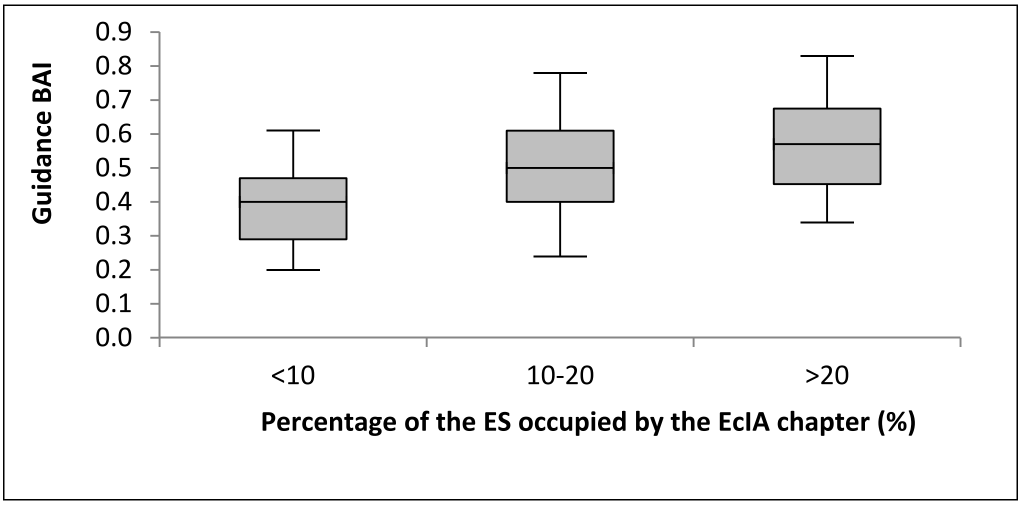


Figure 40: Change in Guidance BAI scores with increasing percentage EcIA chapter occupation of the ES.

6.3.3 Significant Predictors of the Legislation BAI

EcIA Guidelines

The results of the initial data exploration can be found in Section 6.3.2. It was postulated that whilst in theory the EcIA Guidelines should not have had any effect on legal compliance of EcIA chapters, it was considered that in practice they would have a positive impact on the inclusion of legally required information. This does appear to be the case, with a significantly higher median Legislation BAI score for those EcIAs that stated the use of the EcIA Guidelines in comparison with those that did not (Appendix 6.3, Kruskal-Wallis test, H = 5.949, df = 1, P = 0.015, see Figure 41). The EcIA Guidelines include both the legislative information requirements and best practice recommendations for EcIA chapter content. By raising awareness with EcIA practitioners of the latter, it is likely that they also raised awareness of the former.

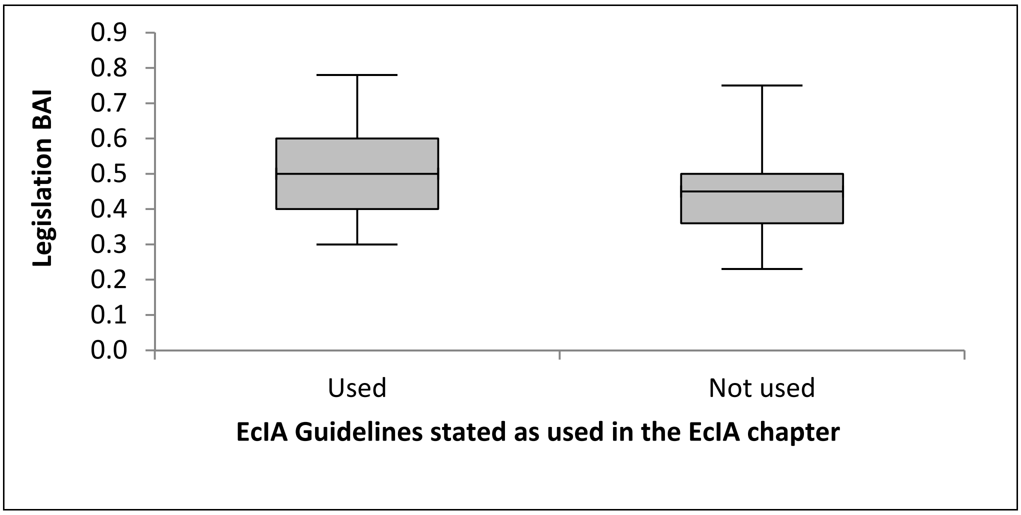


Figure 41: Change in Legislation BAI scores with the use of the EcIA Guidelines.

Location of the Proposed Development

The results of the initial data exploration can be found in Section 6.3.2. There was a significant difference between the mean Legislation BAI scores for proposed developments in the North and South of England (Appendix 6.3, one-way ANOVA, $F_{1, 108}$ = 5.018, P = 0.027, R^2 = 0.044). EcIA chapters for proposed developments located in northern England had higher mean Legislation BAI scores than those for developments in southern England (see Figure 42). As for the Guidance BAI, the reasons for this are unclear but may be related to lack of EIA planning application experience and caution in ES assessment.

Figure 42: Change in Legislation BAI scores with proposed development location.

Ecological Consultancy Type

The results of the initial data exploration can be found in Section 6.3.2. As with the Guidance BAI, the mean Legislation BAI score was significantly higher for EcIA chapters that were authored by the ecology teams of multidisciplinary consultancies than those that were authored by specialist consultants/consultancies (Appendix 6.3, one-way ANOVA, $F_{1, 106} = 7.396$, $P = 0.008$, $R^2 = 0.065$, see Figure 43). As postulated for the Guidance BAIs, this may partly be the result of a relative lack of EcIA experience in comparison to multidisciplinary consultancies, but also potentially due to the reduced opportunities for robust internal review.

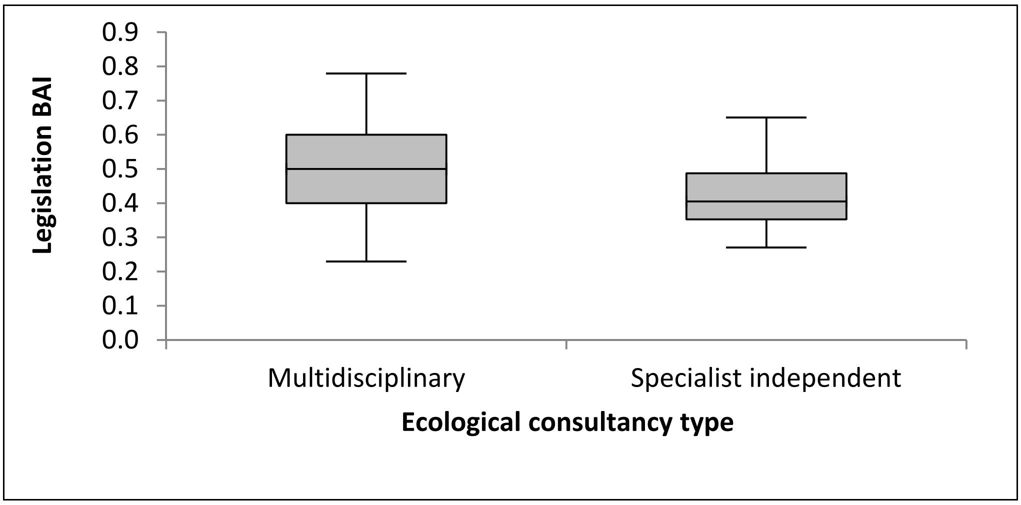


Figure 43: Change in Legislation BAI scores with the type of ecological consultancy that authored the majority of the EcIA chapter.

EcIA Chapter Length

The results of the initial data exploration can be found in Section 6.3.2. One-way ANOVA revealed a significant relationship between the Legislation BAI scores and the EcIA chapter length (Appendix 6.3, $F_{2, 109} = 4.482$, $P = 0.013$, $R^2 = 0.076$, Figure 44). As for the Guidance BAI, short EcIA chapters are almost by definition more likely to contain information gaps. However, the longest EcIA chapters are not necessarily the best in terms of information content: the five EcIA chapters with the highest Legislation BAI scores (excluding the 514 page EcIA chapter) had an average length of 65 pages and the highest scoring EcIA chapter was 31 pages in length.

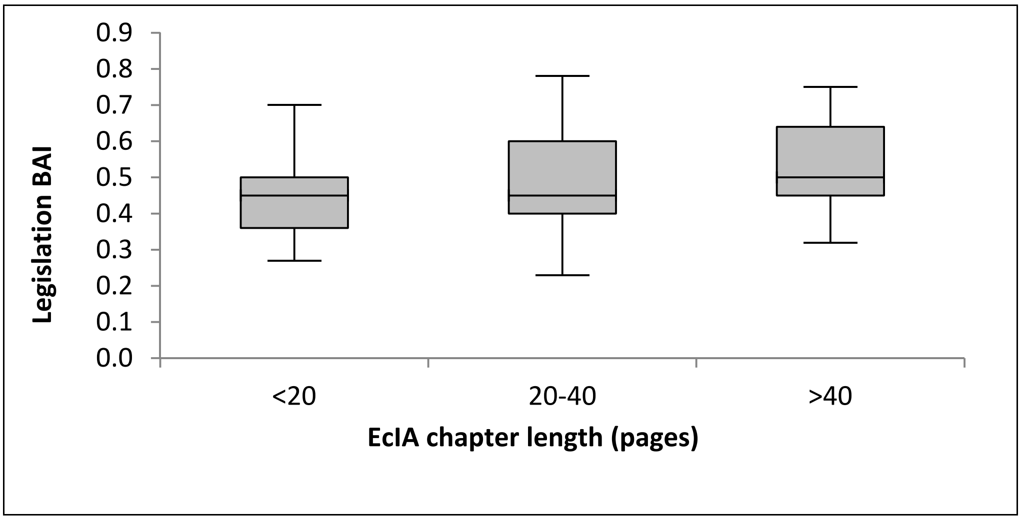


Figure 44: Change in Legislation BAI scores with increasing EcIA chapter length.

Lead Consultancy Independence

Of the 112 EcIA chapters, there were only five instances of the lead consultancy being affiliated to the developer (see Chapter 1 for an example of consultancy affiliation with a developer). As expected, the independence of the lead consultancy from the developer was found to have a significant relationship with the Legislation BAI (Appendix 6.3, Kruskal-Walls, H = 4.532, df = 1, P = 0.033), with independent lead consultancies scoring higher than consultancies affiliated with the developer (see Figure 45). Independent consultancies have a professional reputation to maintain that could suffer from allegations of non-independence.

It would be expected that a significant relationship between lead consultancy independence and the Legislation BAI would accompany a significant relationship with the Guidance BAI. However, this was not the case (Appendix 6.3, Kruskal-Wallis, H = 0.464, df = 1, P = 0.496). Nevertheless, this finding does highlight the importance of consultancy independence in the EIA process. Whilst there is still potential for pressure to be placed on independent consultants by developers, who are their effective employers, that potential is less than for consultancies that form part of the developers' organisation.

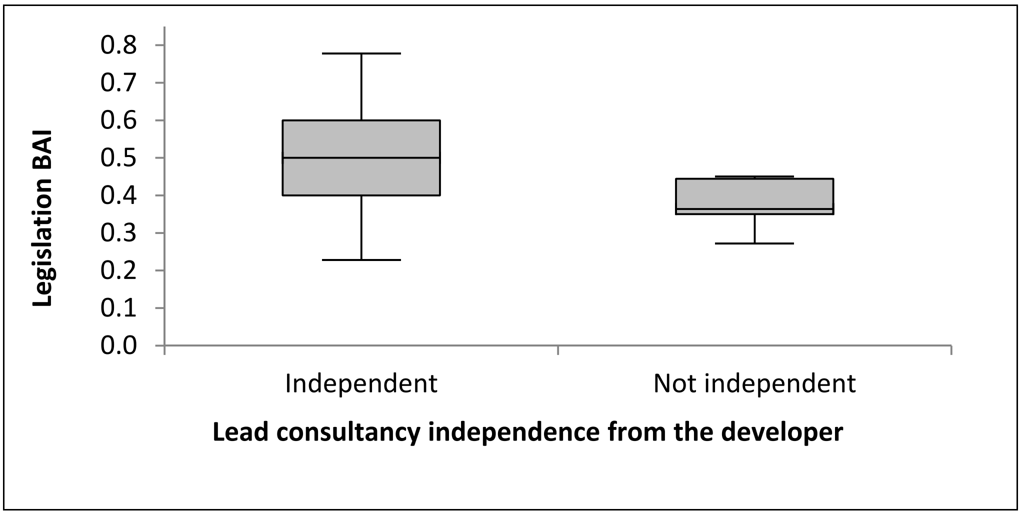


Figure 45: Change in Legislation BAI scores with lead consultancy independence.

6.3.4 Non-significant Predictors of the BAIs

Three of the 14 predictor variables had non-significant effects on either of the two BAIs.

Planning Application Type

Of the 112 EcIA chapters reviewed in this study, 64 (57.1%) were submitted as part of full planning applications and 33 (29.5%) as part of outline planning applications. The application type could not be determined for six EcIA chapters and nine were submitted as other planning application types (e.g. reserved matters). Due to the small numbers of unknown and other planning application types, these were removed from the analysis and only the differences in EcIA chapter quality between full and outline planning applications were investigated.

Analyses revealed no significant difference in the median Legislation and Guidance BAI scores for outline and full planning application EcIA chapters (Appendix 6.3, ANOVA $F_{1, 95}$ = 0.001, df = 1, P = 0.979 and Appendix 6.3, Kruskal-Wallis H = 3.057, df = 1, P = 0.080, respectively), although it should be noted that the mean Guidance BAI was higher for outline than for full planning applications (0.48 in comparison to 0.43): there was no difference between the mean Legislation BAI scores. This is a departure from the finding of the Oxford Brookes University Impact Assessment Unit (1996). It is possible that the change is due to that study being conducted over 15 years ago on a relatively small sample (25 matched pairs) of ESs rather than EcIA chapters. However, it is considered likely that the change is at least partly related to case law requiring outline planning applications to provide more detail than was previously considered necessary (R v Rochdale Metropolitan Borough Council ex parte Tew and others, 1999).

Proposed Development Sector

The original 18 categories for development sector were combined for ease of analysis into five categories; ‘waste’, ‘energy’, ‘transport’, ‘extraction’ and ‘mixed-use & residential’. Energy developments had the highest mean Guidance BAI scores (0.52), followed by transport and extraction (both 0.48), mixed-use and residential (0.43), and waste (0.41). A slightly different pattern was seen for the

Legislation BAI, with the highest mean scores for energy developments (0.54), followed by transport (0.50), mixed-use and residential (0.47) waste (0.45), and extraction (0.44). However, there was no significant difference in the mean Legislation and Guidance BAI scores for different development sectors (Appendix 6.3, Kruskal-Wallis, H = 6.581, df = 4, P = 0.160 and Appendix 6.3,one-way ANOVA, $F_{4, 107}$ = 1.912, P = 0.114, respectively).

This is a departure from the findings of several early studies, which identified relationships between poor quality EcIA chapters and ESs for, for example, urban development and residential projects (RSPB, 1995; Oxford Brookes University Impact Assessment Unit, 1996; Barker and Wood, 1999). An early review of EcIA practice found that "ecological impact assessment has emerged as a subdiscipline which is often under-resourced" (Treweek, 1996, p. 191). However, with an increasing body of case law and with increasing public awareness of ecological issues, the standardisation of EcIA chapter quality across development sectors may be due to the greater emphasis that has been placed on EIA and particularly on ecology within EIA over time.

Public Inquiry Conducted

A link was suggested between quality and development controversy in an earlier study (Barker and Wood, 1999). To help test this, the influence of public inquiry on the BAIs was analysed as a proxy for controversy (the 112 EcIA chapters analysed were the most recent submissions, including any amendments made by addenda or revised EcIA chapters for the public inquiry). Whilst mean Adequacy and Legislation BAI scores were higher for those developments for which a public inquiry was conducted (0.49 and 0.51, respectively) in comparison to those for which a public inquiry was not conducted (0.45 and 0.48, respectively), the differences were not found to be significant (Appendix 6.3, one-way ANOVA, $F_{1, 110}$ = 0.997, P = 0.320 and Appendix 6.3, one-way ANOVA, $F_{1, 110}$ = 1.099, P = 0.297, respectively).

Whilst this is one sense encouraging (i.e. that there is some standardisation across EIA planning applications that do and do not go to public inquiry), the low average Legislation and Guidance BAI scores suggest another explanation; that planning inspectors, like CPA planning officers, do not seem to rely on the ES for decision-making and so do not identify and/or require information gaps to be addressed. Indeed, early studies of the influence of the ES on decision-making revealed this to be the case (e.g. Wood and Jones, 1995; Wood and Jones, 1997, see Section 1.2 for further details) and the results of this study may suggest that this has not changed, although further work would be required to confirm this.

6.3.5 Summary of Individual Predictor Variables

The influence of the 14 predictor variables on both BAIs can be found in Table 13. Of interest, however, is the small number of predictor variables significantly influencing the Legislation BAI in comparison with the Guidance BAI. This is potentially explained by a combination of the lack of change in the legislative information requirements over the time period the ESs in this study were drawn from (2000 to 2011), and continued granting of planning permission despite ES information gaps. This would likely result in a lack of impetus for changing EcIA chapter legally required information content, regardless of proposed development size (Appendix 6.3, one-way ANOVA, $F_{2, 90} = 2.282$, $P = 0.108$), the presence of designated sites (Appendix 6.3, Kruskal-Wallis, $H = 0.466$, $df = 1$, $P = 0.495$), CPA involvement (Appendix 6.3, Kruskal-Wallis, $H = 0.336$, $df = 1$, $P = 0.562$), or the CPA tier to which the planning application was submitted (Appendix 6.3, one-way ANOVA, $F_{5, 105} = 0.857$, $P = 0.512$). The inclusion of best practice (as opposed to legally required) information in EcIA chapters, on the other hand received a boost as a result of the publication of the EcIA Guidelines. The lack of change in Legislation BAI over time (Appendix 6.3, $R^2 = 0.023$, $n = 112$, $P = 0.112$) would not necessarily be a negative finding if the baseline were sufficiently high. However, given a mean score of 0.49, the lack of improvement is of concern.

Table 13: Summary of individual predictor variable influence on the two Biodiversity Assessment Indices.

Number	Predictor Variable	Significant influence of predictor variable on BAI?	
		Legislation BAI	Guidance BAI
1	Use of EcIA Guidelines	✓	✓
2	Year of submission	×	✓
3	Proposed development size	×	✓
4	Proposed development location	✓	✓
5	Designated sites on/adjacent to the proposed development site	×	✓
6	CPA involvement	×	✓
7	CPA tier	×	✓
8	Ecological consultancy type	✓	✓
9	EcIA chapter length	✓	✓
10	Proportion of the ES occupied by the EcIA chapter	×	✓
11	Lead consultancy independence	✓	×
12	Planning application type	×	×
13	Proposed development sector	×	×
14	Public inquiry conducted	×	×
Legend ✓ = significant influence on BAI ($P \leq 0.05$) × = no significant influence on BAI ($P > 0.05$)			

6.3.6 Predictor Variable Combination with the Greatest Explanatory Power

The independence of the lead consultancy from the developer predictor variable was removed from these analyses, as only five of the lead consultancies were directly affiliated with the developer (two extraction projects, an afforestation project, a renewable energy plant, and a park and ride facility). This meant that there were insufficient comparisons between both levels of this variable and the other predictor variables for analysis. All other data were included, including missing or unknown values (all coded as 'Unknown'). All of the final model parameters for both analyses were significant at the 0.05 level or below. As the aim is not to predict the BAI scores for past or future EcIAs, the parameter estimates tables will not be presented here but can be found in Appendix 6.3.

Guidance BAI

The variables with the greatest explanatory power for the Guidance BAI are of interest considering that two of the predictor variables (planning application type and proposed development sector) were not individually significantly associated with Guidance BAI scores (see Table 14 and Section 6.3.2). This is due to the presence of the other variables in the model: planning application type and proposed development sector significantly influence Guidance BAI scores once any differences due to the other variables in the model have been taken into account.

It is encouraging to see the use of the EcIA Guidelines in the final model: their use results in improved Guidance BAI scores (see Appendix 6.3). As a result, greater emphasis should be given to promoting their use to ecological consultants and they should be updated to reflect the differences in information and detail that are required for outline and full planning applications. IEEM could also provide training courses tailored to specific development sectors in an effort to reduce the differences in EcIA chapter information content for developments from different sectors.

Table 14: Final Guidance BAI model predictors.

Parameter	P-value
Intercept	<0.001
Use of the EcIA Guidelines	<0.001
EcIA chapter length	<0.001
Planning application type	0.001
Proposed development sector	0.018

Legislation BAI

As with the analysis of the influence of the individual predictor variables, the Legislation BAI was represented by a smaller number of predictor variables than the Guidance BAI (see Table 15). However, the EcIA Guidelines once again played an important role, with EcIA chapters stating the use of the EcIA Guidelines having higher Legislation BAI scores than those that did not. Interestingly, ecological consultancy type was also included in the final model, with ecology teams from multidisciplinary consultancies producing EcIA chapters with higher Legislation BAI scores than specialist ecological consultancies. This is of considerable concern, as the Legislation BAI assesses EcIA chapters' inclusion of legally required information. It may be that training budgets are lower for specialist ecological consultancies than for ecologists in multidisciplinary consultancies.

Table 15: Final Legislation BAI model predictors.

Parameter	P-value
Intercept	<0.001
Use of the EcIA Guidelines	0.005
Ecological consultancy type	0.017

6.4 Auto-Critique

This quantitative analysis using only EcIA chapters assessed by the same reviewer removes several of the biases and potential issues discussed in the auto-critique of the previous chapter (see Section 5.4). However, as with grade aggregation in the most commonly used EIA checklists, the amalgamation of scores for individual questions into one overall score (either the Guidance BAI or the Legislation BAI) will inevitably result in loss of detail and information. In order to partially compensate for this, the best and worst answered questions were described for both BAIs in Section 6.3.1.

Despite the loss of detail, the use of an aggregated score for EcIA chapter content does provide a useful proxy that can be compared with factors that are considered to have an effect on EcIA chapter content. The importance of the EcIA Guidelines in determining EcIA chapter 'quality' that this approach has revealed demonstrates the utility of this approach in comparison with purely qualitative assessments of EcIA chapters. Nevertheless, it is not considered that a purely quantitative approach is ideal for the analysis of EcIA chapters; both approaches are valid and provide useful insights. As described in Chapter 3, this study attempts to highlight the potential uses of quantitative methods, specifically inferential statistics, in the study of EcIA chapters, other ES chapters, and entire ESs, which has traditionally been dominated by the qualitative approach and descriptive statistics.

6.5 Conclusions and Recommendations

This study is the first comprehensive attempt to identify the variables linked with EcIA chapter quality and to determine which have the greatest explanatory power. This will allow more effective targeting of efforts to improve EcIA chapter quality. Whilst not a novel approach, the BAI calculation has been applied for the first time to English EcIA chapters and has been modified to address one of its main criticisms (see Section 6.2.1). The recommendations in this chapter are aimed at those tasked with quality assurance within EcIA (such as IEEM).

6.5.1 EcIA Guidelines

This assessment of the effectiveness of the EcIA Guidelines shows that their stated use in an EcIA chapter corresponds to a statistically significant increase in both Adequacy and Legislation BAI scores. This is emphasised by the inclusion of the use of the EcIA Guidelines in both the Guidance and Legislation BAI combined predictor models. This should be capitalised on by publicising the EcIA Guidelines to all IEEM members in a more active manner (currently, the EcIA Guidelines are publicly available but not advertised). The establishment of a formal EcIA chapter review process was recommended in Section 5.5 . In the absence of any other quantitative approach to reviewing EcIA chapters, this review process could utilise a BAI combining both compliance with legislation and adherence to guidelines. This would allow detailed analyses of trends over time and changes in predictor variables as a result of future changes in policy, legislation and/or guidance. Whilst useful, this should not be the only review method as the BAI will not pick up, for example, innovative approaches to problem-solving or outstanding treatment of just one theme within the EcIA chapter (e.g. a thoroughly researched and well-justified evaluation section).

6.5.2 Training

Given the low mean Legislation and Guidance BAI scores, training is required for ecological consultants to improve the information content of EcIA chapters. This training need not be prescriptive. As stated by Lawrence (1997), "A greater level of consistency can be achieved and still leave room for innovation and adaptation." However, as the time and funding available for training courses is limited for the majority of ecological consultants, IEEM could consider creating an online, distance-learning EcIA training course, potentially leading to accreditation (see Section 6.5.3). Currently, IEEM offer one- and two-day courses on EcIA, but without some form of attendance requirement, there will be many consultants who write EcIA chapters that have not attended such courses, and indeed consultants who write EcIA chapters who are not members of IEEM or even possess a background or training in ecology. As a result, an accreditation scheme may be the most efficient method to ensure widespread training.

6.5.3 Accreditation

Given the generally poor levels of compliance with the legislative information requirements in EcIA chapters, IEEM could introduce an accreditation scheme whereby only qualified members write EcIA chapters. This could either be required in order to reach certain levels of membership, or preferably be in the form of an additional qualification for those members who require it (not all ecological consultants or environmental managers will write or contribute to EcIA chapters). Crucially, this accreditation scheme should not rely solely on peer review, but include an examination, to ensure that procedural and substantive issues are covered (Buckley, 1998).

Accreditation has been put forward in the European Commission's proposals for amendment of the EIA Directive (see Section 2.7) in response to complaints about poor quality ESs (Evans, 2013a). However, IEEM (and other professional institutes) have objected to this proposal as it would add to the administrative burden

(Evans, 2013b) and it is also unclear which professional institutes would be able to provide such accreditation. There may also be some potential for corruption, as has occurred in other sectors, such as education (Hallak and Poisson, 2007). However, given that the current system allows anyone to write EcIA chapters (there is currently no requirement for technical chapters to be written by consultants with an appropriate background or relevant professional institute membership, for example), accreditation is considered a positive step. In addition, the administrative burden of accreditation would fall on consultants and their institutes, rather than on developers and local authorities, which accords with current government deregulation proposals. Finally, the benefits of an accreditation scheme for EcIA and EIA in general could include, for example, a guaranteed level of training, potentially higher quality technical and a higher profile for accredited consultants.

6.5.4 Planning Process

There was a significant improvement in Legislation BAI scores for consultancies not affiliated to the developer. However, to ensure repeat business and maintain a good commercial reputation, even independent consultancies can come under pressure to conform to developers' demands to at least some extent (e.g. by not including certain mitigation measures within the EcIA chapter). As a result, one recommendation could be to ensure that there is a disconnect between environmental consultants and the developer.

One possible mechanism would involve the CPA commissioning the consultants. The CPA would then obtain details of the proposed development from the developer and communicate them to the consultants. The fees would be paid for by the developer but there would be no opportunity for pressure to alter the ES. There are disadvantages with this recommendation, including slight time delays and a small manpower cost to the CPA. These could be compensated for by a more reliable ES (i.e. one not requiring time-consuming requests for further information under the EIA Regulations), which could encourage CPAs and planning inspectors to rely on them to a greater extent when making planning decisions. However, this recommendation is considered unlikely to be implemented in the current planning system, partly due to austerity measures reducing local authority budgets and partly due to the current emphasis on deregulation (for example the Red Tape Challenge to reduce and simplify legislation (Cabinet Office, 2011)). This makes it all the more important for consultants to state clearly which EcIA chapter mitigation measures have been firmly agreed with the developer and which must be included as decision notice conditions or S106 Agreement obligations.

PART 3: ECOLOGICAL MITIGATION

CHAPTER 7: Overview

7.1 Aims and Objectives

The aim of the following two chapters is to investigate the factors involved in successful ecological mitigation measures. Case study sites will be used to meet the following objectives:

- to investigate ecological mitigation measure implementation in completed EIA developments (Chapter 8); and
- to investigate ecological mitigation measure effectiveness in completed EIA developments (Chapter 9).

7.2 Method

7.2.1 Case Study Site Selection

For this study to be comprehensive, the full planning application documentation for each case study site was required. This comprised the:

- ES (including the EcIA chapter);
- decision notice;
- S106 agreement;
- environmental / ecological management plans; and
- ecological monitoring reports, where available.

As much of the necessary planning documentation had already been collected, the developments from which the EcIA chapters in the current review were drawn from were initially investigated to determine whether construction had been at least partially completed. However, given the long lag-time between planning approval and construction completion, this process revealed only one suitable case study site.

As a result, CPAs across England were contacted for information on completed EIA developments in their area of authority. However, the long lag-time involved in EIA development construction meant that many of the planning officers involved in older EIA developments had left the CPA. As much of the documentation for older (e.g. 10 years old) applications was submitted in paper format rather than electronically, newer CPA staff were often either unwilling or unable to locate all of the necessary documents.

Environmental consultancies were also contacted for potential case study sites (both through an advertisement placed in the Royal Town Planning Institute's e-mail newsletter and through existing contacts). However, this approach suffered from similar problems as contacting CPAs; consultant turnover is relatively rapid, and even in cases where staff were still present, they rarely knew whether construction had been completed and the relevant documents were frequently unavailable. In addition it was found that consultants often did not know whether a development had been granted planning permission, as communication with the developer often ceased upon planning application submission (likely due to the employment of another consultancy to conduct the construction and post-construction work).

Such issues are not limited to this study. An unpublished study on the implementation of mitigation measures (not just ecological mitigation) in completed EIA developments originally intended to investigate several case study sites. However, the difficulties outlined above resulted in the study being limited to one case study site (Boyden, 1998). Despite these considerable problems, seven case study sites and their planning documents were obtained. The details of these sites can be found in Table 16.

Table 16: Details of the seven completed EIA development sites investigated for their ecological mitigation measures.

Development Name	Development Sector	Determining Authority	Year of Submission
Lower Mill Estate	Housing	Cotswold District Council	1998
Oakley Vale	Housing	Corby Borough Council	1998
Kingsway	Housing	Gloucester City Council	2000
Whitemoor Phase 1	Transport	Cambridgeshire County Council	2003
Enderby Park and Ride	Transport	Leicestershire County Council	2006
Caroline Chisholm School	Education	Northamptonshire County Council	2001
Midpoint Park II	Industry / Business	Birmingham City Council	2005

7.2.2 Case Study Site Visits

Permission to visit each of these sites for research purposes was obtained from the CPA, the developer and/or the occupier, depending on the site. Each of the seven completed EIA developments was then visited between two and five times during the summers (May-July) of 2010 and 2011.

CHAPTER 8: Implementation of Ecological Mitigation

8.1 Aims and Objectives

The aim of this chapter is to empirically investigate the implementation of ecological mitigation measures in completed EIA developments, with the objective of identifying the variables affecting implementation rates.

8.2 Method

All of the planning documentation listed in Chapter 7 was thoroughly examined, and all ecological mitigation measures (including those that were integral to the development, such as siting) were extracted to form a checklist for each case study site. Each checklist was incorporated into a mitigation measure database, which included information on which planning document/s each measure was included within.

Each site was then visited and the checklist used to audit the implementation of ecological mitigation measures. Where measures were not, or only partially, implemented, explanations were sought from the CPA, the developer, and/or the occupier, where possible. Measures for which implementation could not be determined were coded as 'Unknown' and included, for example, those that were specific to the construction phase (e.g. avoidance of construction during the breeding bird season). Measures which had yet to be implemented due to construction activities not being sufficiently advanced, or because monitoring thresholds had not yet been reached, were coded as 'N/A'.

8.2.1 Variables Affecting Mitigation Implementation

It was not possible to determine public pressure and so this variable was not investigated. In addition, given the use of EcMPs (which 'translate' EcIA chapter mitigation proposals into more prescriptive proposals) for each of the seven case study sites, an investigation into the use of passive or active descriptions of mitigation measures was not considered to add to the analysis. As a result, the variables investigated with potential to affect mitigation measure implementation comprised:

- the precision of the mitigation description (auditability);
- EcIA chapter quality, as determined by the Adequacy and Legislation BAIs;
- year of planning application submission;
- the use of planning conditions and/or obligations;
- the inclusion of mitigation measures in an ecological management plan (EcMP, or similar document); and
- the implementation of a follow-up programme.

Inconvenience

In addition, to the variables investigated in earlier studies, the inconvenience of the mitigation measures was also investigated. Each mitigation measure was categorised as 'high' and 'low' inconvenience according to:

- estimated raw materials cost;
- estimated planning time requirements;
- estimated implementation time requirements;
- estimated operation time requirements;
- whether heavy or specialist equipment would be needed;
- whether maintenance would be required; and
- whether the measure was to be repeated throughout the operation period.

Labour cost was excluded from this study, as this was felt to be reflected in the time and repetition categories (being a function of an arbitrary monetary amount multiplied by time).

There was no data available from the case study sites for use in this analysis. For example, one developer had gone into administration prior to this study being conducted, and in other cases there was no way of extricating costs for ecological mitigation from the costs of mitigation for other impacts (e.g. landscape). As a result, estimates had to be made, which are inevitably subjective. Nevertheless, this analysis was considered to be useful as an aide to future work. The categories were scored for their inconvenience to the developer, according to the criteria in Table 17. These categories are broad to reflect the lack of available data and the requirement for estimates to be made.

Table 17: High inconvenience thresholds for the mitigation measure categories.

Category	High Inconvenience
Planning time	> 1 month
Implementation time	> 2 years
Operation time	> 5 years
Raw materials cost	>£5,000
Specialist equipment needed	Yes
Maintenance required	Yes
Requiring repeated implementation	Yes

These seven categories were then amalgamated into an 'Inconvenience Index' for each mitigation measure, calculated using Equation 1.

Equation 2: Inconvenience Index equation.

$$\text{Inconvenience Index} = \frac{(1.0 \times A)(0 \cdot 5 \times B)}{C}$$

where

A = the number of 'high inconvenience' categories

B = the number of 'low inconvenience' categories

C = the total number of categories

Adapted from Atkinson *et al*. (2000).

Importantly, the value for 'C' is free to vary according to the number of categories that were applicable to each mitigation measure; for example, some mitigation measures did not require raw materials. The Inconvenience Index produces scores ranging from zero (no raw materials cost, equipment, repetition or time involved) to one. In practice, no mitigation measures will have an Inconvenience Index score of 0, as all mitigation measures will require some time for planning. Whilst the range of scores produced depends on the categories determined by the assessor, all of the measures were assessed in the same way and so the Inconvenience Index provides a useful comparative tool within this study.

8.2.2 Data Analysis

To reduce the number of levels per category for statistical analysis, the ‘Full’ and ‘Partial’ implementation levels were combined (coding ‘Partial’ as missing, or combining it with ‘None’ was felt to be overly pessimistic). All statistical analyses were conducted using SPSS (IBM SPSS Statistics 19).

EcIA Chapter Quality

Implementation, with two levels (‘Full & Partial’ and ‘None’), can be considered a binary categorical variable, and EcIA chapter quality (as determined by the Adequacy and Legislation BAIs calculated in Chapter 6) can be considered as a continuous variable. As a result, a binary logistic regression was conducted to investigate the effect of EcIA chapter quality on mitigation measure implementation.

Year of Planning Application Submission

Since implementation, with two levels (‘Full & Partial’ and ‘None’), can be considered a binary categorical variable, and year of planning application can be considered as a continuous variable, a binary logistic regression was conducted to investigate the effect of year on mitigation measure implementation.

Planning Conditions

As mitigation measures could be included in many different possible combinations of planning documents, any ‘Unknown’ or ‘N/A’ levels for the planning documentation were coded as missing, and ‘Partial’ inclusion in a planning document was combined with ‘Full’ inclusion. Two exact Pearson chi-square analyses were performed. The first analysis examined the effects of planning conditions and planning obligations separately, the second examined the effects of legal requirements (i.e. planning conditions or planning obligations) on mitigation measure implementation rates.

Ecological Management Plan

Mitigation measures coded as 'N/A' for inclusion in an EcMP (e.g. creation of the EcMP itself, and compliance with the EcMP) were coded as missing, whilst measures coded as 'Partially' included within the EcMP were combined with those considered as fully included. The effect of mitigation measure inclusion in an EcMP, or similar document, on implementation was investigated using an exact Pearson chi square test.

Follow-up

A case study site was considered as having conducted some form of follow-up activity if either monitoring (e.g. for European Protected Species (EPS) development licences) or audits of completed mitigation had been conducted. The relationship between follow-up and mitigation implementation was investigated using an exact Pearson chi square test.

Inconvenience

The relationship between the two-level implementation categorical variable and the continuous Inconvenience Index variable was analysed using a binary logistic regression.

Variables with the Greatest Explanatory Power

A backward stepwise binary logistic regression was used to identify the combination of variables with the greatest power to explain ecological mitigation measure implementation rates.

8.3 Results and Discussion

8.3.1 Overview

Extraction and analysis of the ecological mitigation measures from all of the planning documentation across the seven case study sites resulted in a checklist of 238 measures. There were, on average, 34 ecological mitigation measures per site, ranging from a minimum of 19 to a maximum of 66 measures per site. Of these mitigation measures, 148 were at least partially included within the EcIA chapters, the remainder being included in the decision notices, S106 agreements and EcMPs, where present. None of the case study sites implemented EMSs linked to the ES, and so these were not considered further in this study. Of the 238 proposed mitigation measures, 36 measures were not auditable, i.e. were coded as ‘Unknown’ or ‘N/A’ (see Section 8.2.2). These were excluded from further analysis.

8.3.2 Implementation

Of the 202 auditable mitigation measures across the seven case study sites, 65.3% were fully implemented, 18.8% were partially implemented, and 15.8% were not implemented. Full implementation rates for each site were relatively high, ranging from 52.0 to 85.7% (Table 18).

Table 18: Comparison of mitigation implementation by planning document.

Planning Document	Implementation			
	Full	Partial	None	Total
EcIA chapter only	24	6	15	45
EcIA chapter + Decision Notice	2	0	0	2
EcIA chapter + S106	2	1	0	3
EcIA chapter + EcMP	40	9	5	54
EcIA chapter + Decision Notice + S106	0	0	0	0
EcIA chapter + Decision Notice + EcMP	3	2	0	5
EcIA chapter + S106 + EcMP	11	4	1	16
EcIA chapter + Decision Notice + S106 + EcMP	1	0	0	1
Decision Notice only	9	5	0	14
S106 only	3	1	1	5
EcMP only	20	8	10	38
Decision Notice + S106	0	0	0	0
Decision Notice + EcMP	1	1	0	2
S106 + EcMP	16	1	0	17
Decision Notice + S106 + EcMP	0	0	0	0
Total	132	38	32	202

8.3.3 Variables Affecting Implementation

EcIA Chapter Quality

There was no significant relationship identified between ecological mitigation measure implementation and higher EcIA chapter quality, as determined by the Guidance BAI (Appendix 8.1, logistic regression: $R^2_{\text{Nagelkerke}}$ = 0.021, df = 1, P = 0.122). However, there was a significant improvement in ecological mitigation measure implementation with higher EcIA chapter quality, as determined by the Legislation BAI (Appendix 8.1, logistic regression: $R^2_{\text{Nagelkerke}}$ = 0.040, df = 1, P = 0.036, Figure 46), although the amount of variability explained by the Legislation BAI was relatively low (4.0%).

This is an intriguing result, given the positive correlation between Legislation and Guidance BAI scores (see Section 6.3.1). However, this may be an artefact of both the small sample size and the time lag involved for EIA developments to complete construction. Only one of the EcIA chapters was written after the introduction of the EcIA Guidelines, and this was submitted only a few months after the EcIA Guidelines were introduced. As a result, it is perhaps unsurprising that whilst it scored relatively highly according to the Legislation BAI, its Guidance BAI score was relatively low (as were the Guidance BAI scores for the six case study sites that were submitted prior to the publication of the EcIA Guidelines). This is likely to have skewed the relationship between the EcIA Guidelines (and therefore the Guidance BAI) and mitigation implementation. It is possible that if a similar study were to be conducted on later developments, the Guidance BAI score would have a significant relationship with implementation.

It is, however, of interest that EcIA chapters with high levels of compliance with the information requirements of the EIA Directive are linked with higher mitigation implementation rates. Given the large post-submission project changes in project design that have been found to occur relatively frequently in EIA developments (Reeder, 1994), it might be expected that neither the Legislation nor the Guidance BAI scores would have a significant relationship with mitigation implementation. It may be that consultants who write EcIA chapters with higher Legislation BAI scores are more likely to include mitigation measures in EcMPs. Indeed, the average EcIA chapter Legislation BAI score is higher when the EcIA chapter's mitigation measures are included within EcMPs (0.37 in comparison to 0.34), although this was not found to be a statistically significant difference (Appendix 8.1, logistic regression: $R^2_{\text{Nagelkerke}}$ = 0.023, df = 1, P = 0.062).

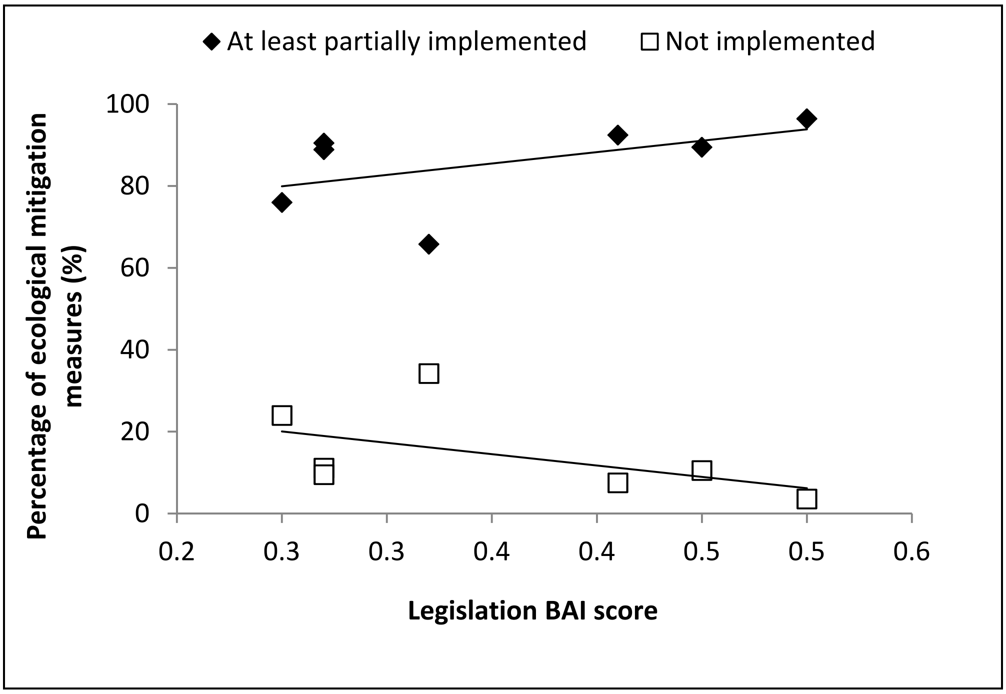


Figure 46: Relationship between EcIA chapter quality, as determined by the Legislation BAI, and the percentage of ecological mitigation measures implemented in the completed development. Trendlines are indicative only.

Year of Planning Application Submission

There was no significant effect of planning application submission year with mitigation measure implementation (Appendix 8.1, logistic regression: $R^2_{\text{Nagelkerke}}$ = 0.028, df = 1, P = 0.069). This may be due to the 10 year gap between the introduction of the UK's EIA legislation in 1988 and the earliest planning application submission in this study in 1998. Young's (1993) study, which identified a correlation between year and mitigation implementation, investigated developments with ESs written over the 10 year period (1972-1982) almost immediately following the introduction of the US' EIA legislation in 1970. It would be expected that year would have a greater effect closer to the introduction of EIA legislation, as this is when the learning curve for all those involved with EIA would be at its steepest and rates of improvement in practice at their greatest.

Planning Conditions and/or Obligations

Surprisingly few EcIA chapter mitigation measures (nine, or 6.1%) were included as planning conditions. In total, 34 ecological mitigation measures (14.3% of all mitigation measures extracted from the planning documentation) were included at least partially as planning conditions. This compares with 50 ecological mitigation measures (21.0% of all mitigation measures) included at least partially as planning obligations within S106 agreements. Encouragingly, only one measure was duplicated by being included as both a condition and an obligation, in contrast to the 23% found by Frost (1997b). As a result, the total number of ecological mitigation measures that were at least partially legally required to be implemented was 83 (34.9% of all ecological mitigation measures). This is comparable to Frost's (1997b) study on all ES mitigation measures (i.e. not just ecology), which found that "40% of all the measures are imposed by some form of condition or legal agreement." However, it is much lower than Boyden's (1998) finding that "88% of the measures [were] required at least possibly through conditions or obligations."

There was a significant improvement in implementation rates for mitigation measures that were included as planning conditions in comparison to those that were not included as conditions (Appendix 8.1, Pearson chi-square = 5.127, df = 1, exact P = 0.031). This was echoed for mitigation measures that were included as planning obligations (Appendix 8.1, Pearson chi-square =6.073, df = 1, exact P = 0.017). A combined analysis identified a significant improvement in in implementation rates for mitigation measures that were subject to some form of legal requirement (i.e. either a planning condition or a planning obligation) for implementation (Appendix 8.1, Pearson chi-square =11.713, df = 1, exact P = 0.001). As expected, a legal requirement to implement an ecological mitigation measure does increase its likelihood of being implemented, regardless of whether that requirement is a planning condition or a planning obligation.

Frost's (1997b) study found that "40% of those measures not implemented are subject to a legal instrument." However, this study found that only 6.3% of unimplemented measures were subject to some form of legal requirement for implementation. Boyden's (1998) study found that "Of the 62 measures required in some form, 51 (82%) were implemented at least partially", in comparison with 96.9% in the current study. In addition, 62.9% of implemented mitigation measures were not subject to a legal instrument, in comparison with 53% in Frost's (Frost, 1997b) study. These are encouraging results for ecological mitigation and perhaps reflect a growing awareness of ecological issues amongst developers and the construction industry.

Ecological Management Plan

Each of the seven case study sites had an EcMP or similar document associated with it (five of the sites were subject to planning conditions or obligations requiring the production of an EcMP or similar document). On average, these EcMPs contained 57% of the mitigation measures recommended in the EcIA. There was a significant improvement in mitigation measure implementation for those measures that were included in an EcMP or similar document (Appendix 8.1, Pearson chi square = 10.509, df = 1, exact P = 0.002). This is an encouraging, though perhaps not a surprising, result given the inclusion of EcMPs in planning conditions and obligations that have themselves been shown to have higher rates of implementation than measures that were not legally required.

Follow-up

Only one site conducted comprehensive and long term follow-up activities, which not only included monitoring but also audits of mitigation implementation and effectiveness (Lower Mill Estate). One site (Whitemoor Phase 1) conducted long term botanical and invertebrate monitoring surveys. Two further sites (Caroline Chisholm School and Oakley Vale) conducted great crested newt (*Triturus cristatus*) monitoring surveys as part of EPS development licences. Three sites did not conduct any form of follow-up activity (Kingsway, Midpoint Park II, and Enderby Park and Ride), although one site (Midpoint Park II) did submit monitoring reports during construction. There was a significant improvement in ecological mitigation measure implementation with the implementation of some form of ecological follow-up (Appendix 8.1, Pearson chi-square = 10.315, df = 1, exact P-value = 0.002). This finding is expected but does serve to reinforce the critical importance of follow-up in ensuring that at least the environmental impacts predicted in the ES are mitigated for. It also supports the speculation of Huggett (2003), as well as the findings of Dodds (1993) and Sánchez and Gallardo (2005), both of which were based on international work.

Inconvenience

High inconvenience measures included, for example, the construction of bat lofts (in this instance disguised as garages), structural landscaping and planting across an entire development site and the creation of 18 hectares of lowland woodland. In contrast, low inconvenience measures include, for example, the development (as opposed to the implementation) of a maintenance regime and the retention of standing and fallen deadwood.

There was no significant relationship identified between the inconvenience of a proposed mitigation measure and its implementation (Appendix 8.1, logistic regression: $R^2_{\text{Nagelkerke}}$ = 0.004, df = 1, P = 0.521). This is an intriguing result, as it suggests that developers do not distinguish between higher and lower inconvenience measures in terms of implementation. This may be due to higher inconvenience measures being more likely to be included as planning conditions or obligations. There is indeed a significant relationship between a mitigation measure's inconvenience and it being included as a planning condition or obligation (Appendix 8.1, logistic regression: $R^2_{\text{Nagelkerke}}$ = 0.150, df = 1, P < 0.001). However, the relationship is negative, with higher inconvenience mitigation measures being less likely to be included as planning conditions or obligations (the mean Inconvenience Index score for conditioned or obligated measures is 0.51, compared to 0.61 for measures not included as planning conditions or obligations).

It is of considerable concern that higher inconvenience mitigation measures are not being included as planning conditions or obligations by CPAs (perhaps because of a lack of in-house technical expertise), but it is encouraging that such measures are still being implemented by developers despite this. One reason for this could be the dual-purpose of many higher inconvenience ecological mitigation measures (e.g. landscaping and flood defence), making them more likely to be implemented.

Table 19: Summary of variables affecting the implementation of ecological mitigation measures.

<table>
<tr><th colspan="2">Variable</th><th>Significant effect on implementation?</th><th>Direction of change</th></tr>
<tr><td rowspan="2">EcIA chapter quality</td><td>Guidance BAI</td><td>✗</td><td>N/A</td></tr>
<tr><td>Legislation BAI</td><td>✓</td><td>+</td></tr>
<tr><td colspan="2">Year of planning application submission</td><td>✗</td><td>N/A</td></tr>
<tr><td rowspan="3">Legal requirement</td><td>Planning conditions</td><td>✓</td><td>+</td></tr>
<tr><td>Planning obligations</td><td>✓</td><td>+</td></tr>
<tr><td>Planning conditions or obligations</td><td>✓</td><td>+</td></tr>
<tr><td colspan="2">Ecological Management Plan</td><td>✓</td><td>+</td></tr>
<tr><td colspan="2">Follow-up</td><td>✓</td><td>+</td></tr>
<tr><td colspan="2">Inconvenience</td><td>✗</td><td>N/A</td></tr>
</table>

8.3.4 Variables with the Greatest Explanatory Power

A backward stepwise regression was conducted using seven of the variables in Table 19. The relationships between implementation and planning conditions and implementation and planning obligations individually were not included in the analysis due to the significant relationship with the combined planning conditions or obligations variable.

The analysis revealed that the combination of seven variables explained 20.2% of the variability in implementation. However, reducing the model to two variables (the inclusion of the mitigation measures in an EcMP or similar document, and the use of follow-up) resulted in only a 4.6% reduction in explanatory power (Appendix 8.1, logistic regression: $R^2_{\text{Nagelkerke}} = 0.156$). This result emphasises the importance of follow-up in the implementation of ecological mitigation measures.

Interestingly, for the three sites for which no follow-up activities were conducted, all specifically included proposals for follow-up in their EcMPs. It is likely that a lack of enforcement, together with a lack of developer interest in and understanding of the benefits of monitoring, combined to result in a lack of monitoring. It is relatively easy for a short paragraph proposing follow-up within an EcMP to be overlooked by both on-site contractors, developers and CPAs, whereas a specific condition or obligation may be more likely to be adhered to. As a result, follow-up activities (including simple implementation audits) should be included as a separate condition or obligation in decision notices and/or S106 agreements, rather than simply included within EcMPs, which themselves are conditioned or obligated, to ensure that they are carried out.

8.3.5 Development-Specific Factors

Whilst not included within the quantitative assessment, development-specific factors may also help to explain variation in habitat mitigation measure implementation across sites. For example, the Lower Mill Estate 'built in' biodiversity into its business plan for the site, recognising that people will pay a premium for holiday homes in biodiverse and attractive surroundings (Lower Mill Estate, 2013). In contrast, the developer at Oakley Vale (Cofton) went into administration in February 2009 (Northamptonshire County Council, 2009), and the ecological consultants for Kingsway changed several times (Gloucestershire County Council planning officer, *pers. comm*.), which likely disrupted lines of communication and may have resulted in lower implementation rates than would otherwise have been expected.

8.4 Auto-Critique

The use of the quantitative approach in this second (completed development) part of the study is less robust than in the first (document review) part. The most important limitation is the small number of case study sites: only seven could be identified in the timeframe of this study. This not only limits the reliability of the statistics, but also the generalisability of the conclusions. However, the time required to identify, gather documentation, and survey sufficient case studies to be able to remove these limitations would be beyond the scope of this study. This emphasises the need for more readily accessible and organised planning data.

In addition, the attempt to calculate the inconvenience of mitigation measures is flawed as a result of the lack of direct evidence. The thresholds chosen were based on personal experience and categories were assigned based on estimates. As a result, whilst the concept of mitigation measure inconvenience is an important one to explore and should be the topic for future work (see Section 10.3), involving both quantitative and qualitative approaches, the conclusions drawn in the current study must be treated with considerable caution.

Despite the relatively low reliability and generalisability of the results (in particular the analysis of mitigation measure inconvenience), it is considered important to attempt the use of the quantitative approach in the study of completed EIA developments. The utility such an approach could have in the study of EcIA, particularly when conducted in conjunction with qualitative approaches, is potentially high given a larger sample size and more comprehensive data. It may be of still greater utility in other technical disciplines within EIA, such as noise and air pollution, which tend to be more amenable to quantitative approaches.

8.5 Conclusions and Recommendations

This investigation of ecological mitigation measures complements and supports work conducted both internationally and in the UK on the variables that affect mitigation implementation. However, this is the first study to investigate the relative importance of these variables in mitigation implementation. In the case of some variables (e.g. year of planning application submission), this is the first attempt to quantify their relationship with implementation. As a result, this study helps address a gap in mitigation implementation research, particularly in the UK.

The rationalist planning model suggests that mitigation measures (particularly those that are conditioned or obligated) will be implemented. This study has shown that 84.1% of proposed ecological mitigation measures are at least partially implemented, and that the inclusion of mitigation measures as planning conditions or obligations is related to higher implementation rates. This would seem to support the rationalist planning model, particularly given the improvements in the implementation of conditioned or obligated mitigation measures since Frost's (1997b) study. To enable more comprehensive inclusion of ecological (or indeed other technical disciplines') mitigation measures, consultants could consider the inclusion of a table of those mitigation measures deemed most important and suitable for inclusion as planning conditions or obligations, at the end of the chapter (see also Section 6.5.4). This would also facilitate more rapid review of EcIA chapters by consultees and the CPA.

The inclusion of follow-up in the final model of variables with the greatest explanatory power highlights the critical importance of a post-decision mechanism to ensure that proposed mitigation is implemented and that unforeseen impacts are mitigated for. For many proposed developments, a simple audit of mitigation implementation would be the only follow-up that would be necessary. For certain developments, protected species monitoring would be sufficient, and for others comprehensive ecological monitoring would be required. This, along with the time period required for monitoring, should be negotiated by the developer, the developer's consultants, the statutory nature conservation consultees and the CPA. The likelihood of this occurring may increase if the European Commission's proposals to include follow-up in the amended EIA Directive are implemented, although there is still no proposed mechanism to link follow-up with changes in management (see Section 2.7.2).

The inclusion of a mitigation implementation audit as a separate planning condition or obligation to the EcMP is recommended as a simple measure that could help to further improve mitigation measure implementation. Crucially, to avoid follow-up becoming simply a *post hoc* addition to EIA (Holling, 1986), its results must be made publicly available, and this should be included in the follow-up condition. This would enable consultants to learn from mistakes and interested parties (such as the public) to be reassured that mitigation is being implemented. There will always be unforeseen circumstances that may necessitate changes in mitigation implementation. To avoid fear of self-incrimination, no enforcement action should be necessary so long as reasonable measures are shown to be taken by the developer. In order to facilitate a mitigation implementation audit, the description of mitigation measures in EcIA chapters should be more precise. This would also increase their likelihood of being included as planning conditions (see Section 5.3.9).

These conclusions and recommendations also have a bearing on the recent proposals to introduce biodiversity offsetting, or habitat banking, into the UK (Defra, 2011b). For example, any offsetting proposal should include a monitoring programme to ensure appropriate mitigation implementation, as well as a flexible management plan that can be modified in response to changes in circumstances (e.g. flooding or drought).

CHAPTER 9: Effectiveness of Ecological Mitigation Implementation

9.1 Aims and Objectives

The aim of this chapter is to determine the effectiveness of habitat mitigation measure implementation, as well as identifying factors affecting this. As a result, the main objectives are to:

- identify whether there is a link between poor habitat mitigation effectiveness and poor EcIA chapter quality, as identified by the Guidance and Legislation BAIs;
- identify whether there is a link between the effectiveness of ecological mitigation measures and the implementation of ecological follow-up programmes.

9.2 Method

From the 202 auditable ecological mitigation measures obtained from the planning documentation for the seven case study sites (see Chapter 8), all of the habitat mitigation measures were extracted. The type of habitat mitigation measures (e.g. creation, translocation, etc.) was noted, along with the description of the proposed habitat and any other goals pertaining to the mitigation measure (e.g. habitat structure or function).

This list included measures such as broadleaved woodland and hedgerow creation, which would not have matured sufficiently (e.g. developed a characteristic ground flora) to be able to identify whether they had met their goals. Survey of these measures would merely have been part of the implementation audit (see Chapter 8), rather than determining effectiveness. As a result, only grassland and marginal habitat mitigation measures were selected for survey. These habitat types had a greater likelihood of being established due to the relatively rapid growth of their component species. However, since grasslands can require several decades to reach their goals (Walker *et al.*, 2004b), the potential for goals to be achieved based on the species present and the current management regime was inferred.

The site surveys (see Chapter 7) were carried out during the optimal botanical survey period (JNCC, 2010). For each habitat mitigation measure, a standard National Vegetation Classification (NVC) survey was conducted. This entailed identifying the botanical species present (and their percentage cover according to the Domin scale) in five quadrats located in the most homogeneous areas of the habitat. Depending on the habitat type, structure and size, different quadrat shapes and sizes were used, according to the guidance outlined in the NVC Users' Handbook (Rodwell, 2006).

The quadrat data for each habitat mitigation measure was entered into specialist software (Malloch, 1992). The software provides a numerical measure of the similarity of the sample habitat with the closest matching NVC communities, ranging from 1 to 100. This was used in combination with the relevant NVC volumes to identify the closest British plant community to the habitat surveyed (Rodwell, 1992; Rodwell, 1995; Rodwell, 2000). This was then compared to the habitat description included in the planning documentation. Where the habitat description corresponded with a Phase 1 habitat type (JNCC, 2010), a publicly available database was used to determine whether the identified British plant community could be considered equivalent to that Phase 1 habitat type (National Biodiversity Network, 2005).

The NVC communities were originally described from habitats of high conservation value and so a high degree of similarity was not expected. In general, similarity scores of greater than 60 are considered as acceptable matches for NVC communities, according to the following scale (Morris and Therivel, 2001, p. 504):

- 0-49 = very poor;
- 50-59 = poor;
- 60-69 = fair;
- 70-79 = good; and
- 80-100 = very good.

The final list of habitat mitigation measures also included measures for which the habitat descriptions were insufficiently detailed for an NVC survey to be useful in determining whether their implementation had been effective. Such descriptions did not conform to recognised plant community terminology (e.g. Rodwell, 2006; JNCC, 2010; JNCC, 2012) and so these mitigation measures were visually surveyed for implementation, but excluded from further analysis.

9.2.1 Data Analysis

Only the ten mitigation measures for which mitigation implementation effectiveness could be surveyed for were included in this analysis. In order to facilitate analysis, the number of levels per category was reduced by including the single instance of a partially effective mitigation measure with the fully effective mitigation measures. All statistical analyses were conducted using SPSS (IBM SPSS Statistics 19).

EcIA Chapter Quality

Effectiveness (i.e. whether or not the implemented habitat mitigation measure matched the habitat description in the EcIA chapter or the EcMP) is a binary categorical variable and EcIA chapter quality is a continuous variable. As a result, two binomial logistic regression analyses were used to investigate the effect of EcIA chapter quality, as determined by the Adequacy and Legislation BAIs.

Follow-up

An exact Pearson chi-square test was used to determine whether there was a relationship between the two categorical variables ‘use of any form of follow-up’ and ‘effectiveness’. To investigate whether the type of follow-up activity was related to effectiveness, the use of habitat mitigation measure follow-up activities (i.e. not those solely concerned with protected fauna species) was compared with effectiveness using an exact Pearson chi square test.

9.3 Results and Discussion

9.3.1 Habitat Mitigation Measure Implementation Effectiveness

Fifteen habitat mitigation measures relating to grassland or marginal habitats were extracted from the planning documentation for the seven case study sites.

Details of these habitat mitigation measures can be found in Table 20. All of the measures were extracted from the EcIA chapter and/or the EcMP: the decision notices and S106 agreements did not provide additional details regarding habitat mitigation measures.

EcMPs can be written at any stage in the planning process whether prior to, or after gaining, planning permission (often being included as a planning condition). The EcMP in theory 'translates' the recommendations of the EcIA chapter into a more detailed mitigation programme for developers, contractors and consultants. They can contain timetables of when actions should be taken prior to, during and after construction, and by whom they should be taken. EcMPs may not necessarily be written by the same consultants as those who wrote the EcIA chapter, and so care should be given when writing the EcIA chapter that its recommendations can be readily incorporated into an EcMP.

The descriptions of measures included in both the EcIA chapter and the EcMP did not increase in detail in the EcMP, as would perhaps be expected. In addition, each of the descriptions of the habitat mitigation measures that were surveyed in this study was confined to naming a habitat type, rather than including goals relating to function or structure (with the exception of naming component species). This highlights a major failing in the way that habitat mitigation measures are proposed, as simply including a habitat type limits the potential for meaningful follow-up.

Of the fifteen measures, one third comprised habitat descriptions that were too vague for implementation effectiveness, as opposed to purely implementation, to be determined. All proposed the creation or management of grassland habitats, but without referring to recognised plant communities. As a result, implementation could be determined, but not its effectiveness.

Of the ten habitat mitigation measures that could be surveyed to determine implementation effectiveness, only three could be considered to have at least partially achieved the goals set out in the EcIA chapter or EcMP. Given the broad habitat descriptions in the EcIA chapter or EcMP, reedbed and neutral grassland are relatively straightforward to create. The management of the calcareous grassland, however, required modification to ensure the continued presence of a calcareous grassland community. Whilst there were calcareous grassland indicator species present, such as yellow-wort (*Blackstonia perfoliata*) the sward was identified as a neutral grassland under the NVC, partly due to colonisation by tufted hair grass (*Deschampsia cespitosa*). This complements findings from a recent study, which determined that restoration efforts for sites with acid and calcareous soils tended to result in neutral grasslands, whilst neutral grassland restoration tended to result in greater similarity to their target NVC communities (Pywell *et al.*, 2002).

The poor success-rate of grassland and marginal habitat mitigation measures is of considerable concern. These measures are commonly proposed (56.5% of the 85 EcIA chapters that proposed habitat mitigation measures specified grassland creation, re-creation or restoration), despite the difficulties of creating, re-creating or restoring grasslands having long been known (e.g. Hopkins, 1989). Indeed, a study on compensatory wetlands in the US identified grassland habitat types as having an 87% failure rate (Robb, 2002). Consideration should, therefore, perhaps be given to either avoiding such habitat mitigation proposals (e.g. through project design rendering habitat mitigation measures unnecessary), or at the very least following the recommendations outlined in Section 9.4 .

Of the seven habitat mitigation measures that were not effectively implemented, five involved habitats that required the presence of at least temporary standing water (marshland, marshy grassland, wet grassland, and marginal habitat). In each case, there was insufficient water for the habitat to develop. This reflects early findings that “the hydrological conditions of damp or wet habitats are very difficult to create” (Chinn *et al.*, 1999).

Table 20: The effectiveness of habitat mitigation measures extracted from the EcIA chapter and EcMP.

Habitat mitigation measure	EcIA chapter habitat description	EcMP habitat description	Auditable?	Mitigation effective?	British plant community category	British plant community name	Similarity score
Creation	N/A	Wildflower meadow	No	N/A	Mesotrophic grassland	MG1 Arrhenatherum elatius	36.9
Creation	N/A	Meadow	No	N/A	Mesotrophic grassland	MG6 Lolium perenne-Cynosurus cristatus	37.9
Management	N/A	Unmaintained grassland	No	N/A	Mesotrophic grassland	MG1 Arrhenatherum elatius	40.3
Management	Grassland	Meadow	No	N/A	Mesotrophic grassland	MG5 Cynosurus cristatus-Centaurea nigra	58.2
Management	N/A	Meadow	No	N/A	Mesotrophic grassland	MG5 Cynosurus cristatus-Centaurea nigra	56.7
Creation	Marginal	Marshland	Yes	No	Open vegetation	OV25 Urtica dioica - Cirsium arvense	37.1
Creation	N/A	Species-rich wet grassland	Yes	No	Mesotrophic grassland	MG6 Lolium perenne - Cynosurus cristatus	62.8

Habitat mitigation measure	EcIA chapter habitat description	EcMP habitat description	Auditable?	Mitigation effective?	British plant community category	British plant community name	Similarity score
Creation	Unknown	Marginal	Yes	No	Mesotrophic grassland	MG9 Holcus lanatus-Deschampsia cespitosa	37.5
Creation	N/A	Wet grassland	Yes	No	Mesotrophic grassland	MG6 Lolium perenne-Cynosurus cristatus	41.4
Creation	Acid grassland	Acid grassland	Yes	No	Open vegetation	OV19 Poa annua-Matricaria perforata	19.4
Management	N/A	Unimproved neutral grassland	Yes	No	Mesotrophic grassland	MG6 Lolium perenne - Cynosurus cristatus	63.8
Management	Grassland	Marshy grassland	Yes	No	Open vegetation	OV19 Poa annua-Matricaria perforata	36.8
Management	Unimproved species-rich calcareous grassland	Calcareous grassland	Yes	Partially	Mesotrophic grassland	MG5 Cynosurus cristatus-Centaurea nigra	36.2
Creation	Reedbed	Reedbed	Yes	Yes	Swamp & reedbeds	S4 Phragmites australis	43.2

Habitat mitigation measure	EcIA chapter habitat description	EcMP habitat description	Auditable?	Mitigation effective?	British plant community category	British plant community name	Similarity score
Creation	Grassland	Neutral grassland	Yes	Yes	Mesotrophic grassland	MG6 Lolium perenne-Cynosurus cristatus	42.1

Even for those habitat mitigation measures that failed to match their proposed habitat descriptions, it is of interest to examine their similarity with British plant communities. Of the 15 habitat mitigation measures surveyed, 13 had only poor or very poor similarity to their closest British plant community and none had good or very good similarities. Whilst perhaps not unexpected, given that the habitats surveyed were relatively disturbed due to recent creation or management practices (Morris and Therivel, 2001), it is of concern that habitat mitigation measures do not closely resemble British plant communities of high conservation value. Whilst this does not necessarily mean that the habitats are of no value for wildlife, it does call into question the likelihood of a development achieving no net loss of biodiversity.

9.3.2 Effectiveness and EcIA Chapter Quality

There was no significant relationship identified between either the Adequacy (Appendix 9.1, logistic regression: $R^2_{Nagelkerke}$ = 0.021, df = 1, P = 0.699) or the Legislation BAI scores (Appendix 9.1, logistic regression: $R^2_{Nagelkerke}$ = 0.015, df = 1, P = 0.749) for the EcIA chapters and the effectiveness of the habitat mitigation measure implementation on the completed development site. As discussed in Section 8.3.3, the lack of a significant relationship with the Guidance BAI is unsurprising given that only one of the EcIA chapters stated the use of the EcIA Guidelines. However, the lack of a significant relationship with the Legislation BAI potentially highlights the declining relevance and importance of the EcIA chapter as construction (and mitigation) progresses.

Whilst high quality EcIA chapters in terms of the Legislation BAI were significantly related to higher implementation rates (see Section 8.3.3), it is likely that the EcMP plays a greater role in ensuring effective mitigation implementation. In this case, although little extra detail as to the habitat mitigation measure goals was provided in the EcMPs, there was greater information on the management and maintenance activities required, i.e. those activities that help ensure effectiveness. However, the EcMPs were very variable in their emphasis. For example, the Lower Mill Estate 2010 Management Plan reported management objectives against S106 Agreement obligations, whilst the Midpoint Park II 2008 Management Plan focused on habitat themes rather than planning decision document requirements. There is no guidance available as to the information and level of detail that should be included in an EcMP, and this should perhaps be given greater attention in order to maximise the effectiveness of habitat mitigation measure implementation.

9.3.3 Effectiveness and Follow-up

There was no significant relationship between the use of any form of follow-up and the effectiveness of the habitat mitigation measure implementation on the completed development site (Appendix 9.1, Pearson chi square = 1.270, df = 1, exact P = 0.500). This was reinforced when follow-up activities specifically relating to habitats were taken into account (Appendix 9.1, Pearson chi square =0.023, df = 1, exact P = 1.000).

Only two of the case study sites conducted follow-up of habitat mitigation measures. Whitemoor Phase 1 involved on-site creation of acid grassland and translocation of acid grassland to an off-site location. Acid grassland requires very specific geological conditions. It can be challenging to identify sites with such conditions and then to manage them appropriately. It is understood from the monitoring reports available that the off-site translocation has had mixed success. Whilst the grassland has become colonized by species more characteristic of calcareous grassland, areas are of nature conservation importance and support several rare plant species, such as the nationally scarce dittander (*Lepidium latifolium*). However, the area of on-site acid grassland creation that could be safely accessed and surveyed for this study was identified as an 'Open Vegetation' habitat, rather than acid grassland. As a result, despite a highly commendable monitoring and management regime being in place, the implementation effectiveness (in terms of the goals set out in the EcIA chapter and the EcMP) is low, which may have skewed the relationship between effectiveness and habitat follow-up.

The Lower Mill Estate also conducted follow-up of habitat mitigation measures, and successfully created reedbed habitats. However, the goal of managing a previously semi-improved neutral grassland towards developing an unimproved neutral grassland flora has not yet been met, due to the high abundance of perennial rye-grass (*Lolium perenne*), a species characteristic of improved grasslands. Despite this, it is considered that with time and continued management, this grassland may achieve its target habitat description.

With these two case study sites, it is clear that despite thorough follow-up of habitat mitigation measures and feedback of the results into management practices, there is no guarantee that habitat mitigation measures will achieve the goals set out for them in the EcIA chapters and EcMPs, and that even where there is a high likelihood of success, considerable time can be required.

9.3.4 Development-Specific Factors

The same development-specific factors that may have influenced mitigation implementation rates are also likely to have influenced mitigation effectiveness. Two contrasting factors will be briefly discussed below. These are only intended to be illustrations, with firm conclusions being difficult to draw from qualitative data.

Oakley Vale

In the case of Oakley Vale, the developer going into administration will have had inevitable consequences for the ongoing maintenance and management of ecological mitigation measures. Whilst not included within this study of mitigation effectiveness, the agreed creation of two on-site great crested newt reserves as mitigation was only partially effective. One reserve on Corby Borough Council land in the north of the site contained the proposed ditch and ponds, but these were entirely filled with extensive fly-tipping. This was reported to both Corby Borough Council and Natural England. It is not known what, if any, action was taken to remedy this. The second reserve in the south of the site contained shallow hollows and depressions that were all dry at the time of survey (mid-June 2011). If this occurs each year, the reserve will not be able to support breeding great crested newts. It was unclear who was ultimately responsible for management of these reserves and this is likely to be a major contributing factor to their lack of success.

Lower Mill Estate

As described in Section 8.3.5, the Lower Mill Estate incorporated biodiversity into its business plan. This site is a good example of what can be achieved when biodiversity is considered at an early stage in built developments. Not only were habitats brought under good management (e.g. a former hay meadow) and a nature reserve created, but various hibernacula and shelters were also installed (including otter holts, hedgehog boxes, bee boxes, house martin nests and an osprey platform). Boards were erected across the site to educate and inform the public about the wildlife present and to highlight dog owners' responsibilities.

In addition to the consideration of biodiversity in the business plan, there were two other important factors in helping to achieve the site's success. The first was the bilateral S106 agreements between the developer and the local authority, which included 61% of all the EcIA's recommended mitigation measures (in contrast, the S106 Agreement for Oakley Vale did not contain any ecological mitigation measures). This ensured a legal requirement for these measures to be implemented.

The second factor was the collaboration with the then Cotswold Water Park Society (known as the Cotswold Water Park Trust since 2011), a charity that conducted all the ecological monitoring for the site since 2001 (Cotswold Water Park Society, 2009). As a result of operating across the entire Water Park, the Society was able to implement Park-wide projects at Lower Mill Estate (such as the mink eradication programme), which were not included in the EcIA or the planning decision documents (Lower Mill Estate, 2010).

9.4 Auto-Critique

As described in the auto-critique for the previous chapter (see Section 8.4), one of the main problems with using the quantitative approach, and particularly inferential statistics, in this study is the small sample size of seven case study sites. In addition, small numbers of habitat mitigation measures were investigated (a total of 10 measures across the seven sites), which reduces the reliability and generalisability of the conclusions.

In addition, the attempt to assign a 'pass or fail' score to each habitat mitigation measure is simplistic. It is widely recognised that the NVC categories are not necessarily representative of all British plant communities as a result of the methodology used to develop them (JNCC, 2003). In addition, classification of plant communities and habitats is unreliable, with low replicability rates (Cherrill and McClean, 1999; Hearn *et al.*, 2011). Nevertheless, in the absence of a more accurate and widely accepted classification system, the NVC remains the standard survey and classification methodology (JNCC, 2003) and so was used in this study.

As a result of these flaws, the conclusions that can be drawn from this study are limited. Yet as with the previous chapter, a greater sample size and number of habitats could allow a more accurate picture to be drawn of habitat mitigation effectiveness. Ideally other forms of mitigation would also be investigated, as well as other categories of habitat mitigation measures. Whilst useful in EcIA, to provide broad information about the types of habitats that are more amenable for use in mitigation, it is possible that the quantitative approach would be of still greater relevance and utility to other technical disciplines with EIA, such as land contamination and traffic, which involve greater amounts of quantitative data.

9.5 Conclusions and Recommendations

This chapter has identified that habitat mitigation measures are commonly recommended in EcIA chapters. Establishing implementation effectiveness requires there to have been clear goals set for what the proposed habitat should be and how it should function. However, the frequently limited and/or vague descriptions within EcIAs and EcMPs meant that effectiveness could not be readily determined. This is a major flaw in current practice that must be remedied and also has a bearing on the potential success, or otherwise, of future biodiversity offsetting projects.

The lack of significant relationships between effectiveness and either EcIA chapter quality or follow-up in this study does not necessarily mean that these factors are unimportant in determining effectiveness. The sample of habitat measures surveyed was small and so conclusions are difficult to draw. Of concern is the fact that few EcIA chapters referenced any of the existing literature surrounding habitat creation, re-creation and restoration, whether journal articles or books. Such literature is invaluable in identifying which habitats are less readily creatable and therefore should not be included as a mitigation recommendation without considerable caution.

Even where habitat descriptions were sufficiently detailed to enable at least a minimal assessment of effectiveness, many measures were found not to meet their stated goals. This has considerable implications, both for on-site mitigation and off-site biodiversity offsetting. First, it illustrates the importance of following the mitigation hierarchy (Mitchell, 1997). Avoidance of habitat impacts should be the first and preferred mitigation method, if nothing else because of the considerable uncertainty inherent in establishing effective habitat mitigation measures. Ideally, habitat mitigation measures should be limited to use as enhancement measures, and for this there is considerable scope. The Lower Mill Estate, for example, demonstrated this principle in practice and the enhancement measures have added value to the development. Indeed, there is no reason why enhancement measures should not be seen as complementary to, and an integral part of, every built development's business plan (João *et al.*, 2011). The difficulty is in educating developers of the possibilities that ecological enhancement can provide in adding value to a built development, and this is where consultants and IEEM can play an important role as communicators.

However, where avoidance measures are not possible, the following recommendations (also applicable to biodiversity offsetting) should be considered:

- only those habitat types that are more readily creatable, re-creatable or translocatable should be included as mitigation (requiring further work to establish which habitats should and should not be included as mitigation measures);
- as a minimum, consultants should include an estimate of the likely success of all habitat mitigation measures proposed;
- for habitat mitigation measures that are particularly important for reducing the residual impacts of a proposed development, or that have low chances of success, modifications and/or alternatives should be provided in the event of their failure;

- the time required for the habitat mitigation measure to achieve its goals should also be stated; and
- adequate habitat descriptions and monitoring are crucial to ensure that goals are met.

All of these recommendations are included within the EcIA Guidelines but are rarely adhered to (see Section 5.3.9). The introduction of a formal EcIA review process (recommended in Section 5.5.1) would go some way to helping address this issue.

Additional solutions to the problems of implementation effectiveness include the implementation of habitat mitigation measures as soon as possible (preferably at least one year prior to construction commencing) in order to give them time to provide refuge for fauna species during construction. Since consultants cannot rely on complex habitat mitigation measures (e.g. calcareous and acid grasslands and habitats reliant on particular hydrological conditions) being implemented effectively, larger areas may need to be considered to help compensate for poor implementation effectiveness. EcIA practitioners could in this instance look towards the research conducted on replacement ratios in the context of biodiversity offsetting (e.g. Moilanen *et al.*, 2009). However, further research on the implementation effectiveness of habitat mitigation measures is required to determine the optimum ratio of lost to created habitat to ensure no net loss.

Finally, whilst follow-up cannot guarantee the implementation effectiveness of a habitat mitigation measure, it can help determine the management regimes most likely to achieve effectiveness. Without follow-up and its feedback into management, there is a danger that lack of implementation effectiveness will simply equate to a net loss of biodiversity. This also applies to biodiversity offsetting. As a result, follow-up should be included as a planning condition or obligation for every EIA development that relies on habitat mitigation measures to significantly reduce its residual ecological impacts. Where net biodiversity loss has been deemed to occur (according to pre-agreed criteria) after the agreed follow-up period, the developer should be liable for a pre-agreed monetary payment. This would either fund further mitigation work on-site, or contribute to off-site conservation work. This arrangement could be included as an obligation within a S106 agreement. Currently, S106 Agreements frequently require developers to pay for air quality or traffic monitoring (Drayson, unpublished data); ecological follow-up would simply need to be added to this, with the proviso that non-sensitive data is made publicly available.

Alternatively, a performance bond could be used. Performance bonds are a legal guarantee that mitigation will be effectively implemented (even if the developer becomes bankrupt), and are frequently used in mitigation banking in the US (Dodd, 2007). If mitigation is not implemented or fails, the CPA is guaranteed reimbursement up to the value of the performance bond in order to ensure no net loss of biodiversity. The advantage of this mechanism is that it avoids the costs of seeking legal action, which would be required to enforce S106 obligations or planning conditions (Braidwood *et al.*, 2011). However, to be effective, the value of the performance bond must be sufficiently high that it acts as an incentive for the developer to implement the mitigation effectively, in order to be released from the bond. In addition, the follow-up must be conducted by an independent consultant commissioned by the CPA (but paid for by the developer), to ensure that follow-up reports are as accurate as possible. Performance bonds have been used for ecological mitigation in the UK (e.g. Minshull, 2008) but their use is not widespread, potentially due to developer opposition (Braidwood *et al.*, 2011). The use of performance bonds should be investigated to identify whether it is a suitable mechanism for ensuring effective mitigation implementation in English EIA developments.

This study's finding of the relative lack of habitat mitigation effectiveness in EcIA could provide an important argument in favour of introducing biodiversity offsetting into the UK planning system. For example, a dedicated mechanism to ensure that habitat mitigation measures are carried out (so long as it adhered to the recommendations provided here, such as monitoring) could in theory result in greater success in achieving no net loss of biodiversity as a result of built development. However, the considerable difficulty of, and uncertainty inherent in, habitat mitigation measures suggests that an approach to make habitat mitigation measures 'easier' for developers (in that third parties would be carrying out and managing the mitigation measures) could be counter-productive for biodiversity, even with the inclusion of generous replacement ratios. It is possible that there should be instead be a shift in emphasis from how better to deliver mitigation to how better to make decisions, both in terms of the developer in selecting sites (considerations of alternatives are not conducted well in EIAs, see Table 2) and in terms of the CPA in determining planning permission.

PART 4: ECOLOGICAL IMPACT ASSESSMENT & MITIGATION

CHAPTER 10: Synthesis & Conclusions

10.1 Summary

This study is the most comprehensive investigation of English EcIA chapter quality since the 1990s. It is the first to investigate the link between EcIA chapter quality and mitigation implementation and implementation effectiveness, and the statistical approaches used (e.g. to identify variables with the greatest explanatory power) are novel in the field of EcIA research. This study is also the first to investigate the ecological mitigation in completed EIA development sites from a variety of development sectors. It is also novel in its use of quantitative methods to investigate EcIA chapter quality and on-site mitigation implementation and effectiveness.

Chapters 5, 6, 8 and 9 have each highlighted positive and negative aspects of EcIA practice. There have been significant improvements in EcIA chapter content over time (Chapter 5), but each individual chapter on average contains only half of the information legally required under the EIA Directive and recommended in the EcIA Guidelines (Chapter 6). In terms of completed developments, ecological mitigation implementation is relatively high (Chapter 8), but is not as effective as it should be to guarantee no net loss of biodiversity (Chapter 9). Throughout this study, therefore, recommendations have been made in order to improve EcIA practice. These are summarised in Table 21.

Table 21: Summary of recommendations made throughout this document to improve EcIA practice.

Chapter	Category	Recommendation	Organisation/s best placed to implement recommendations
5, 6 & 8	EcIA Guidelines	The pending revision of the EcIA Guidelines presents an opportunity to improve the Guidelines in light of the results of this study. Suggested improvements include clarifying the level of detail required for Full and Outline planning applications and emphasising the importance of naming the consultants involved in the EcIA process.	IEEM
5	EcIA chapter review	Formal annual review of a small proportion of EcIA chapters across a variety of sectors, along with dissemination of the anonymised results of that review, would help improve the quality of EcIA chapters by highlighting strengths and weaknesses of current practice.	IEEM
5, 8 & 9	Follow-up	There is unlikely to be government funding available for a national EIA development monitoring programme. As a result, lobbying for changes in practice is required, perhaps to ensure that CPAs regularly include follow-up in S106 obligations or planning conditions. All EIA developments should require a post-construction mitigation implementation audit, and implementation effectiveness monitoring may be required depending on the mitigation that was proposed.	IEEM, CPAs

Chapter	Category	Recommendation	Organisation/s best placed to implement recommendations
5	Knowledge transfer	A publicly accessible document repository for EcIA chapters would not only act as a valuable resource for practitioners, but also for the public and researchers. It would also form the population from which samples are drawn for formal review.	IEEM
6	Training	Training of ecological consultants is necessary to improve EcIA chapter quality. The current offering of courses is insufficient to ensure that all ecological consultants involved in writing EcIA chapters are appropriately trained. An online course is likely to reach a greater audience, and this could be improved with some form training requirement for consultants (e.g. accreditation).	IEEM
6	Accreditation	Currently, it is possible for anyone to write an EcIA chapter; there are no formal training or qualification requirements. This should change, with accredited ecologists receiving certain levels of training and undergoing examination.	IEEM
9	Performance bonds	The use of performance bonds to ensure effective implementation of ecological mitigation measures in EIA developments within the English planning system should be comprehensively investigated to ensure no net loss of biodiversity.	Central and local government, Natural England

Chapter	Category	Recommendation	Organisation/s best placed to implement recommendations
9	Biodiversity offsetting	To identify the optimum area of land for mitigation to ensure no net loss of biodiversity, investigation of failure rates for different habitat types is required.	Natural England

These recommendations need to be seen in the context of the relationships between the various actors in the planning process (Figure 47) and in the context of the time in which these relationships occur. For example, Natural England's budget has been significantly reduced as a result of Government austerity measures, reducing its scope for certain activities (Natural England, 2010b). These relationships can be extremely complex, even within just the technical discipline of ecology, and each actor is restricted in what it can and cannot accomplish, necessitating cooperation and collaboration for these recommendations to succeed. This may not be easy given historical precedent. For example, ecology was traditionally, and in some instances still is (e.g. Chancellor of the Exchequer, 2011), perceived as a barrier to development and so relationships between developers and consultants may not be conducive to collaboration. In addition, with only 40% of CPAs employing ecologists (Newey, 2012), some CPA relationships with ecological consultants may not be as productive as they should be. This serves to highlight the role that IEEM (and by extension the professional institutes for other technical disciplines) could play as an 'ambassador' for ecology in the planning system.

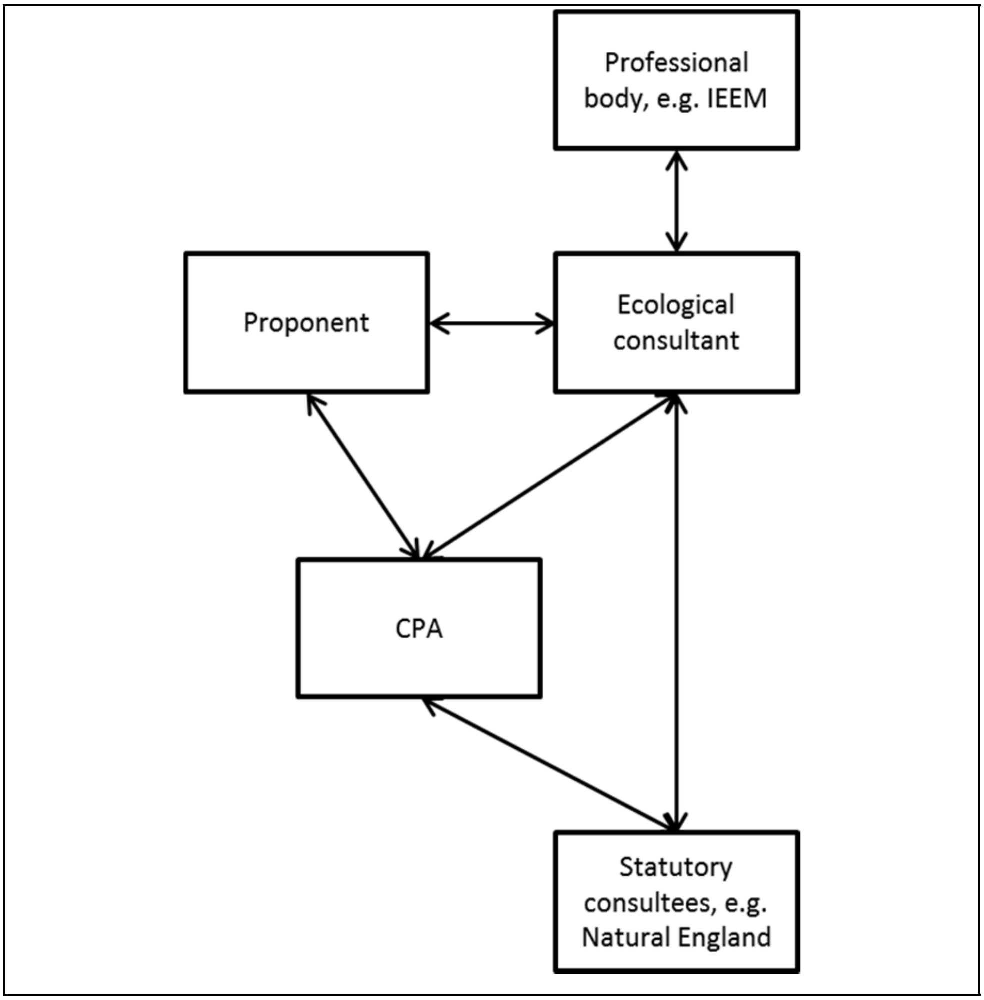


Figure 47: Summary of the lines of communication between different actors in the planning process with regard to ecology.

10.2 Conclusions

EIA has attracted considerable criticism since its inception. Perhaps the most succinct comment was provided by Benson (2003), who stated that "EIA is a procedure that imposes no environmental standards, imposes no performance standards and sets few targets". Despite these considerable flaws, there is currently no adequate replacement for EIA. As a result, building on the results of the numerous critical investigations into EIA process and practice is the best option. The proposed amendments to the EIA Directive not only link EIA to defined environmental targets but will impose limited performance standards. However, for EIA to be effective in helping achieve the EU target of halting EU biodiversity loss by 2020 further changes will be required, focusing not only on improvements to EIA and EcIA procedure but also on how it can be better integrated with decision-making. However, if this is not accompanied by mainstreaming of the environment and biodiversity in government policies, “there is a tremendous risk that the EIA process is reduced to EIS [ES] preparation” (Sanchez, 2006). Co-ordinated efforts to improve EIA are therefore required.

Whilst the EIA Directive proposals and the UK’s Natural Environment White Paper are steps in the right direction, implementation will continue to be a challenge until it is fully recognised by all (including governments and developers) that ecology need not act as a barrier to development. The benefit of this approach was seen in the Lower Mill Estate case study described in Section 9.3.4. Early engagement with ecological consultants can help unlock the potential of development sites to contribute not only to no net loss of biodiversity, but to net gains in biodiversity. What is required is leadership in ensuring that sites for which net gains in biodiversity are not possible (such as ancient woodlands and species-rich lowland unimproved grassland) are protected from inappropriate development, and that sites for which net gains in biodiversity are possible are promoted for development. Caution should also be applied to a blanket introduction of biodiversity offsetting, given the poor effectiveness of habitat mitigation measures identified in this study.

In terms of EcIA, ecological consultants, IEEM, CPA ecologists, Natural England, Defra and wildlife NGOs must co-operate to ensure that developer and CPA awareness of the critical importance of biodiversity is increased, that EcIA chapter quality improves, and that adequate monitoring and management of ecological mitigation measures is carried out. In particular, greater emphasis must be placed on enhancement of development sites for biodiversity, to help achieve net biodiversity gain. In combination, these will help to ensure England meets its EU obligation to halt biodiversity loss by 2020. However, it should be noted that other technical disciplines within EIA, such as hydrology and landscape, can also play an important role in ensuring net biodiversity gain. Many of the recommendations aimed towards IEEM are therefore also relevant to other professional institutes with members working in EIA.

10.3 Further Research

This study has highlighted several important areas requiring further research:

- The majority of studies linking EIA and ESs to decision-making (at the design and planning stages) were conducted in the 1990s. Considering the many changes in relevant legislation, policy and guidance since that time, further research into the effect of EIA and ESs on decision-making would be useful.
- A formal qualitative approach to determine the views of major stakeholders as to the success, or otherwise, of ecological mitigation implementation and effectiveness would prove important insights and highlight areas for further work.
- A review of EcMP quality would be valuable, particularly in comparison with on-site mitigation implementation and effectiveness. This would be challenging as there is currently no guidance available on what an EcMP should include, but such guidance could develop from the research.
- This study's attempt at assessing mitigation implementation in terms of the inconvenience of the recommended measures was preliminary and not based on site data. The results are therefore indicative only. An in-depth assessment of the barriers to mitigation implementation based on site data would therefore be useful.
- This study only investigated the effectiveness of a subset of habitat mitigation measures: other forms of mitigation should also be investigated. For example, Natural England holds extensive monitoring records for European Protected Species, such as great crested newts and bats, which could be analysed to determine success.
- Research is required to establish which habitat types best lend themselves as candidates for habitat mitigation, and which should not be included as mitigation.
- Only one site conducted any off-site mitigation at the time of survey (Whitemoor Phase 1). A study comparing and contrasting the effectiveness of on-site versus off-site mitigation would have timely implications for the current debate on whether the UK should adopt a more formal approach to biodiversity offsetting within the planning system.

REFERENCES

Ahammed, A.K.M.R. & Nixon, B.M. 2006. Environmental Impact Monitoring in the EIA Process of South Australia. *Environmental Impact Assessment Review,* 26**,** 426-447.

Anderson, D.R. & Burnham, K.P. 2002. Avoiding Pitfalls When Using Information-Theoretic Methods. *The Journal of Wildlife Management,* 66**,** 912-918.

Anderson, P. 1995. Ecological Restoration and Creation: a Review. *Biological Journal of the Linnean Society,* 56**,** 187-211.

Anyadike-Danes, M. 2004. The Real North–South Divide? Regional Gradients in UK Male Non-employment. *Regional Studies,* 38**,** 85-95.

Armstrong, J., Bassi, S., Bowyer, C., Farmer, A., Gantioler, S., Geeraerts, K., Hjerp, P., Lewis, M., Pallemaerts, M., Watkins, E. & Withana, S. 2010. *Sourcebook on EU Environmental Law*. Institute for European Environmental Policy.

Aronson, J., Clewell, A.F., Blignaut, J.N. & Milton, S.J. 2006. Ecological Restoration: a New Frontier for Nature Conservation and Economics. *Journal for Nature Conservation,* 14**,** 135-139.

Atkins. 2004. *The Blackwater Valley – Shaping the Landscape*. Blackwater Valley Countryside Partnership. Aldershot, UK.

Atkinson, S.F., Bhatia, S., Schoolmaster, F.A. & Waller, W.T. 2000. Treatment of Biodiversity Impacts in a Sample of US Environmental Impact Statements. *Impact Assessment and Project Appraisal,* 18**,** 271-282.

Bagri, A., McNeely, J. & Vorhies, F. 1998. Biodiversity and Impact Assessment. *In:* INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN) (ed.) *Biodiversity and Impact Assessment.* Christchurch, New Zealand: IUCN.

Bailey, J. 1997. Environmental Impact Assessment and Management: An Underexplored Relationship. *Environmental Management,* 21**,** 317-327.

Bailey, J. & Hobbs, V. 1990. A Proposed Framework and Database for EIA Auditing. *Journal of Environmental Management,* 31**,** 163-172.

Bailey, J., Hobbs, V. & Saunders, A. 1992. Environmental Auditing: Artificial Waterway Developments in Western Australia. *Journal of Environmental Management,* 34**,** 1-13.

Barker, A. & Wood, C. 1999. An Evaluation of EIA System Performance in Eight EU Countries. *Environmental Impact Assessment Review,* 19**,** 387-404.

Bartlett, R.V. & Kurian, P.A. 1999. The Theory of Environmental Impact Assessment: Implicit Models of Policy Making. *Policy & Politics,* 27**,** 415-433.

Bat Conservation Trust. 2007. *Bat Surveys: Good Practice Guidelines*. Bat Conservation Trust. London, UK.

BCT & ILE. 2008. *Bats and Lighting in the UK*. Bat Conservation Trust & Institution of Lighting Engineers.

Beanlands, G.E. & Duinker, P.N. 1983. *An Ecological Framework for Environmental Impact Assessment in Canada*. Institute for Resource and Environmental Studies, Dalhousie University. Halifax, Canada.

Benson, J.F. 2003. What is the Alternative? Impact Assessment Tools and Sustainable Planning. *Impact Assessment and Project Appraisal,* 21**,** 261-280.

Benstead, P. 2000. Practical Wetland Restoration: some Recent Experiences of the Royal Society for the Protection of Birds. *Landscape Research,* 25**,** 394 - 398.
Bisset, R. & Tomlinson, P. 1988. Monitoring and Auditing of Impacts. *In:* WATHERN, P. (ed.) *Environmental Impact Assessment Theory and Practice.* London, UK: Unwin Hyman Ltd.
Bojórquez-Tapia, L.A. & García, O. 1998. An Approach for Evaluating EIAs - Deficiencies of EIA in Mexico. *Environmental Impact Assessment Review,* 18**,** 217-240.
Bond, A. 2003. Let's not be Rational about this: Response to Benson. *Impact Assessment and Project Appraisal,* 21**,** 266-269.
Box, J. 1996. Setting Objectives and Defining Outputs for Ecological Restoration and Habitat Creation. *Restoration Ecology,* 4**,** 427-432.
Box, J. 2003. Critical Factors and Evaluation Criteria for Habitat Translocation. *Journal of Environmental Planning and Management,* 46**,** 839-856.
Box, J. 2011. Reassessing Habitat Translocation as a Tool for Delivering New Nature Conservation Priorities and for Conserving Ecological Resources. *In Practice: Bulletin of the Institute of Ecology and Environmental Management.*
Boyden, A. 1998. *Keeping a Promise: The Implementation of Mitigation Measures in Environmental Assessment.* Oxford Brookes University.
Braidwood, P., Carter, S., Hodgkinson, P. & Palmer, A. 2011. *S.106 Performance Bonds: A Review by the Working Group Established by the Overview and Scrutiny Committee - Outcome Report*. Cotswold District Council.
Briggs, S. & Hudson, M.D. 2013. Determination of Significance in Ecological Impact Assessment: Past Change, Current Practice and Future Improvements. *Environmental Impact Assessment Review,* 38**,** 16-25.
Bryman, A. 1984. The Debate about Quantitative and Qualitative Research: A Question of Method or Epistemology? *The British Journal of Sociology,* 35**,** 75-92.
Buckley, R. 1998. Improving the Quality of Environmental Impact Statements (EISs). *In:* PORTER, A. L. & FITTIPALDI, J. J. (eds.) *Environmental Methods Review: Retooling Impact Assessment for the New Century.* Fargo, North Dakota, USA: The Press Club.
Bullock, J.M. 1998. Community Translocation in Britain: Setting Objectives and Measuring Consequences. *Biological Conservation,* 84**,** 199-214.
Bullock, J.M., Hodder, K.H., Manchester, S.J. & Stevenson, M.J. 1996. *Review of Information, Policy and Legislation on Species Translocation*. Institute of Terrestrial Ecology. Peterborough, UK.
Burstein, L. 1978. *Secondary Analysis: An Important Resource for Educational Research and Evaluation*. Center for the Study of Evaluation. Los Angeles, California, USA.
Butchart, S.H.M., Walpole, M., Collen, B., van Strien, A., Scharlemann, J.P.W., Almond, R.E.A., Baillie, J.E.M., Bomhard, B., Brown, C., Bruno, J., Carpenter, K.E., Carr, G.M., Chanson, J., Chenery, A.M., Csirke, J., Davidson, N.C., Dentener, F., Foster, M., Galli, A., Galloway, J.N., Genovesi, P., Gregory, R.D., Hockings, M., Kapos, V., Lamarque, J.-F., Leverington, F., Loh, J., McGeoch, M.A., McRae, L., Minasyan, A., Morcillo, M.H., Oldfield, T.E.E., Pauly, D., Quader, S., Revenga, C., Sauer, J.R., Skolnik, B., Spear, D., Stanwell-Smith, D., Stuart, S.N., Symes, A., Tierney, M., Tyrrell, T.D., Vie, J.-C. & Watson, R. 2010. Global Biodiversity: Indicators of Recent Declines. *Science,* 328**,** 1164-1168.

Byron, H. 2001. *The Integraton of Biodiversity into National Environmental Assessment Procedures: National Case Studies: United Kingdom*. Biodiversity Planning Support Programme.
Byron, H., Treweek, J., Sheate, W.R. & Thompson, S. 2000. Road Developments in the UK: an Analysis of Ecological Assessment in Environmental Impact Statements Produced between 1993 and 1997. *Journal of Environmental Planning and Management,* 43**,** 71-97.
Cabinet Office. 2011. *Red Tape Challenge* [Online]. Available: http://www.redtapechallenge.cabinetoffice.gov.uk/home/index/ [Accessed 03/08/2012].
Cambridgeshire and Peterborough Biodiversity Partnership. 2008. *Acid Grassland and Heathland*
Canelas, L., Almansa, P., Merchan, M. & Cifuentes, P. 2005. Quality of Environmental Impact Statements in Portugal and Spain. *Environmental Impact Assessment Review,* 25**,** 217-225.
Carroll, B. & Turpin, T. 2009. *Environmental Impact Assessment Handbook,* London, UK, Thomas Telford Ltd.
Cashmore, M. 2004. The Role of Science in Environmental Impact Assessment: Process and Procedure Versus Purpose in the Development of Theory. *Environmental Impact Assessment Review,* 24**,** 403-426.
Cashmore, M., Bond, A. & Cobb, D. 2008. The Role and Functioning of Environmental Assessment: Theoretical Reflections upon an Empirical Investigation of Causation. *Journal of Environmental Management,* 88**,** 1233-1248.
Cashmore, M., Gwilliam, R., Morgan, R., Cobb, D. & Bond, A. 2004. The Interminable Issue of Effectiveness: Substantive Purposes, Outcomes and Research Challenges in the Advancement of Environmental Impact Assessment Theory. *Impact Assessment and Project Appraisal,* 22**,** 295-310.
CBD Conference of Parties. 2002. Strategic Plan for the Convention on Biological Diversity. *In:* CONVENTION ON BIOLOGICAL DIVERSITY (ed.).
CBD Conference of Parties. 2006. Impact Assessment: Voluntary Guidelines on Biodiversity-inclusive Impact Assessment. *In:* CONVENTION ON BIOLOGICAL DIVERSITY (ed.).
CBD Conference of Parties. 2010a. Strategic Plan for Biodiversity 2011-2020. *In:* CONVENTION ON BIOLOGICAL DIVERSITY (ed.).
CBD Conference of Parties. 2010b. United Nations Decade on Biodiversity 2011-2020. *In:* CONVENTION ON BIOLOGICAL DIVERSITY (ed.).
Chancellor of the Exchequer. 2011. *Autumn Statement*. HM Treasury. London, UK.
Cherrill, A. & McClean, C. 1999. Between-observer Variation in the Application of a Standard Method of Habitat Mapping by Environmental Consultants in the UK. *Journal of Applied Ecology,* 36**,** 989-1008.
Chinn, L., Hughes, J. & Lewis, A. 1999. *Mitigation of the Effects of Road Construction on Sites of High Ecological Interest*. Transport Research Laboratory.
Cole, C.A. & Shafer, D. 2002. Section 404 Wetland Mitigation and Permit Success Criteria in Pennsylvania, USA, 1986–1999. *Environmental Management,* 30**,** 508-515.
Coleby, A.M., van der Horst, D., Hubacek, K., Goodier, C., Burgess, P.J., Graves, A., Lord, R. & Howard, D. 2011. Environmental Impact Assessment, Ecosystems Services and the Case of Energy Crops in England. *Journal of Environmental Planning and Management,* 55**,** 369-385.

Commission of the European Communities. 2001. *Presidency Conclusions: Göteborg European Council 15 and 16 June 2001*.
Commission of the European Communities. 2006. *Halting the Loss of Biodiversity by 2010 - And Beyond: Sustaining Ecosystem Services for Human Well-being*.
Commission of the European Communities. 2009a. *The Application and Effectiveness of the EIA Directive (Directive 85/337/EEC, as amended by Directives 97/11/EC and 2003/35/EC)*. Commission of the European Communities. Brussels.
Commission of the European Communities. 2009b. *Mainstreaming Sustainable Development into EU Policies: 2009 Review of the European Union Strategy for Sustainable Development*.
Cooper, L.M. & Sheate, W.R. 2002. Cumulative Effects Assessment: A Review of UK Environmental Impact Statements. *Environmental Impact Assessment Review,* 22**,** 415-439.
Cotswold Water Park Society. 2009. *Wintering Waterbird Surveys & Badger Surveys: Winter 2008-2009*. Cotswold Water Park Society. Cirencester, UK.
Council of the European Union. 1985, as amended. Council Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment (85/337/EEC). *Official Journal of the European Communities,* 175**,** 40-48.
Council of the European Union. 1992. Council Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC). *Official Journal of the European Communities,* 206**,** 7-50.
Council of the European Union. 2006. *Renewed EU Sustainable Development Strategy*. Brussels, Belgium.
Cowell, R. 1997. Stretching the Limits: Environmental Compensation, Habitat Creation and Sustainable Development. *Transactions of the Institute of British Geographers,* 22**,** 292-306.
CPRE. 1991. *The Environmental Assessment Directive - Five Years On*. Council for the Protection of Rural England. London, UK.
Culhane, P.J. 1987. The Precision and Accuracy of U.S. Environmental Impact Statements. *Environmental Monitoring and Assessment,* 8**,** 217-238.
Culhane, P.J. 1993. Post-EIS Environmental Auditing: a First Step to Making Rational Environmental Assessment a Reality. *The Environmental Professional,* 15**,** 66-75.
Cullingworth, J.B. & Nadin, V. 1994. *Town & Country Planning in Britain,* London, UK, Routledge.
DCLG. 2006. *Environmental Impact Assessment: A Guide to Good Practice and Procedures (a consultation paper)*. Department for Communities and Local Government. London, UK.
DCLG. 2012a. *National Planning Policy Framework*. DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT. London, UK.
DCLG. 2012b. *Table P120: District Planning Authorities - Planning Applications Received and Decided* [Online]. London, UK: Department for Communities and Local Government. Available: http://www.communities.gov.uk/planningandbuilding/planningbuilding/planningstatistics/livetables/livetablesondevelopmentcontrolst/ [Accessed 02/05/2012].
DCLG. 2012c. *Table P134: District Planning Authorities - Applications Received, Decided, Granted and Delegated, Environmental Statements Received and Flow of Applications by Authority* [Online]. London, UK: Department for

Communities and Local Government. Available: http://www.communities.gov.uk/planningandbuilding/planningbuilding/planningstatistics/livetables/livetablesondevelopmentcontrolst/ [Accessed 02/05/2012].
DCLG. unpublished data. Environmental Impact Assessment in the UK to 31/12/2008. *In:* DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT (ed.). London, UK.
de Garis, Y. 2003. What is the Alternative? Response to Benson. *Impact Assessment and Project Appraisal,* 21**,** 272.
Deelstra, Y., Nooteboom, S.G., Kohlmann, H.R., van den Berg, J. & Innanen, S. 2003. Using Knowledge for Decision-Making Purposes in the Context of Large Projects in The Netherlands. *Environmental Impact Assessment Review,* 23**,** 517-541.
Defra. 2011a. *Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services*. Department for Environment, Food and Rural Affairs. London, UK.
Defra. 2011b. *The Natural Choice: Securing the Value of Nature. CM 8082*. London, UK: Department for Environment Food and Rural Affairs, The Stationery Office.
DETR. 1997. *Mitigation Measures in Environmental Statements*. Rotherham, UK: Department of the Environment Transport and the Regions.
Dipper, B. 1998. Monitoring and Post-auditing in Environmental Impact Assessment: a Review. *Journal of Environmental Planning and Management,* 41**,** 731-747.
Dodd, A.M. 2007. *EU Habitats Directive and Habitat Compensation: Spatial Planning in England and Implementing Habitat Compensation under Article 6(4) of the Habitats Directive.* MSc, Oxford Brookes University.
Dodds, P.J. 1993. The I-476 Environmental Monitor: an effective approach for NEPA documents. *In:* HILDEBRAND, S. G. & CANNON, J. B. (eds.) *Environmental Analysis: The NEPA Experience.* Florida, USA: CRC Press.
DoE. 1995a. *Preparation of Environmental Statements for Planning Projects that Require Environmental Assessment: a Good Practice Guide*. London, UK: Department of the Environment, Her Majesty's Stationery Office.
DoE. 1995b. *The Use of Conditions in Planning Permission*. London, UK: Department of the Environment, Office of the Deputy Prime Minister.
DoT. 1989. *Roads for Prosperity*. DEPARTMENT OF TRANSPORT. HMSO.
DTI. 2003. *Our Energy Future - Creating a Low Carbon Economy*. DEPARTMENT OF TRADE AND INDUSTRY. London, UK: The Stationery Office.
Dudley, G. 2007. Individuals and the Dynamics of Policy Learning: The Case of the Third Battle of Newbury. *Public Administration,* 85**,** 405-428.
Duxbury, R. & Telling, A.E. 2009. *Telling & Duxbury's Planning Law and Procedure,* Oxford, UK, Oxford University Press.
E.ON. 2006. *E.ON Engineering Ltd* [Online]. Available: http://www.eon-uk.com/about/eonengineering.aspx [Accessed 16/10/2012].
Elliott, M., Burdon, D., Hemingway, K.L. & Apitz, S.E. 2007. Estuarine, Coastal and Marine Ecosystem Restoration: Confusing Management and Science – A Revision of Concepts. *Estuarine, Coastal and Shelf Science,* 74**,** 349-366.
Environment Agency. 2012. *Living on the Edge: A Guide to your Rights and Responsibilities of Riverside Ownership*. Environment Agency. Bristol, UK.
Environment Agency, Natural England & Forestry Commission. 2012. *Building a Better Environment: Our Role in Development and How We Can Help (consultation version)*.

Environment Food and Rural Affairs Committee. 2012. *Natural Environment White Paper: Fourth Report of Session 2012–13*. HOUSE OF COMMONS. London, UK: The Stationery Office Ltd.
Environmental Resources Management. 2001. *Guidance on EIA - EIS Review*. European Commission. Luxembourg: Office for Official Publications of the European Communities.
European Commission. 2011. *Our Life Insurance, Our Natural Capital: an EU Biodiversity Strategy to 2020*. Brussels.
European Commission. 2012. *Proposal for a Directive of the European Parliament and of the Council amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*.
European Commission v Ireland. 2011. Failure of a Member State to Fulfil Obligations – Directive 85/337/EEC. *In:* JUSTICE, E. C. O. (ed.) *C-50/09.*
European Parliament & Council of the European Union. 2002. Decision No. 1600/2002/EC laying down the Sixth Community Environment Action Programme. *Official Journal of the European Communities,* 242**,** 1-15.
European Parliament & Council of the European Union. 2009. Directive 2009/147/EC on the Conservation of Wild Birds. *Official Journal of the European Communities,* 20**,** 7-25.
European Union Council. 2010. *EU Council Conclusions on Biodiversity Post-2010* [Online]. Available: http://www.europa-eu-un.org/articles/en/article_9571_en.htm [Accessed 05/05/2010].
Evans, S. 2013a. Concern over EIA 'Burdens'. *The ENDS Report.*
Evans, S. 2013b. EIAs 'Undermined' by EU Reforms, say Environmental Professionals *The ENDS Report.*
Ferreira, A., Sykes, O. & Batey, P. 2009. Planning Theory or Planning Theories? The Hydra Model and its Implications for Planning Education. *Journal for Education in the Built Environment,* 4**,** 29-54.
Firestone, W.A. 1987. Meaning in Method: The Rhetoric of Quantitative and Qualitative Research. *Educational Researcher,* 16**,** 16-21.
Fothergill, J. 2011. *The State of Environmental Impact Assessment Practice in the UK*. Institute of Environmental Management & Assessment.
Four Countries' Biodiversity Group. 2012. *UK Post-2010 Biodiversity Framework*.
Freckleton, R. 2011. Dealing with Collinearity in Behavioural and Ecological Data: Model Averaging and the Problems of Measurement Error. *Behavioral Ecology and Sociobiology,* 65**,** 91-101.
Frost, R. 1994. Project Design Beyond Environmental Impact Statements. *In:* THERIVEL, R. (ed.) *Issues in Environmental Impact Assessment.* School of Planning, Oxford Brookes University, Oxford, UK.
Frost, R. 1997a. EIA Monitoring and Audit. *In:* WESTON, J. (ed.) *Planning and Environmental Impact Assessment in Practice.* Harlow, UK: Addison Wesley Longman.
Frost, R. 1997b. *Post Development Audit of Prediction and Mitigation for EIA Projects in the UK.* PhD, Oxford Brookes University.
GHK Technopolis. 2008. *Evaluation on EU Legislation - Directive 85/337/EEC (Environmental Impact Assessment, EIA) and Associated Amendments*. Brussels.
Ginzburg, L.R. & Jensen, C.X.J. 2004. Rules of Thumb for Judging Ecological Theories. *Trends in Ecology & Evolution,* 19**,** 121-126.
Glass, G.V., Peckham, P.D. & Sanders, J.R. 1972. Consequences of Failure to Meet Assumptions Underlying the Fixed Effects Analyses of Variance and Covariance. *Review of Educational Research,* 42**,** 237-288.

Glasson, J. 1994a. EIA - Only the Tip of the Iceberg? *Town and Country Planning,* 63**,** 42-45.

Glasson, J. 1994b. Life after the Decision: the Importance of Monitoring in EIA. *Built Environment,* 20**,** 309-320.

Glasson, J. 1999. The First 10 Years of the UK EIA System: Strengths, Weaknesses, Opportunities and Threats. *Planning Practice & Research,* 14**,** 363-375.

Glasson, J., Therivel, R., Weston, J., Wilson, E. & Frost, R. 1997. EIA - Learning from Experience: Changes in the Quality of Environmental Impact Statements for UK Planning Projects. *Journal of Environmental Planning and Management,* 40**,** 451 - 464.

Goriup, P., Thompson, J. & Hayns, S. 2012. IEEM In Practice - The First 21 Years. *In Practice: Bulletin of the Institute of Ecology and Environmental Management,* 76**,** 13-18.

Gray, I. & Edwards-Jones, G. 2003. A Review of Environmental Statements in the British Forest Sector. *Impact Assessment and Project Appraisal,* 21**,** 303-312.

Guernier, V., Hochberg, M.E. & Guégan, J.-F. 2004. Ecology Drives the Worldwide Distribution of Human Diseases. *PLoS Biology,* 2**,** 740-746.

Gwilliam, R.S. 2002. *The Integration of Environmental Impact Assessment into Development Control and Planning Decisions: the Perception of English Planning Officers.* MSc, University of East Anglia, Norwich.

Hall, L.S., Krausman, P.R. & Morrison, M.L. 1997. The Habitat Concept and a Plea for Standard Terminology. *Wildlife Society Bulletin,* 25**,** 173-182.

Hallak, J. & Poisson, M. 2007. Academic Fraud, Accreditation and Quality Assurance: Learning from the Past and Challenges for the Future. *Higher Education in the World 2007.* Global University Network for Innovation.

Hartley, N. & Wood, C. 2005. Public Participation in Environmental Impact Assessment - Implementing the Aarhus Convention. *Environmental Impact Assessment Review,* 25**,** 319-340.

Hearn, S.M., Healey, J.R., McDonald, M.A., Turner, A.J., Wong, J.L.G. & Stewart, G.B. 2011. The Repeatability of Vegetation Classification and Mapping. *Journal of Environmental Management,* 92**,** 1174-1184.

Highways Agency. 1992, as amended. *Design Manual for Roads and Bridges: Volume 11*. London, UK.

Hildebrand, S.G. & Cannon, J.B. (eds.) 1993. *Environmental Analysis: The NEPA Experience,* Florida, USA: CRC Press.

HMG. 1947. Town and Country Planning Act. Her Majesty's Stationery Office.

HMG. 1988. Town and Country Planning (Assessment of Environmental Effects) Regulations 1988. Her Majesty's Stationery Office.

HMG. 1994, as amended. Conservation (Natural Habitats, &c.) Regulations. Her Majesty's Stationery Office.

HMG. 1999, as amended. Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations. Her Majesty's Stationery Office.

HMG. 2000. Countryside and Rights of Way Act. Her Majesty's Stationery Office.

HMG. 2006. Natural Environment and Rural Communities Act. Her Majesty's Stationery Office.

HMG. 2010. The Conservation of Habitats and Species Regulations. Her Majesty's Stationery Office.

HMG. 2011. Town and Country Planning (Environmental Impact Assessment) Regulations. Her Majesty's Stationery Office.

HMG. 2012. The Conservation of Habitats and Species (Amendment) Regulations. Her Majesty's Stationery Office.
Holling, C.S. 1986. Adaptive Environmental Management. *Environment: Science and Policy for Sustainable Development,* 28**,** 39-39.
Hooper, D.U., Adair, E.C., Cardinale, B.J., Byrnes, J.E.K., Hungate, B.A., Matulich, K.L., Gonzalez, A., Duffy, J.E., Gamfeldt, L. & O/'Connor, M.I. 2012. A Global Synthesis Reveals Biodiversity Loss as a Major Driver of Ecosystem Change. *Nature,* advance online publication.
Hopkins, J.J. 1989. Prospects for Habitat Creation. *Landscape Design,* 179**,** 19-22.
House of Commons. 1990. *Written Answers to Questions: Tuesday 6 March 1990*. Hansard.
Huggett, D. 2003. Mitigation – is it Working? An RSPB perspective. *In:* EARLL, R. (ed.) *Mitigation – Does it Measure Up? Steps to best practice.* London, UK: CIWEM.
IAIA. 2005. *Biodiversity in Impact Assessment*. International Association for Impact Assessment. Fargo.
IEEM. 2006. *Guidelines for Ecological Impact Assessment in the United Kingdom* [Online]. Winchester, UK: Institute of Ecology and Environmental Management. Available: http://www.ieem.org.uk/ecia/index.html [Accessed 06/01/2011].
IEEM. 2012. *Institute of Ecology and Environmental Management* [Online]. Available: http://www.ieem.net/ [Accessed 10/09/2012].
IEMA. 2004. *Guidelines for Environmental Impact Assessment*. Institute of Environmental Management and Assessment. Lincoln.
IEMA. 2011. *EIA Quality Mark Commitments*. Institute of Environmental Management and Assessment.
IEMA. 2013. *Corporate Membership Benefits* [Online]. Available: http://www.iema.net/corporate-benefits [Accessed 01/02/2013].
ISO. 2004. *14001:2004(en) Environmental management systems - Requirements with Guidance for Use*. International Organization for Standardization.
Jay, S., Jones, C., Slinn, P. & Wood, C. 2007. Environmental Impact Assessment: Retrospect and Prospect. *Environmental Impact Assessment Review,* 27**,** 287-300.
Jick, T.D. 1979. Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly,* 24**,** 602-611.
JNCC. 2003. *National Vegetation Classification – Ten Years' Experience Using the Woodland Section*, Joint Nature Conservation Committee.
JNCC. 2010. *Handbook for Phase 1 Habitat Survey - a Technique for Environmental Audit*, Joint Nature Conservation Committee.
JNCC. 2012. *The UK Biodiversity Action Plan (UK BAP)* [Online]. Available: http://jncc.defra.gov.uk/page-5155 [Accessed 30/11/2012].
João, E., Vanclay, F. & den Broeder, L. 2011. Emphasising Enhancement in all Forms of Impact Assessment: Introduction to a Special Issue. *Impact Assessment and Project Appraisal,* 29**,** 170-180.
Johnson, J.B. & Omland, K.S. 2004. Model Selection in Ecology and Evolution. *Trends in Ecology Evolution,* 19**,** 101-108.
Johnson, R.B. & Onwuegbuzie, A.J. 2004. Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher,* 33**,** 14-26.
Johnston, R.A. & McCartney, W.S. 1991. Local Government Implementation of Mitigation Requirements under the California Environmental Quality Act. *Environmental Impact Assessment Review,* 11**,** 53-67.

Jones, C., Wood, C. & Dipper, B. 1998. Environmental Assessment in the UK Planning Process: A Review of Practice. *Town Planning Review,* 69**,** 315.

Jones, C.E., Lee, N. & Wood, C. 1991. *UK Environmental Statements 1988-1990: an Analysis*. EIA Centre, Department of Planning and Landscape, University of Manchester. Manchester.

Kennedy, W.V. 1988. Environmental Impact Assessment in North America, Western Europe: What has Worked Where, How, and Why. *International Environment Reporter,* 11**,** 257-262.

Kerr, C. 2002. *Information Sheet on the Impacts of Artificial Lighting on Wildlife: Guidance and Best Practice*. English Nature.

Khera, N. & Kumar, A. 2010. Inclusion of Biodiversity in Environmental Impact Assessments (EIA): A Case Study of Selected EIA Reports in India. *Impact Assessment and Project Appraisal,* 28**,** 189-200.

Kobus, D. & Lee, N. 1993. The Role of Environmental Assessment in the Planning and Authorisation of Extractive Industry Projects. *Project Appraisal,* 8**,** 147-156.

Lackie, J. 2007. Chambers Dictionary of Science and Technology. Edinburgh: Chambers Harrap.

Land Use Consultants. 2005. *Going, Going, Gone? The Cumulative Impact of Land Development on Biodiversity in England*. English Nature. Peterborough, UK.

Lauranson, C. 2012. *Environment Policy: General Principles and Strategic Orientations*. European Parliament.

Law Commission. 2012. *Wildlife* [Online]. Available: http://lawcommission.justice.gov.uk/areas/wildlife.htm [Accessed 05/12/2012].

Lawrence, D.P. 1997. Quality and Effectiveness of Environmental Impact Assessments: Lessons and Insights from Ten Assessments in Canada. *Project Appraisal,* 12**,** 219-232.

Lawrence, D.P. 2000. Planning Theories and Environmental Impact Assessment. *Environmental Impact Assessment Review,* 20**,** 607-625.

Lawrence, D.P. 2007. Impact Significance Determination—Back to Basics. *Environmental Impact Assessment Review,* 27**,** 755-769.

Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J. & Wynne, G.R. 2010. *Making Space for Nature: a Review of England's Wildlife Sites and Ecological Network*. Department for the Environment, Food and Rural Affairs.

Lee, N. & Brown, D. 1992. Quality Control in Environmental Statements. *Project Appraisal,* 7**,** 41-45.

Lee, N. & Colley, R. 1991. Reviewing the Quality of Environmental Statements: Review Methods and Findings. *Town Planning Review,* 62**,** 239.

Lee, N. & Colley, R. 1992. *Reviewing the Quality of Environmental Statements (Occasional Paper 24)*. Department of Planning and Landscape, University of Manchester.

Lee, N., Colley, R., Bonde, J. & Simpson, J. 1999. *Reviewing the Quality of Environmental Statements and Environmental Appraisals (Occasional Paper 55)*. Department of Planning and Landscape, University of Manchester.

Lee, N., Walsh, F. & Reeder, G. 1994. Assessing the Performance of the EA Process. *Project Appraisal,* 9**,** 161-172.

Legg, C.J. & Nagy, L. 2006. Why most Conservation Monitoring is, but need not be, a Waste of Time. *Journal of Environmental Management,* 78**,** 194-199.
Lewis, J. 2003. Institutional Environments And Everyday EU Decision Making: Rationalist or Constructivist? *Comparative Political Studies,* 36**,** 97-124.
Lix, L.M., Keselman, J.C. & Keselman, H.J. 1996. Consequences of Assumption Violations Revisited: A Quantitative Review of Alternatives to the One-Way Analysis of Variance "F" Test. *Review of Educational Research,* 66**,** 579-619.
Lower Mill Estate. 2010. *Wildlife Management Plan*.
Lower Mill Estate. 2013. *The Estate* [Online]. Available: http://www.lowermillestate.com/the-estate/ [Accessed 11/06/2013].
Malloch, A.J.C. 1992. MATCH - A Computer Programme to Aid the Assignment of Vegetation Data to the Communities and Sub-communities of the National Vegetation Classification. 1.4 ed. Lancaster: University of Lancaster.
Marshall, R. 2005. Environmental Impact Assessment Follow-up and its Benefits for Industry. *Impact Assessment and Project Appraisal,* 23**,** 191-196.
Matrunola, L. 2007. *Mitigation Measures Proposed for Ecological Conservation: Opinions of Consultants and a Review of Environmental Statements.* MSc, University of East Anglia.
Matthews, J.W. & Endress, A.G. 2008. Performance Criteria, Compliance Success, and Vegetation Development in Compensatory Mitigation Wetlands. *Environmental Management,* 41**,** 130-141.
McGrath, C. & Bond, A. 1997. The Quality of Environmental Impact Statements: A Review of those Submitted in Cork, Eire from 1988–1993. *Project Appraisal,* 12**,** 43-52.
McKenney, B.A. & Kiesecker, J.M. 2010. Policy Development for Biodiversity Offsets: a Review of Offset Frameworks. *Environmental Management,* 45**,** 165-176.
Mehta, C.R. & Patel, N.R. 2010. *IBM SPSS Exact Tests*. IBM.
Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-being: Biodiversity Synthesis*. World Resources Institute. Washington, DC, USA.
Minshull, B. Mitigation on Pipeline Projects: A Practitioner's View. *In:* JACKSON, N., KNIGHTS, G. & YOST, L., eds. Mitigation: Smoke and Mirrors or Biodiversity Enhancement?, 18-20 November 2008 Glasgow, UK. Institute of Ecology and Environmental Management, 107-125.
Mitchell, J. 1997. Mitigation in Environmental Assessment - Furthering Best Practice. *Environmental Assessment,* 5**,** 28-29.
Moilanen, A., van Teeffelen, A.J.A., Ben-Haim, Y. & Ferrier, S. 2009. How Much Compensation is Enough? A Framework for Incorporating Uncertainty and Time Discounting when Calculating Offset Ratios for Impacted Habitat. *Restoration Ecology,* 17**,** 470-478.
Morgan, R.K. 2012. Environmental Impact Assessment: The State of the Art. *Impact Assessment and Project Appraisal,* 30**,** 5-14.
Morris, P. & Therivel, R. 2001. *Methods of Environmental Impact Assessment,* London, UK, SPON Press.
Morris, R.K.A., Alonso, I., Jefferson, R.G. & Kirby, K.J. 2006. The Creation of Compensatory Habitat: can it Secure Sustainable Development? *Journal for Nature Conservation,* 14**,** 106-116.
Morrison-Saunders, A. & Arts, J. 2004. Introduction to EIA Follow-up. *In:* MORRISON-SAUNDERS, A. & ARTS, J. (eds.) *Assessing Impact: Handbook of EIA and SEA Follow-up.* London, UK: Earthscan.

Morrison-Saunders, A. & Bailey, J. 1999. Exploring the EIA/Environmental Management Relationship. *Environmental Management,* 24**,** 281-295.
Mossman, H.L., Davy, A.J. & Grant, A. 2012. Does Managed Coastal Realignment Create Saltmarshes with 'Equivalent Biological Characteristics' to Natural Reference Sites? *Journal of Applied Ecology***,** n/a-n/a.
Mundry, R. & Nunn, C.L. 2009. Stepwise Model Fitting and Statistical Inference: Turning Noise into Signal Pollution. *The American Naturalist,* 173**,** 119-123.
National Biodiversity Network. 2005. NBN Habitats Dictionary.
Natural England. 2010a. *Lost Life: England's Lost and Threatened Species*. Natural England. Peterborough, UK.
Natural England. 2010b. *Natural England Grant-In-Aid Settlement - Update* [Online]. Available: http://www.naturalengland.org.uk/about_us/finance/grant-in-aidsettlement.aspx [Accessed 29/07/2011].
Nelder, J.A. & Wedderburn, R.W.M. 1972. Generalized Linear Models. *Journal of the Royal Statistical Society. Series A (General),* 135**,** 370-384.
NERC. 2011. *Biodiversity and Ecosystem Service Sustainability* [Online]. Natural Environment Research Council. Available: http://www.nerc-bess.net/ [Accessed 13/09/2012].
Neuman, W.L. 2006. *Social Research Methods: Qualitative and Quantitative Approaches,* Boston, USA, Pearson Education Inc.
Newey, G. 2012. *Nurturing Nature: Policy to Protect and Improve Biodiversity*. Policy Exchange. London, UK.
Nilsson, M. & Dalkmann, H. 2001. Decision Making and Strategic Environmental Assessment. *Journal of Environmental Assessment Policy and Management,* 03**,** 305-327.
Northamptonshire County Council. 2009. *Cabinet 10 November 2009*.
ODPM. 1995. *Circular 11/95: Use of Conditions in Planning Permission*. OFFICE OF THE DEPUTY PRIME MINISTER. London, UK.
ODPM. 2000. *Our Towns and Cities: The Future - Full Report*. Office of the Deputy Prime Minister.
ODPM. 2005a. *Circular 05/2005: Planning Obligations*. OFFICE OF THE DEPUTY PRIME MINISTER.
ODPM. 2005b. *Planning Policy Statement 1: Delivering Sustainable Development*. OFFICE OF THE DEPUTY PRIME MINISTER. London, UK: Her Majesty's Stationery Office.
ODPM. 2005c. *Planning Policy Statement 9: Biodiversity and Geological Conservation*. OFFICE OF THE DEPUTY PRIME MINISTER. London, UK: Her Majesty's Stationery Office.
ONS. 2010. *Regions (Former GORs)* [Online]. Office for National Staistics. Available: http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/england/government-office-regions/index.html [Accessed 19/07/2010].
Oxford Brookes University Impact Assessment Unit. 1996. *Changes in the Quality of Environmental Statements for Planning Projects*. London, UK: Department of the Environment, Her Majesty's Stationery Office.
Oxford Brookes University Impacts Assessment Unit. 2009. Environmental Impact Statement Review. Oxford, UK: Oxford Brookes University.
Patton, M.Q. 2002. *Qualitative Research & Evaluation Methods,* Thousand oaks, California, USA, Sage Publications.

Peltzer, D.A., Ferriss, S. & FitzJohn, R.G. 2008. Predicting Weed Distribution at the Landscape Scale: Using Naturalized Brassica as a Model System. *Journal of Applied Ecology,* 45**,** 467-475.

Peters, R.H. 1991. *A Critique for Ecology*, Cambridge University Press.

Põder, T. & Lukki, T. 2011. A Critical Review of Checklist-based Evaluation of Environmental Impact Statements. *Impact Assessment and Project Appraisal,* 29**,** 27-36.

Pywell, R.F., Bullock, J.M., Hopkins, A., Walker, K.J., Sparks, T.H., Burke, M.J.W. & Peel, S. 2002. Restoration of Species-rich Grassland on Arable Land: Assessing the Limiting Processes using a Multi-site Experiment. *Journal of Applied Ecology,* 39**,** 294-309.

R (on the application of Blewett) v Derbyshire County Council [2003] EWHC. 2775 (Admin).

R (on the application of Kent) v First Secretary of State [2004] EWHC. 2953 (Admin).

R v Cornwall County Council, ex parte Hardy [2001] Env LR. 473.

R v Rochdale Metropolitan Borough Council ex parte Tew and others [1999] PLR. 74.

R v Rochdale Metropolitan Borough Council, ex parte Milne [2000] Env. L.R. 22.

Rajvanshi, A., Brownlie, S., Slootweg, R. & Arora, R. 2011. Maximizing benefits for biodiversity: the potential of enhancement strategies in impact assessment. *Impact Assessment and Project Appraisal,* 29**,** 181-193.

Reeder, G.R. 1994. *The Influence of the Environmental Assessment Process on the Specification of Projects and their Environmental Impacts.* MSc, University of Manchester.

Robb, J.T. 2002. Assessing Wetland Compensatory Mitigation Sites to Aid in Establishing Mitigation Ratios. *Wetlands,* 22**,** 435-440.

Rodwell, J.S. (ed.) 1992. *NVC Volume 3: Grasslands and Montane Communities,* Cambridge, UK: Cambridge University Press.

Rodwell, J.S. (ed.) 1995. *NVC Volume 4: Aquatic Communities, Swamps and Tall-herb Fens,* Cambridge, UK: Cambridge University Press.

Rodwell, J.S. (ed.) 2000. *NVC Volume 5: Maritime Communities and Vegetation of Open Habitats,* Cambridge, UK: Cambridge University Press.

Rodwell, J.S. 2006. *National Vegetation Classification Users' Handbook,* Peterborough, UK, Joint Nature Conservation Committee.

Roelle, J.E. & Manci, K.M. 1993. Postproject Analyses of Fish and Wildlife Mitigation. *In:* HILDEBRAND, S. G. & CANNON, J. B. (eds.) *Environmental Analysis: The NEPA Experience.* Florida, USA: CRC Press.

Ross, W.A. 1987. Evaluating Environmental Impact Statements. *Journal of Environmental Management,* 25**,** 137-147.

RSPB. 1995. *Wildlife Impact: the Treatment of Nature Conservation in Environmental Assessment*. Royal Society for the Protection of Birds. Sandy, UK.

Ryan, T.P. 2013. *Sample Size Determination and Power,* Hoboken, New Jersey, USA, John Wiley & Sons.

Sadler, B. 1996. *Environmental Assessment in a Changing World: Evaluating Practice to Improve Performance*. Canadian Environmental Assessment Agency. Ottawa, Canada.

Sanchez, L.E. 2006. On Common Sense and Environmental Impact Assessment. *Impact Assessment and Project Appraisal,* 24**,** 10-11.

Sánchez, L.E. & Gallardo, A.L.C.F. 2005. On the Successful Implementation of Mitigation Measures. *Impact Assessment and Project Appraisal,* 23**,** 182-190.
Sánchez, L.E. & Hacking, T. 2002. An Approach to Linking Environmental Impact Assessment and Environmental Management Systems. *Impact Assessment and Project Appraisal,* 20**,** 25-38.
Secretary of State for Transport. 2004. *Dibden Bay Container Terminal: Decision Letter*. London: Department for Transport.
Sheate, W.R. 2003. EIA: there's Life in the Old Dog yet - Response to Benson. *Impact Assessment and Project Appraisal,* 21**,** 273-275.
Shepherd, A. 1998. Post-Project Impact Assessment and Monitoring. *In:* PORTER, A. L. & FITTIPALDI, J. J. (eds.) *Environmental Methods Review: Retooling Impact Assessment for the New Century.* Fargo, North Dakota, USA: The Press Club.
Söderman, T. 2005. Treatment of Biodiversity Issues in Finnish Environmental Impact Assessment. *Impact Assessment and Project Appraisal,* 23**,** 87-99.
Spellerberg, I.F. & Minshull, A. 1992. An Investigation into the Nature and Use of Ecology in Environmental Impact Assessments. *British Ecological Society Bulletin,* 23**,** 38-45.
Spieles, D., Coneybeer, M. & Horn, J. 2006. Community Structure and Quality After 10 Years in Two Central Ohio Mitigation Bank Wetlands. *Environmental Management,* 38**,** 837-852.
TEEB. 2010a. *The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers*. The Economics of Ecosystems & Biodiversity.
TEEB. 2010b. *Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB*.
Thompson, D. & Hearn, K. 2012. Soils and Land Capability - Assessing the Capacity of Land to Deliver Ecosystem Services for the National Trust. *In Practice: Bulletin of the Institute of Ecology and Environmental Management,* 77**,** 17-22.
Thompson, S., Treweek, J. & Thurling, D. 1997. The Ecological Component of Environmental Impact Assessment: A Critical Review of British Environmental Statements. *Journal of Environmental Planning and Management,* 40**,** 157-171.
Tinker, L., Cobb, D., Bond, A. & Cashmore, M. 2005. Impact Mitigation in Environmental Impact Assessment: Paper Promises or the Basis of Consent Conditions? *Impact Assessment and Project Appraisal,* 23**,** 265-280.
Tischew, S., Baasch, A., Conrad, M.K. & Kirmer, A. 2010. Evaluating Restoration Success of Frequently Implemented Compensation Measures: Results and Demands for Control Procedures. *Restoration Ecology,* 18**,** 467-480.
Tomlinson, P. & Atkinson, S.F. 1987a. Environmental Audits: A Literature Review. *Environmental Monitoring and Assessment,* 8**,** 239-261.
Tomlinson, P. & Atkinson, S.F. 1987b. Environmental Audits: Proposed Terminology. *Environmental Monitoring and Assessment,* 8**,** 187-198.
Treweek, J. 1995. Ecological Impact Assessment. *In:* VANCLAY, F. & BRONSTEIN, D. A. (eds.) *Environmental and Social Impact Assessment.* Chichester: J. Wiley.
Treweek, J. 1996. Ecology and Environmental Impact Assessment. *Journal of Applied Ecology,* 33**,** 191-199.
Treweek, J. 1999. *Ecological Impact Assessment,* Oxford, UK, Blackwell Science.

Treweek, J. & Thompson, S. 1997. A Review of Ecological Mitigation Measures in UK Environmental Statements with Respect to Sustainable Development. *International Journal of Sustainable Development & World Ecology,* 4**,** 40 - 50.

Treweek, J., Thompson, S., Veitch, N. & Japp, C. 1993. Ecological Assessment of Proposed Road Developments: a Review of Environmental Statements. *Journal of Environmental Planning and Management,* 36**,** 295-307.

UEBT. 2012. *Biodiversity Barometer 2012*. Union for Ethical BioTrade. Amsterdam, Netherlands.

UK National Ecosystem Assessment. 2011. *The UK National Ecosystem Assessment: Technical Report*. UNEP-WCMC. Cambridge, UK.

UKELA, King's College London & Cardiff University. 2012. *The State of UK Environmental Law in 2011-2012: Is there a case for legislative reform?* UK Environmental Law Association, King's College London, Cardiff University's ESRC Centre for Business Relationships, Accountability, Sustainability & Society.

UN Plan of Implementation of the World Summit on Sustainable Development. UN World Summit on Sustainable Development, 2002 Johannesburg, South Africa. United Nations.

UNECE. 1998. *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*. Aarhus, Denmark: United Nations Economic Commission for Europe.

UNEP & CBD. 2008. *Mainstreaming Biodiversity: Workshops on National Biodiversity Strategies and Action Plans*. United Nations Environment Programme and Convention on Biological Diversity. Montreal, Canada.

United States Congress. 1969. National Environmental Policy Act.

University of Westminster, Llewelyn-Davies, Civic Trust & Pettersson Stafford. 2002. *Mixed-Use Development: Practice and Potential*. DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT. London, UK.

US EPA. 2012. *Environmental Impact Statement (EIS) Database* [Online]. US Environmental Protection Agency. Available: http://www.epa.gov/compliance/nepa/eisdata.html [Accessed 06/12/2012].

Vivid Economics. 2012. *Inexpensive Progress? A Framework for Assessing the Costs and Benefits of Planning Reform*. Report prepared for the Campaign to Protect Rural England, National Trust & Royal Society for the Protection of Birds.

Vun, L.-W., Latiff, A. & Nordin, M. 2004. Review of Ecological Input in Preliminary EIAs for Coastal Resort Development Projects in Malaysia. *Journal of Environmental Assessment Policy and Management,* 06**,** 385-401.

Walker, K.J., Pywell, R.F., Warman, E.A., Fowbert, J.A., Bhogal, A. & Chambers, B.J. 2004a. The Importance of Former Land Use in Determining Successful Re-creation of Lowland Heath in Southern England. *Biological Conservation,* 116**,** 289-303.

Walker, K.J., Stevens, P.A., Stevens, D.P., Mountford, J.O., Manchester, S.J. & Pywell, R.F. 2004b. The Restoration and Re-creation of Species-rich Lowland Grassland on Land Formerly Managed for Intensive Agriculture in the UK. *Biological Conservation,* 119**,** 1-18.

Walker, L.J. & Johnston, J. 1999. *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions*. European Commission. Luxembourg: Office for Official Publications of the European Communities.

Walsh, F. 1993. *UK Environmental Assessment Process (Statistical Analysis)*. Unpublished Working Paper, EIA Centre, Department of Planning and Landscape, University of Manchester: Manchester.
Weston, J. 2000a. EIA, Decision-making Theory and Screening and Scoping in UK Practice. *Journal of Environmental Planning and Management,* 43**,** 185-203.
Weston, J. 2000b. Reviewing Environmental Statements: New Demands for the UK's EIA Procedures. *Planning Practice & Research,* 15**,** 135-142.
Weston, J. 2010. EIA Theories - All Chinese Whispers and No Critical Theory. *Journal of Environmental Assessment Policy and Management,* 12**,** 357-374.
Whittingham, M.J., Stephens, P.A., Bradbury, R.B. & Freckleton, R.P. 2006. Why do we still use Stepwise Modelling in Ecology and Behaviour? *Journal of Animal Ecology,* 75**,** 1182-1189.
Wildlife and Countryside Link. 2012. *The First Year of the Natural Environment White Paper: Is the Ambition being Delivered?* Wildlife and Countryside Link. London, UK.
Wolf, S. & Stanley, N. 2010. *Wolf and Stanley on Environmental Law,* London, UK, Routledge.
Wood, C. 2003. *Environmental Impact Assessment: A Comparative Review,* Edinburgh, UK, Pearson: Prentice Hall.
Wood, C., Barker, A., Jones, C. & Hughes, J. 1996. *Evaluation of the Performance of the EIA Process*. EIA Centre, University of Manchester. Manchester.
Wood, C., Dipper, B. & Jones, C. 2000. Auditing the Assessment of the Environmental Impacts of Planning Projects. *Journal of Environmental Planning and Management,* 43**,** 23 - 47.
Wood, C. & Jones, C. 1991. *Monitoring Environmental Assessment and Planning*. Department of the Environment Planning Research Programme. London.
Wood, C. & Jones, C.E. 1995. The Impact of Environmental Assessment on Public Inquiry Decisions. *Journal of Planning & Environment Law***,** 890-904.
Wood, C. & Jones, C.E. 1997. The Effect of Environmental Assessment on UK Local Planning Authority Decisions. *Urban Studies,* 34**,** 1237-1257.
World Commission on Environment and Development. 1987. *Our Common Future*. London.
Worm, B., Barbier, E.B., Beaumont, N., Duffy, J.E., Folke, C., Halpern, B.S., Jackson, J.B.C., Lotze, H.K., Micheli, F., Palumbi, S.R., Sala, E., Selkoe, K.A., Stachowicz, J.J. & Watson, R. 2006. Impacts of Biodiversity Loss on Ocean Ecosystem Services. *Science,* 314**,** 787-790.
Xin, Z. & Wencong, W. 2012. Environmental Assessments Go Online. *China Daily* [Online]. Available: http://www.chinadaily.com.cn/china/2012-08/30/content_15718158.htm [Accessed 10/09/2012].
Young, B.M. 1993. Implementation of Mitigation at US Army Corps of Engineers Water Projects in the Southern United States. *In:* HILDEBRAND, S. G. & CANNON, J. B. (eds.) *Environmental Analysis: The NEPA Experience.* Florida, USA: CRC Press.
Zedler, J.B. & Callaway, J.C. 1999. Tracking Wetland Restoration: Do Mitigation Sites Follow Desired Trajectories? *Restoration Ecology,* 7**,** 69-73.

APPENDICES

Appendix 5.1: List of EcIA Chapters Reviewed by Development Sector

EcIA name	Development category	Competent Planning Authority	Year of Submission
110 Bishopsgate (Heron Tower)	Other	City of London	2005
20 Fenchurch Street	Other	City of London	2006
21 Wapping Lane	Mixed development	Tower Hamlets Borough Council	2006
30 Old Bailey	Other	City of London	2007
399 Edgware Road	Mixed development	London Borough of Brent	2006
A11 Fiveways to Thetford	Roads	Secretary of State for Transport	2008
A23 Handcross toWarninglid	Roads	Secretary of State for Transport	2008
Addenbrookes Access Road	Roads	Cambridgeshire County Council	2006
Bathside Bay	Port & harbour	Tendring District Council	2003

EcIA name	Development category	Competent Planning Authority	Year of Submission
Battersea Power Station	Mixed development	Wandsworth Borough Council	2009
Bent Farm Quarry	Mineral extraction	Cheshire East Council	2008
Billingham Biomass Plant	Power stations	Stockton-on-Tees Borough Council	2009
Billingham Mine Waste Management Facility	Other	Stockton-on-Tees Borough Council	2010
Bishopsgate Tower	Other	City of London	2006
Blackburn Meadows	Power stations	Sheffield City Council	2008
Blackstone Edge	Wind farms	Barnsley Metropolitan Borough Council	2008
Brent Cross	Mixed development	Barnet Borough Council	2008
Broadgate	Other	City of London	2010
Broom Hill Quarry	Mineral extraction	Bedfordshire County Council	2005
Burton Wold Wind Farm Extension	Wind farms	Kettering Borough Council	2007
Cambridge Biomedical Centre Expansion	Other	Cambridge City Council	2006

APPENDIX 5.2 – STATISTICS OUTPUTS

1 GENERAL

1.1 DEVELOPMENT SECTOR

1.1.1 Mixed Developments

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Mixed_developments	485	100.0%	0	.0%	485	100.0%

Study * Mixed_developments Crosstabulation

			Mixed_developments		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	29	150	179
		Expected	30.6	148.4	179.0
	Treweek & Thompson 1997	Count	18	176	194
		Expected	33.2	160.8	194.0
	Current Review	Count	36	76	112
		Expected	19.2	92.8	112.0
Total		Count	83	402	485
		Expected	83.0	402.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	26.336[a]	2	.000	.000		
Likelihood Ratio	24.835	2	.000	.000		
Fisher's Exact Test	24.718			1.000		
Linear-by-Linear Association	8.515[b]	1	.004	.004	.002	.001
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 19.17.

b. The standardized statistic is -2.918.

1.1.2 Roads

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Roads	485	100.0%	0	.0%	485	100.0%

Study * Roads Crosstabulation

			Roads		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	26	153	179
		Expected	25.1	153.9	179.0
	Treweek & Thompson 1997	Count	33	161	194
		Expected	27.2	166.8	194.0
	Current Review	Count	9	103	112
		Expected	15.7	96.3	112.0
Total		Count	68	417	485
		Expected	68.0	417.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.804[a]	2	.091	.031		
Likelihood Ratio	5.242	2	.073	.020		
Fisher's Exact Test	4.968			1.000		
Linear-by-Linear Association	1.700[b]	1	.192	.200	.111	.030
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 15.70.

b. The standardized statistic is 1.304.

1.1.3 Power Stations

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Power_stations	485	100.0%	0	.0%	485	100.0%

Study * Power_stations Crosstabulation

			Power_stations		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	25	154	179
		Expected	18.5	160.5	179.0
	Treweek & Thompson 1997	Count	17	177	194
		Expected	20.0	174.0	194.0
	Current Review	Count	8	104	112
		Expected	11.5	100.5	112.0
Total		Count	50	435	485
		Expected	50.0	435.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.305[a]	2	.116	.035		
Likelihood Ratio	4.230	2	.121	.054		
Fisher's Exact Test	4.049			1.000		
Linear-by-Linear Association	3.902[b]	1	.048	.050	.029	.011
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 11.55.

b. The standardized statistic is 1.975.

1.1.4 Mineral Extraction

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Mineral_extraction	485	100.0%	0	.0%	485	100.0%

Study * Mineral_extraction Crosstabulation

			Mineral_extraction		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	18	161	179
		Expected	13.3	165.7	179.0
	Treweek & Thompson 1997	Count	15	179	194
		Expected	14.4	179.6	194.0
	Current Review	Count	3	109	112
		Expected	8.3	103.7	112.0
Total		Count	36	449	485
		Expected	36.0	449.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.501[a]	2	.064	.013		
Likelihood Ratio	6.444	2	.040	.013		
Fisher's Exact Test	5.859			1.000		
Linear-by-Linear Association	5.182[b]	1	.023	.023	.014	.007
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 8.31.

b. The standardized statistic is 2.276.

1.1.5 Opencast Mines

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Opencast_mines	485	100.0%	0	.0%	485	100.0%

Study * Opencast_mines Crosstabulation

			Opencast_mines		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	15	164	179
		Expected	7.0	172.0	179.0
	Treweek & Thompson 1997	Count	4	190	194
		Expected	7.6	186.4	194.0
	Current Review	Count	0	112	112
		Expected	4.4	107.6	112.0
Total		Count	19	466	485
		Expected	19.0	466.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	15.811[a]	2	.000	.000		
Likelihood Ratio	18.299	2	.000	.000		
Fisher's Exact Test	15.156			1.000		
Linear-by-Linear Association	14.411[b]	1	.000	.000	.000	.000
N of Valid Cases	485					

a. 1 cells (16.7%) have Expected less than 5. The minimum Expected is 4.39.

b. The standardized statistic is 3.796.

1.1.6 Other

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Other	485	100.0%	0	.0%	485	100.0%

Study * Other Crosstabulation

			Other		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	14	165	179
		Expected	35.4	143.6	179.0
	Treweek & Thompson 1997	Count	42	152	194
		Expected	38.4	155.6	194.0
	Current Review	Count	40	72	112
		Expected	22.2	89.8	112.0
Total		Count	96	389	485
		Expected	96.0	389.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	34.464[a]	2	.000	.000		
Likelihood Ratio	35.678	2	.000	.000		
Fisher's Exact Test	35.343			1.000		
Linear-by-Linear Association	34.392[b]	1	.000	.000	.000	.000
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 22.17.

b. The standardized statistic is -5.864.

1.1.7 Landfill

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Landfill	485	100.0%	0	.0%	485	100.0%

Study * Landfill Crosstabulation

			Landfill		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	12	167	179
		Expected	8.5	170.5	179.0
	Treweek & Thompson 1997	Count	11	183	194
		Expected	9.2	184.8	194.0
	Current Review	Count	0	112	112
		Expected	5.3	106.7	112.0
Total		Count	23	462	485
		Expected	23.0	462.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.470[a]	2	.024	.007		
Likelihood Ratio	12.590	2	.002	.002		
Fisher's Exact Test	9.647			1.000		
Linear-by-Linear Association	6.103[b]	1	.013	.016	.008	.005
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 5.31.

b. The standardized statistic is 2.470.

1.1.8 Pipelines

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Pipelines	485	100.0%	0	.0%	485	100.0%

Study * Pipelines Crosstabulation

			Pipelines		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	8	171	179
		Expected	6.6	172.4	179.0
	Treweek & Thompson 1997	Count	7	187	194
		Expected	7.2	186.8	194.0
	Current Review	Count	3	109	112
		Expected	4.2	107.8	112.0
Total		Count	18	467	485
		Expected	18.0	467.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.628[a]	2	.731	.427		
Likelihood Ratio	.646	2	.724	.427		
Fisher's Exact Test	.572			1.000		
Linear-by-Linear Association	.626[b]	1	.429	.440	.266	.093
N of Valid Cases	485					

a. 1 cells (16.7%) have Expected less than 5. The minimum Expected is 4.16.

b. The standardized statistic is .791.

1.1.9 Waste Treatment

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Waste_treatment	485	100.0%	0	.0%	485	100.0%

Study * Waste_treatment Crosstabulation

			Waste_treatment		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	8	171	179
		Expected	10.0	169.0	179.0
	Treweek & Thompson 1997	Count	17	177	194
		Expected	10.8	183.2	194.0
	Current Review	Count	2	110	112
		Expected	6.2	105.8	112.0
Total		Count	27	458	485
		Expected	27.0	458.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.226[a]	2	.027	.011		
Likelihood Ratio	7.765	2	.021	.010		
Fisher's Exact Test	6.985			1.000		
Linear-by-Linear Association	.347[b]	1	.556	.606	.325	.088
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 6.24.

b. The standardized statistic is .589.

1.1.10 Leisure

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Leisure	485	100.0%	0	.0%	485	100.0%

Study * Leisure Crosstabulation

			Leisure		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	6	173	179
		Expected	8.1	170.9	179.0
	Treweek & Thompson 1997	Count	15	179	194
		Expected	8.8	185.2	194.0
	Current Review	Count	1	111	112
		Expected	5.1	106.9	112.0
Total		Count	22	463	485
		Expected	22.0	463.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	8.588[a]	2	.014	.005		
Likelihood Ratio	9.508	2	.009	.004		
Fisher's Exact Test	8.322			1.000		
Linear-by-Linear Association	.314[b]	1	.575	.669	.341	.098
N of Valid Cases	485					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 5.08.

b. The standardized statistic is .561.

1.1.11 Wind Farms

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Wind_farms	485	100.0%	0	.0%	485	100.0%

Study * Wind_farms Crosstabulation

			Wind_farms		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	5	174	179
		Expected	5.9	173.1	179.0
	Treweek & Thompson 1997	Count	3	191	194
		Expected	6.4	187.6	194.0
	Current Review	Count	8	104	112
		Expected	3.7	108.3	112.0
Total		Count	16	469	485
		Expected	16.0	469.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.199[a]	2	.027	.006		
Likelihood Ratio	6.389	2	.041	.020		
Fisher's Exact Test	6.320			1.000		
Linear-by-Linear Association	3.014[b]	1	.083	.096	.059	.030
N of Valid Cases	485					

a. 1 cells (16.7%) have Expected less than 5. The minimum Expected is 3.69.

b. The standardized statistic is -1.736.

1.1.12 Agricultural

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Agricultural	485	100.0%	0	.0%	485	100.0%

Study * Agricultural Crosstabulation

			Agricultural		
			Yes	No	Total
Study	Thompson *et al*. 1997	Count	5	174	179
		Expected	3.7	175.3	179.0
	Treweek & Thompson 1997	Count	5	189	194
		Expected	4.0	190.0	194.0
	Current Review	Count	0	112	112
		Expected	2.3	109.7	112.0
Total		Count	10	475	485
		Expected	10.0	475.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.087[a]	2	.214	.073		
Likelihood Ratio	5.331	2	.070	.083		
Fisher's Exact Test	3.241			1.000		
Linear-by-Linear Association	2.297[b]	1	.130	.148	.094	.055
N of Valid Cases	485					

a. 3 cells (50.0%) have Expected less than 5. The minimum Expected is 2.31.

b. The standardized statistic is 1.515.

1.1.13 Port & Harbour

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Port_and_harbour	485	100.0%	0	.0%	485	100.0%

Study * Port_and_harbour Crosstabulation

			Port_and_harbour		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	5	174	179
		Expected	4.4	174.6	179.0
	Treweek & Thompson 1997	Count	5	189	194
		Expected	4.8	189.2	194.0
	Current Review	Count	2	110	112
		Expected	2.8	109.2	112.0
Total		Count	12	473	485
		Expected	12.0	473.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.304[a]	2	.859	.549		
Likelihood Ratio	.324	2	.850	.549		
Fisher's Exact Test	.298			1.000		
Linear-by-Linear Association	.264[b]	1	.607	.705	.378	.135
N of Valid Cases	485					

a. 3 cells (50.0%) have Expected less than 5. The minimum Expected is 2.77.

b. The standardized statistic is .514.

1.1.14 Power Transmission

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Power_transmission	485	100.0%	0	.0%	485	100.0%

Study * Power_transmission Crosstabulation

			Power_transmission		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	3	176	179
		Expected	1.8	177.2	179.0
	Treweek & Thompson 1997	Count	2	192	194
		Expected	2.0	192.0	194.0
	Current Review	Count	0	112	112
		Expected	1.2	110.8	112.0
Total		Count	5	480	485
		Expected	5.0	480.0	485.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.897[a]	2	.387	.164		
Likelihood Ratio	2.935	2	.230	.264		
Fisher's Exact Test	1.548			1.000		
Linear-by-Linear Association	1.851[b]	1	.174	.246	.145	.101
N of Valid Cases	485					

a. 3 cells (50.0%) have Expected less than 5. The minimum Expected is 1.15.

b. The standardized statistic is 1.361.

1.2 CHANGE IN USE OF ECOLOGICAL CONSULTANCIES OVER TIME

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Ecological Consultancy involved	149	38.7%	236	61.3%	385	100.0%

Study * Ecological Consultancy involved Crosstabulation

			Ecological Consultancy involved		Total
			Yes	No	
Study	RSPB	Count	76	36	112
		Expected	70.7	41.3	112.0
	Current Review	Count	18	19	37
		Expected	23.3	13.7	37.0
Total		Count	94	55	149
		Expected	94.0	55.0	149.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.407[a]	1	.036	.049	.030	
Continuity Correction[b]	3.620	1	.057			
Likelihood Ratio	4.305	1	.038	.049	.030	
Fisher's Exact Test				.049	.030	
Linear-by-Linear Association	4.377[c]	1	.036	.049	.030	.018
N of Valid Cases	149					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 13.66.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.092.

2 BASELINE: DESK STUDY

2.1 SIZE OF PROPOSED DEVELOPMENT SITE STATED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Size of the proposed development site specified? * Linear_Development	368	100.0%	0	.0%	368	100.0%

Study * Size of the proposed development site specified? * Linear_Development Crosstabulation

Linear_Development				Size of the proposed development site specified? Yes	No	Total
Yes	Study	Treweek	Count	1	36	37
			Expected	7.8	29.2	37.0
		Thompson	Count	0	39	39
			Expected	8.3	30.7	39.0
		Byron	Count	15	25	40
			Expected	8.5	31.5	40.0
		Current Review	Count	12	4	16
			Expected	3.4	12.6	16.0
	Total		Count	28	104	132
			Expected	28.0	104.0	132.0
No	Study	Thompson	Count	105	35	140
			Expected	113.9	26.1	140.0
		Current Review	Count	87	9	96
			Expected	78.1	17.9	96.0
	Total		Count	192	44	236
			Expected	192.0	44.0	236.0
Total	Study	Treweek	Count	1	36	37
			Expected	22.1	14.9	37.0
		Thompson	Count	105	74	179
			Expected	107.0	72.0	179.0
		Byron	Count	15	25	40
			Expected	23.9	16.1	40.0
		Current Review	Count	99	13	112
			Expected	67.0	45.0	112.0
	Total		Count	220	148	368
			Expected	220.0	148.0	368.0

Chi-Square Tests

Linear_Development		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Yes	Pearson Chi-Square	52.132[a]	3	.000	.000		
	Likelihood Ratio	56.309	3	.000	.000		
	Fisher's Exact Test	51.415			1.000		
	Linear-by-Linear Association	42.146[b]	1	.000	.000	.000	.000
	N of Valid Cases	132					
No	Pearson Chi-Square	9.166[c]	1	.002	.003	.002	
	Continuity Correction[d]	8.165	1	.004			
	Likelihood Ratio	9.851	1	.002	.002	.002	
	Fisher's Exact Test				.002	.002	
	Linear-by-Linear Association	9.128[e]	1	.003	.003	.002	.001
	N of Valid Cases	236					
Total	Pearson Chi-Square	96.624[f]	3	.000	.000		
	Likelihood Ratio	110.686	3	.000	.000		
	Fisher's Exact Test	107.795			1.000		
	Linear-by-Linear Association	62.715[g]	1	.000	.000	.000	.000
	N of Valid Cases	368					

a. 1 cells (12.5%) have Expected less than 5. The minimum Expected is 3.39.

b. The standardized statistic is -6.492.

c. 0 cells (.0%) have Expected less than 5. The minimum Expected is 17.90.

d. Computed only for a 2x2 table

e. The standardized statistic is -3.021.

f. 0 cells (.0%) have Expected less than 5. The minimum Expected is 14.88.

g. The standardized statistic is -7.919.

2.2 LENGTH OF LINEAR DEVELOPMENTS SPECIFIED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Linear development length stated?	93	100.0%	0	.0%	93	100.0%

Study * Linear development length stated? Crosstabulation

			Linear development length stated?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	21	16	37
		Expected	27.1	9.9	37.0
	Byron *et al*. 2000	Count	34	6	40
		Expected	29.2	10.8	40.0
	Current Review	Count	13	3	16
		Expected	11.7	4.3	16.0
Total		Count	68	25	93
		Expected	68.0	25.0	93.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	8.451[a]	2	.015	.007		
Likelihood Ratio	8.392	2	.015	.006		
Fisher's Exact Test	8.020			1.000		
Linear-by-Linear Association	5.642[b]	1	.018	.022	.012	.007
N of Valid Cases	93					

a. 1 cells (16.7%) have Expected less than 5. The minimum Expected is 4.30.

b. The standardized statistic is -2.375.

2.3 LAND USE

2.3.1 Agriculture

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Agriculture	368	100.0%	0	.0%	368	100.0%

Study * Agriculture Crosstabulation

			Pre-existing agricultural land use on site?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	25	12	37
		Expected	20.8	16.2	37.0
	Thompson *et al*. 1997	Count	115	64	179
		Expected	100.7	78.3	179.0
	Byron *et al*. 2000	Count	35	5	40
		Expected	22.5	17.5	40.0
	Current Review	Count	32	80	112
		Expected	63.0	49.0	112.0
Total		Count	207	161	368
		Expected	207.0	161.0	368.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	57.315[a]	3	.000	.000		
Likelihood Ratio	60.198	3	.000	.000		
Fisher's Exact Test	59.073			1.000		
Linear-by-Linear Association	30.341[b]	1	.000	.000	.000	.000
N of Valid Cases	368					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.19.

b. The standardized statistic is 5.508.

2.3.2 Amenity

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Amenity	152	100.0%	0	.0%	152	100.0%

Study * Amenity Crosstabulation

			Pre-existing amenity land use on site?		
			Yes	No	Total
Study	Byron *et al.* 2000	Count	16	24	40
		Expected	6.3	33.7	40.0
	Current Review	Count	8	104	112
		Expected	17.7	94.3	112.0
Total		Count	24	128	152
		Expected	24.0	128.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	23.931[a]	1	.000	.000	.000	
Continuity Correction[b]	21.524	1	.000			
Likelihood Ratio	21.113	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	23.774[c]	1	.000	.000	.000	.000
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 6.32.

b. Computed only for a 2x2 table

c. The standardized statistic is 4.876.

2.3.3 Urban

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Yes_No	368	100.0%	0	.0%	368	100.0%

Study * Yes_No Crosstabulation

			Pre-existing urban land use on site?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	3	34	37
		Expected	13.6	23.4	37.0
	Thompson *et al*. 1997	Count	55	124	179
		Expected	65.7	113.3	179.0
	Byron *et al*. 2000	Count	18	22	40
		Expected	14.7	25.3	40.0
	Current Review	Count	59	53	112
		Expected	41.1	70.9	112.0
Total		Count	135	233	368
		Expected	135.0	233.0	368.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	29.270[a]	3	.000	.000		
Likelihood Ratio	32.075	3	.000	.000		
Fisher's Exact Test	31.060			1.000		
Linear-by-Linear Association	27.577[b]	1	.000	.000	.000	.000
N of Valid Cases	368					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 13.57.

b. The standardized statistic is -5.251.

2.3.4 Waste

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Waste	291	100.0%	0	.0%	291	100.0%

Study * Waste Crosstabulation

			Pre-existing waste land use on site?		Total
			Yes	No	
Study	Thompson *et al.* 1997	Count	29	150	179
		Expected	33.2	145.8	179.0
	Current Review	Count	25	87	112
		Expected	20.8	91.2	112.0
Total		Count	54	237	291
		Expected	54.0	237.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.708[a]	1	.191	.216	.125	
Continuity Correction[b]	1.327	1	.249			
Likelihood Ratio	1.681	1	.195	.216	.125	
Fisher's Exact Test				.216	.125	
Linear-by-Linear Association	1.702[c]	1	.192	.216	.125	.052
N of Valid Cases	291					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 20.78.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.304.

2.3.5 Suburban

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Yes_No	368	100.0%	0	.0%	368	100.0%

Study * Suburban Crosstabulation

			Pre-existing suburban land use on site?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	9	28	37
		Expected	4.7	32.3	37.0
	Thompson *et al*. 1997	Count	5	174	179
		Expected	22.9	156.1	179.0
	Byron *et al*. 2000	Count	22	18	40
		Expected	5.1	34.9	40.0
	Current Review	Count	11	101	112
		Expected	14.3	97.7	112.0
Total		Count	47	321	368
		Expected	47.0	321.0	368.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	85.332[a]	3	.000	.000		
Likelihood Ratio	67.490	3	.000	.000		
Fisher's Exact Test	67.227			1.000		
Linear-by-Linear Association	.839[b]	1	.360	.362	.200	.040
N of Valid Cases	368					

a. 1 cells (12.5%) have Expected less than 5. The minimum Expected is 4.73.

b. The standardized statistic is -.916.

2.3.6 Suburban (Roads Only)

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Suburban	86	100.0%	0	.0%	86	100.0%

Study * Suburban Crosstabulation

			Pre-existing suburban land use on road sites?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	9	28	37
		Expected	13.8	23.2	37.0
	Byron *et al*. 2000	Count	22	18	40
		Expected	14.9	25.1	40.0
	Current Review	Count	1	8	9
		Expected	3.3	5.7	9.0
Total		Count	32	54	86
		Expected	32.0	54.0	86.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.672[a]	2	.005	.002		
Likelihood Ratio	11.146	2	.004	.004		
Fisher's Exact Test	10.295			1.000		
Linear-by-Linear Association	2.025[b]	1	.155	.167	.093	.029
N of Valid Cases	86					

a. 1 cells (16.7%) have Expected less than 5. The minimum Expected is 3.35.

b. The standardized statistic is -1.423.

2.3.7 Suburban Early Road Reviews Only

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Suburban	216	58.7%	152	41.3%	368	100.0%

Study * Suburban Crosstabulation

			Pre-existing suburban land use on site?		
			Yes	No	Total
Study	Treweek *et al.* 1993	Count	25	12	37
		Expected	24.0	13.0	37.0
	Thompson *et al.* 1997	Count	115	64	179
		Expected	116.0	63.0	179.0
Total		Count	140	76	216
		Expected	140.0	76.0	216.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.148[a]	1	.700	.712	.427	
Continuity Correction[b]	.038	1	.845			
Likelihood Ratio	.150	1	.699	.712	.427	
Fisher's Exact Test				.850	.427	
Linear-by-Linear Association	.148[c]	1	.701	.712	.427	.141
N of Valid Cases	216					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.02.

b. Computed only for a 2x2 table

c. The standardized statistic is .384.

2.4 CONSULTATION

2.4.1 Change In Ecological Consultation Over Time

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Any ecological consultation conducted?	291	100.0%	0	.0%	291	100.0%

Study_1 * Any ecological consultation conducted? Crosstabulation

			Any ecological consultation conducted?		
			Yes	No	Total
Study	Thompson *et al.* 1997	Count	120	59	179
		Expected	115.6	63.4	179.0
	Current Review	Count	68	44	112
		Expected	72.4	39.6	112.0
Total		Count	188	103	291
		Expected	188.0	103.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.205[a]	1	.272	.314	.166	
Continuity Correction[b]	.944	1	.331			
Likelihood Ratio	1.199	1	.274	.314	.166	
Fisher's Exact Test				.314	.166	
Linear-by-Linear Association	1.201[c]	1	.273	.314	.166	.055
N of Valid Cases	291					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 39.64.

b. Computed only for a 2x2 table

c. The standardized statistic is 1.096.

2.4.2 Change In Statutory Consultation Over Time

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Natural England or equivalent consulted?	331	100.0%	0	.0%	331	100.0%

Study * Natural England or equivalent consulted? Crosstabulation

			Natural England or equivalent consulted?		
			Yes	No	Total
Study	Thompson *et al.* 1997	Count	86	93	179
		Expected	98.4	80.6	179.0
	Byron *et al*. 2000	Count	35	5	40
		Expected	22.0	18.0	40.0
	Current Review	Count	61	51	112
		Expected	61.6	50.4	112.0
Total		Count	182	149	331
		Expected	182.0	149.0	331.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	20.581[a]	2	.000	.000		
Likelihood Ratio	23.183	2	.000	.000		
Fisher's Exact Test	22.416			1.000		
Linear-by-Linear Association	2.035[b]	1	.154	.166	.086	.017
N of Valid Cases	331					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 18.01.

b. The standardized statistic is -1.427.

2.4.3 Change In Wildlife Trust Consultation Over Time

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Wildlife Trust consulted?	376	100.0%	0	.0%	376	100.0%

Study * Wildlife Trust consulted? Crosstabulation

			Wildlife Trust consulted?		Total
			Yes	No	
Study	Spellerberg & Minshull 1992	Count	23	22	45
		Expected	18.6	26.4	45.0
	Thompson *et al*. 1997	Count	63	116	179
		Expected	73.8	105.2	179.0
	Byron *et al*. 2000	Count	33	7	40
		Expected	16.5	23.5	40.0
	Current Review	Count	36	76	112
		Expected	46.2	65.8	112.0
Total		Count	155	221	376
		Expected	155.0	221.0	376.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	36.438[a]	3	.000	.000		
Likelihood Ratio	37.267	3	.000	.000		
Fisher's Exact Test	36.657			1.000		
Linear-by-Linear Association	.696[b]	1	.404	.421	.217	.028
N of Valid Cases	376					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.49.

b. The standardized statistic is .834.

3 BASELINE: SURVEYS

3.1 NEW ECOLOGY SURVEY CONDUCTED OVER TIME

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * New_Survey	413	100.0%	0	.0%	413	100.0%

Study * New_Survey Crosstabulation

			New_Survey		Total
			Yes	No	
Study	Spellerberg & Minshull 1992	Count	38	7	45
		Expected	30.1	14.9	45.0
	Treweek *et al*. 1993	Count	13	24	37
		Expected	24.7	12.3	37.0
	Thompson *et al*. 1997	Count	81	98	179
		Expected	119.6	59.4	179.0
	Byron *et al*. 2000	Count	35	5	40
		Expected	26.7	13.3	40.0
	Current Review	Count	109	3	112
		Expected	74.8	37.2	112.0
Total		Count	276	137	413
		Expected	276.0	137.0	413.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	115.345[a]	4	.000	.000		
Likelihood Ratio	133.649	4	.000	.000		
Fisher's Exact Test	130.548			1.000		
Linear-by-Linear Association	35.809[b]	1	.000	.000	.000	.000
N of Valid Cases	413					

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	115.345[a]	4	.000	.000		
Likelihood Ratio	133.649	4	.000	.000		
Fisher's Exact Test	130.548			1.000		
Linear-by-Linear Association	35.809[b]	1	.000	.000	.000	.000
N of Valid Cases	413					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 12.27.

b. The standardized statistic is -5.984.

3.2 CHANGE IN NAMING ECOLOGISTS OVER TIME

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Have the ecologists been named?	152	100.0%	0	.0%	152	100.0%

Study * Have the ecologists been named? Crosstabulation

			Have the ecologists been named?		Total
			Yes	No	
Study	Byron *et al.* 2000	Count	20	20	40
		Expected	14.7	25.3	40.0
	Current Review	Count	36	76	112
		Expected	41.3	70.7	112.0
Total		Count	56	96	152
		Expected	56.0	96.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.039[a]	1	.044	.056	.035	
Continuity Correction[b]	3.308	1	.069			
Likelihood Ratio	3.955	1	.047	.056	.035	
Fisher's Exact Test				.056	.035	
Linear-by-Linear Association	4.013[c]	1	.045	.056	.035	.021
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 14.74.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.003.

3.3 SURVEY METHODS STATED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Survey methodology stated?	144	100.0%	0	.0%	144	100.0%

Study * Survey methodology stated? Crosstabulation

			Survey methodology stated?		
			Yes	No	Total
Study	Byron *et al.* 2000	Count	29	6	35
		Expected	31.4	3.6	35.0
	Current Review	Count	100	9	109
		Expected	97.6	11.4	109.0
Total		Count	129	15	144
		Expected	129.0	15.0	144.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.242[a]	1	.134	.199	.121	
Continuity Correction[b]	1.391	1	.238			
Likelihood Ratio	2.033	1	.154	.199	.121	
Fisher's Exact Test				.199	.121	
Linear-by-Linear Association	2.226[c]	1	.136	.199	.121	.081
N of Valid Cases	144					

a. 1 cells (25.0%) have Expected less than 5. The minimum Expected is 3.65.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.492.

3.4 QUANTITATIVE SURVEY RESULTS OVER TIME

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Survey results quantitative?	157	100.0%	0	.0%	157	100.0%

Study * Survey results quantitative? Crosstabulation

			Survey results quantitative?		
			Yes	No	Total
Study	Treweek *et al.* 1993	Count	3	10	13
		Expected	7.9	5.1	13.0
	Byron *et al*. 2000	Count	15	20	35
		Expected	21.4	13.6	35.0
	Current Review	Count	78	31	109
		Expected	66.6	42.4	109.0
Total		Count	96	61	157
		Expected	96.0	61.0	157.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	17.833[a]	2	.000	.000		
Likelihood Ratio	17.771	2	.000	.000		
Fisher's Exact Test	17.431			1.000		
Linear-by-Linear Association	17.554[b]	1	.000	.000	.000	.000
N of Valid Cases	157					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 5.05.

b. The standardized statistic is -4.190.

3.5 STUDIES CONDUCTED OVER > 1 YEAR

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Surveys conducted over more than one year?	149	100.0%	0	.0%	149	100.0%

Study * Surveys conducted over more than one year? Crosstabulation

			Surveys conducted over more than one year?		
			Yes	No	Total
Study	RSPB 1995	Count	35	2	37
		Expected	16.6	20.4	37.0
	Current Review	Count	32	80	112
		Expected	50.4	61.6	112.0
Total		Count	67	82	149
		Expected	67.0	82.0	149.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	48.990[a]	1	.000	.000	.000	
Continuity Correction[b]	46.359	1	.000			
Likelihood Ratio	55.472	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	48.662[c]	1	.000	.000	.000	.000
N of Valid Cases	149					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.64.

b. Computed only for a 2x2 table

c. The standardized statistic is 6.976.

3.6 FAUNA SURVEYS

3.6.1 Fauna Surveys Conducted Over Time

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Fauna surveys conducted?	291	100.0%	0	.0%	291	100.0%

Study * Fauna surveys conducted? Crosstabulation

			Fauna surveys conducted?		
			Yes	No	Total
Study	Thompson *et al.* 1997	Count	35	144	179
		Expected	76.9	102.1	179.0
	Current Review	Count	90	22	112
		Expected	48.1	63.9	112.0
Total		Count	125	166	291
		Expected	125.0	166.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	103.947[a]	1	.000	.000	.000	
Continuity Correction[b]	101.480	1	.000			
Likelihood Ratio	109.740	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	103.590[c]	1	.000	.000	.000	.000
N of Valid Cases	291					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 48.11.

b. Computed only for a 2x2 table

c. The standardized statistic is -10.178.

3.6.2 Multiple Response Analysis Frequencies Of Fauna Surveys Conducted (By Taxon)

Case Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
$Fauna_Surveys[a]	90	80.4%	22	19.6%	112	100.0%

a. Dichotomy group tabulated at value 1.

$Fauna_Surveys Frequencies

		Responses		Percent of Cases
		N	Percent	
Fauna surveys[a]	Amphibians	41	12.0%	45.6%
	Aerial Mammals (bats)	74	21.7%	82.2%
	Terrestrial Mammals	46	13.5%	51.1%
	Aquatic Mammals (water vole/otter)	34	10.0%	37.8%
	Reptiles	46	13.5%	51.1%
	Fish (not fisheries)	4	1.2%	4.4%
	Terrestrial Invertebrates	21	6.2%	23.3%
	Aquatic Invertebrates	12	3.5%	13.3%
	Marine Invertebrates	6	1.8%	6.7%
	Birds	57	16.7%	63.3%
Total		341	100.0%	378.9%

a. Dichotomy group tabulated at value 1.

3.6.3 Bats

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Bats	152	100.0%	0	.0%	152	100.0%

Study * Bats Crosstabulation

			Bats		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	7	33	40
		Expected	21.3	18.7	40.0
	Current Review	Count	74	38	112
		Expected	59.7	52.3	112.0
Total		Count	81	71	152
		Expected	81.0	71.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	27.934[a]	1	.000	.000	.000	
Continuity Correction[b]	26.017	1	.000			
Likelihood Ratio	29.475	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	27.751[c]	1	.000	.000	.000	.000
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 18.68.

b. Computed only for a 2x2 table

c. The standardized statistic is -5.268.

3.6.4 Amphibians

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Amphibians	152	100.0%	0	.0%	152	100.0%

Study * Amphibians Crosstabulation

			Amphibians		Total
			Yes	No	
Study	Byron *et al.* 2000	Count	5	35	40
		Expected	12.1	27.9	40.0
	Current Review	Count	41	71	112
		Expected	33.9	78.1	112.0
Total		Count	46	106	152
		Expected	46.0	106.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	8.116[a]	1	.004	.005	.003	
Continuity Correction[b]	7.014	1	.008			
Likelihood Ratio	9.104	1	.003	.005	.003	
Fisher's Exact Test				.005	.003	
Linear-by-Linear Association	8.063[c]	1	.005	.005	.003	.002
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 12.11.

b. Computed only for a 2x2 table

c. The standardized statistic is -2.839.

3.6.5 Birds

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Birds	152	100.0%	0	.0%	152	100.0%

Study * Birds Crosstabulation

			Birds		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	7	33	40
		Expected	16.8	23.2	40.0
	Current Review	Count	57	55	112
		Expected	47.2	64.8	112.0
Total		Count	64	88	152
		Expected	64.0	88.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	13.482[a]	1	.000	.000	.000	
Continuity Correction[b]	12.147	1	.000			
Likelihood Ratio	14.584	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	13.394[c]	1	.000	.000	.000	.000
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.84.

b. Computed only for a 2x2 table

c. The standardized statistic is -3.660.

3.6.6 Otter

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Otter	152	100.0%	0	.0%	152	100.0%

Study * Otter Crosstabulation

			Otter		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	3	37	40
		Expected	6.3	33.7	40.0
	Current Review	Count	21	91	112
		Expected	17.7	94.3	112.0
Total		Count	24	128	152
		Expected	24.0	128.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.805[a]	1	.094	.129	.072	
Continuity Correction[b]	2.023	1	.155			
Likelihood Ratio	3.185	1	.074	.129	.072	
Fisher's Exact Test				.129	.072	
Linear-by-Linear Association	2.787[c]	1	.095	.129	.072	.052
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 6.32.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.669.

3.6.7 Aquatic Invertebrates

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Aquatic invertebrates	152	100.0%	0	.0%	152	100.0%

Study * Aquatic invertebrates Crosstabulation

			Aquatic invertebrates		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	3	37	40
		Expected	3.9	36.1	40.0
	Current Review	Count	12	100	112
		Expected	11.1	100.9	112.0
Total		Count	15	137	152
		Expected	15.0	137.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.342[a]	1	.558	.760	.407	
Continuity Correction[b]	.076	1	.782			
Likelihood Ratio	.361	1	.548	.760	.407	
Fisher's Exact Test				.760	.407	
Linear-by-Linear Association	.340[c]	1	.560	.760	.407	.218
N of Valid Cases	152					

a. 1 cells (25.0%) have Expected less than 5. The minimum Expected is 3.95.

b. Computed only for a 2x2 table

c. The standardized statistic is -.583.

3.6.8 Badger

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Badger	152	100.0%	0	.0%	152	100.0%

Study * Badger Crosstabulation

			Badger		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	16	24	40
		Expected	16.1	23.9	40.0
	Current Review	Count	45	67	112
		Expected	44.9	67.1	112.0
Total		Count	61	91	152
		Expected	61.0	91.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.000[a]	1	.984	1.000	.569	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.000	1	.984	1.000	.569	
Fisher's Exact Test				1.000	.569	
Linear-by-Linear Association	.000[c]	1	.984	1.000	.569	.149
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.05.

b. Computed only for a 2x2 table

c. The standardized statistic is -.020.

3.6.9 Terrestrial Invertebrates

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Terrestrial invertebrates	152	100.0%	0	.0%	152	100.0%

Study * Terrestrial invertebrates Crosstabulation

			Terrestrial invertebrates		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	8	32	40
		Expected	7.6	32.4	40.0
	Current Review	Count	21	91	112
		Expected	21.4	90.6	112.0
Total		Count	29	123	152
		Expected	29.0	123.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.030[a]	1	.863	1.000	.515	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.030	1	.863	1.000	.515	
Fisher's Exact Test				.819	.515	
Linear-by-Linear Association	.030[c]	1	.863	1.000	.515	.180
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 7.63.

b. Computed only for a 2x2 table

c. The standardized statistic is .172.

3.6.10 Deer

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Deer	152	100.0%	0	.0%	152	100.0%

Study * Deer Crosstabulation

			Deer		
			Yes	No	Total
Study	Byron *et al*. 2000	Count	1	39	40
		Expected	.5	39.5	40.0
	Current Review	Count	1	111	112
		Expected	1.5	110.5	112.0
Total		Count	2	150	152
		Expected	2.0	150.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.586[a]	1	.444	1.000	.458	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.516	1	.473	1.000	.458	
Fisher's Exact Test				.458	.458	
Linear-by-Linear Association	.582[c]	1	.445	1.000	.458	.390
N of Valid Cases	152					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is .53.

b. Computed only for a 2x2 table

c. The standardized statistic is .763.

3.6.11 Bryophytes

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Bryophytes	152	100.0%	0	.0%	152	100.0%

Study * Bryophytes Crosstabulation

			Bryophytes		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	1	39	40
		Expected	.8	39.2	40.0
	Current Review	Count	2	110	112
		Expected	2.2	109.8	112.0
Total		Count	3	149	152
		Expected	3.0	149.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.078[a]	1	.780	1.000	.603	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.074	1	.786	1.000	.603	
Fisher's Exact Test				1.000	.603	
Linear-by-Linear Association	.077[c]	1	.781	1.000	.603	.433
N of Valid Cases	152					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is .79.

b. Computed only for a 2x2 table

c. The standardized statistic is .278.

3.6.12 Fungi

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Fungi	152	100.0%	0	.0%	152	100.0%

Study * Fungi Crosstabulation

			Fungi		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	1	39	40
		Expected	.3	39.7	40.0
	Current Review	Count	0	112	112
		Expected	.7	111.3	112.0
Total		Count	1	151	152
		Expected	1.0	151.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.819[a]	1	.093	.263	.263	
Continuity Correction[b]	.291	1	.589			
Likelihood Ratio	2.689	1	.101	.263	.263	
Fisher's Exact Test				.263	.263	
Linear-by-Linear Association	2.800[c]	1	.094	.263	.263	.263
N of Valid Cases	152					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is .26.

b. Computed only for a 2x2 table

c. The standardized statistic is 1.673.

4 EVALUATION

4.1 GEOGRAPHIC CONTEXT OF HABITATS STATED OVER TIME

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Is the geographic context of habitats assessed?	152	100.0%	0	.0%	152	100.0%

Study * Is the geographic context of habitats assessed? Crosstabulation

			Is the geographic context of habitats assessed?		Total
			Yes	No	
Study	Byron *et al.* 2000	Count	10	30	40
		Expected	26.6	13.4	40.0
	Current Review	Count	91	21	112
		Expected	74.4	37.6	112.0
Total		Count	101	51	152
		Expected	101.0	51.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	41.829[a]	1	.000	.000	.000	
Continuity Correction[b]	39.344	1	.000			
Likelihood Ratio	40.875	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	41.554[c]	1	.000	.000	.000	.000
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 13.42.

b. Computed only for a 2x2 table

c. The standardized statistic is -6.446.

5 IMPACT ASSESSMENT APPROACH

5.1 ECOLOGICAL IMPACTS CONSIDERED OR OMITTED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Ecological impacts omitted?	383	100.0%	0	.0%	383	100.0%

Study * Ecological impacts omitted? Crosstabulation

			Ecological impacts omitted?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	32	5	37
		Expected	32.7	4.3	37.0
	Treweek & Thompson 1997	Count	154	40	194
		Expected	171.2	22.8	194.0
	Byron *et al*. 2000	Count	40	0	40
		Expected	35.3	4.7	40.0
	Current Review	Count	112	0	112
		Expected	98.8	13.2	112.0
Total		Count	338	45	383
		Expected	338.0	45.0	383.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	35.065[a]	3	.000	.000		
Likelihood Ratio	50.472	3	.000	.000		
Fisher's Exact Test	43.533			1.000		
Linear-by-Linear Association	24.710[b]	1	.000	.000	.000	.000
N of Valid Cases	383					

a. 2 cells (25.0%) have Expected less than 5. The minimum Expected is 4.35.

b. The standardized statistic is -4.971.

5.2 ASSESSMENT METHOD STATED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Assessment method stated?	154	100.0%	0	.0%	154	100.0%

Study * Assessment method stated? Crosstabulation

			Assessment method stated?		
			Yes	No	Total
Study	RSPB 1995	Count	5	37	42
		Expected	28.1	13.9	42.0
	Current Review	Count	98	14	112
		Expected	74.9	37.1	112.0
Total		Count	103	51	154
		Expected	103.0	51.0	154.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	78.808[a]	1	.000	.000	.000	
Continuity Correction[b]	75.432	1	.000			
Likelihood Ratio	80.523	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	78.296[c]	1	.000	.000	.000	.000
N of Valid Cases	154					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 13.91.

b. Computed only for a 2x2 table

c. The standardized statistic is -8.849.

5.3 AT LEAST ONE IMPACT QUANTIFIED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * At least one impact quantified?	368	100.0%	0	.0%	368	100.0%

Study * At least one impact quantified? Crosstabulation

			At least one impact quantified?		
			Yes	No	Total
Study	Treweek *et al.* 1993	Count	3	34	37
		Expected	11.2	25.8	37.0
	Thompson *et al.* 1997	Count	16	163	179
		Expected	54.0	125.0	179.0
	Byron *et al.* 2000	Count	31	9	40
		Expected	12.1	27.9	40.0
	Current Review	Count	61	51	112
		Expected	33.8	78.2	112.0
Total		Count	111	257	368
		Expected	111.0	257.0	368.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	120.772[a]	3	.000	.000		
Likelihood Ratio	124.962	3	.000	.000		
Fisher's Exact Test	123.035			1.000		
Linear-by-Linear Association	81.744[b]	1	.000	.000	.000	.000
N of Valid Cases	368					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 11.16.

b. The standardized statistic is -9.041.

5.4 LAND TAKE QUANTIFIED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Land take quantified?	152	100.0%	0	.0%	152	100.0%

Study * Land take quantified? Crosstabulation

			Land take quantified?		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	31	9	40
		Expected	18.4	21.6	40.0
	Current Review	Count	39	73	112
		Expected	51.6	60.4	112.0
Total		Count	70	82	152
		Expected	70.0	82.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	21.609[a]	1	.000	.000	.000	
Continuity Correction[b]	19.925	1	.000			
Likelihood Ratio	22.336	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	21.467[c]	1	.000	.000	.000	.000
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 18.42.

b. Computed only for a 2x2 table

c. The standardized statistic is 4.633.

5.5 AREAS OF HABITAT TYPES TO BE LOST QUANTIFIED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Quantification of areas of habitat types to be lost?	152	100.0%	0	.0%	152	100.0%

Study * Quantification of areas of habitat types to be lost? Crosstabulation

			Quantification of areas of habitat types to be lost?		
			Yes	No	Total
Study	Byron *et al.* 2000	Count	6	34	40
		Expected	12.9	27.1	40.0
	Current Review	Count	43	69	112
		Expected	36.1	75.9	112.0
Total		Count	49	103	152
		Expected	49.0	103.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.383[a]	1	.007	.010	.004	
Continuity Correction[b]	6.351	1	.012			
Likelihood Ratio	8.117	1	.004	.006	.004	
Fisher's Exact Test				.006	.004	
Linear-by-Linear Association	7.335[c]	1	.007	.010	.004	.003
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 12.89.

b. Computed only for a 2x2 table

c. The standardized statistic is -2.708.

5.6 ANY OTHER IMPACTS QUANTIFIED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Quantification of any other ecological impacts?	152	100.0%	0	.0%	152	100.0%

Study * Quantification of any other ecological impacts? Crosstabulation

			Quantification of any other ecological impacts?		
			Yes	No	Total
Study	Byron *et al.* 2000	Count	1	39	40
		Expected	4.7	35.3	40.0
	Current Review	Count	17	95	112
		Expected	13.3	98.7	112.0
Total		Count	18	134	152
		Expected	18.0	134.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.538[a]	1	.033	.043	.024	
Continuity Correction[b]	3.405	1	.065			
Likelihood Ratio	5.855	1	.016	.029	.024	
Fisher's Exact Test				.043	.024	
Linear-by-Linear Association	4.508[c]	1	.034	.043	.024	.021
N of Valid Cases	152					

a. 1 cells (25.0%) have Expected less than 5. The minimum Expected is 4.74.

b. Computed only for a 2x2 table

c. The standardized statistic is -2.123.

5.7 DURATION OF ECOOGICAL IMPACTS STATED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Duration of ecological impacts stated?	291	100.0%	0	.0%	291	100.0%

Study * Duration of ecological impacts stated? Crosstabulation

			Duration of ecological impacts stated?		
			Yes	No	Total
Study	Thompson *et al.* 1997	Count	5	174	179
		Expected	28.3	150.7	179.0
	Current Review	Count	41	71	112
		Expected	17.7	94.3	112.0
Total		Count	46	245	291
		Expected	46.0	245.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	59.187[a]	1	.000	.000	.000	
Continuity Correction[b]	56.674	1	.000			
Likelihood Ratio	61.254	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	58.984[c]	1	.000	.000	.000	.000
N of Valid Cases	291					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 17.70.

b. Computed only for a 2x2 table

c. The standardized statistic is -7.680.

5.8 INDIRECT IMPACTS IDENTIFIED?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Indirect impacts identified?	331	100.0%	0	.0%	331	100.0%

Study * Indirect impacts identified? Crosstabulation

			Indirect impacts identified?		
			Yes	No	Total
Study	Thompson *et al.* 1997	Count	0	179	179
		Expected	37.3	141.7	179.0
	Byron *et al.* 2000	Count	5	35	40
		Expected	8.3	31.7	40.0
	Current Review	Count	64	48	112
		Expected	23.3	88.7	112.0
Total		Count	69	262	331
		Expected	69.0	262.0	331.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	138.256[a]	2	.000	.000		
Likelihood Ratio	155.770	2	.000	.000		
Fisher's Exact Test	150.566			1.000		
Linear-by-Linear Association	132.387[b]	1	.000	.000	.000	.000
N of Valid Cases	331					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 8.34.

b. The standardized statistic is -11.506.

5.9 'DO NOTHING' SCENARIO CONSIDERED?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Is the 'do nothing' scenario considered?	149	100.0%	0	.0%	149	100.0%

Study * Is the 'do nothing' scenario considered? Crosstabulation

			Is the 'do nothing' scenario considered?		
			Yes	No	Total
Study	RSPB 1995	Count	13	24	37
		Expected	11.9	25.1	37.0
	Current Review	Count	35	77	112
		Expected	36.1	75.9	112.0
Total		Count	48	101	149
		Expected	48.0	101.0	149.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.192[a]	1	.661	.688	.403	
Continuity Correction[b]	.055	1	.814			
Likelihood Ratio	.190	1	.663	.688	.403	
Fisher's Exact Test				.688	.403	
Linear-by-Linear Association	.191[c]	1	.662	.688	.403	.144
N of Valid Cases	149					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 11.92.

b. Computed only for a 2x2 table

c. The standardized statistic is .437.

5.10 TYPE OF ECOLOGICAL IMPACT

5.10.1 Direct Habitat Loss Impacts Described?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Habitat_Loss	562	100.0%	0	.0%	562	100.0%

Study * Habitat_Loss Crosstabulation

			Habitat loss described?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	23	14	37
		Expected	25.0	12.0	37.0
	Thompson *et al*. 1997	Count	116	63	179
		Expected	120.7	58.3	179.0
	Treweek & Thompson 1997	Count	128	66	194
		Expected	130.8	63.2	194.0
	Byron *et al*. 2000	Count	40	0	40
		Expected	27.0	13.0	40.0
	Current Review	Count	72	40	112
		Expected	75.5	36.5	112.0
Total		Count	379	183	562
		Expected	379.0	183.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	21.043[a]	4	.000	.000		
Likelihood Ratio	33.218	4	.000	.000		
Fisher's Exact Test	29.405			1.000		
Linear-by-Linear Association	1.186[b]	1	.276	.279	.146	.017
N of Valid Cases	562					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 12.05.

b. The standardized statistic is -1.089.

5.10.2 Habitat Fragmentation Impacts Described?

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Habitat_Fragmentation	562	100.0%	0	.0%	562	100.0%

Study * Habitat_Fragmentation Crosstabulation

			Habitat fragmentation described?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	1	36	37
		Expected	3.4	33.6	37.0
	Thompson *et al*. 1997	Count	7	172	179
		Expected	16.2	162.8	179.0
	Treweek & Thompson 1997	Count	8	186	194
		Expected	17.6	176.4	194.0
	Byron *et al*. 2000	Count	4	36	40
		Expected	3.6	36.4	40.0
	Current Review	Count	31	81	112
		Expected	10.2	101.8	112.0
Total		Count	51	511	562
		Expected	51.0	511.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	60.390[a]	4	.000	.000		
Likelihood Ratio	48.872	4	.000	.000		
Fisher's Exact Test	47.431			1.000		
Linear-by-Linear Association	46.566[b]	1	.000	.000	.000	.000
N of Valid Cases	562					

a. 2 cells (20.0%) have Expected less than 5. The minimum Expected is 3.36.

b. The standardized statistic is -6.824.

5.10.3 Noise Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Noise	306	100.0%	0	.0%	306	100.0%

Study * Noise Crosstabulation

			Potential noise impacts?		Total
			Yes	No	
Study	Treweek & Thompson 1997	Count	17	177	194
		Expected	39.9	154.1	194.0
	Current Review	Count	46	66	112
		Expected	23.1	88.9	112.0
Total		Count	63	243	306
		Expected	63.0	243.0	306.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	45.335[a]	1	.000	.000	.000	
Continuity Correction[b]	43.380	1	.000			
Likelihood Ratio	44.254	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	45.186[c]	1	.000	.000	.000	.000
N of Valid Cases	306					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 23.06.

b. Computed only for a 2x2 table

c. The standardized statistic is -6.722.

5.10.4 Construction Disturbance

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Construction	291	100.0%	0	.0%	291	100.0%

Study * Construction Crosstabulation

			Potential construction disturbance impacts?		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	30	149	179
		Expected	61.5	117.5	179.0
	Current Review	Count	70	42	112
		Expected	38.5	73.5	112.0
Total		Count	100	191	291
		Expected	100.0	191.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	63.904[a]	1	.000	.000	.000	
Continuity Correction[b]	61.892	1	.000			
Likelihood Ratio	64.445	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	63.684[c]	1	.000	.000	.000	.000
N of Valid Cases	291					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 38.49.

b. Computed only for a 2x2 table

c. The standardized statistic is -7.980.

5.10.5 Operation Disturbance

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Operation	291	100.0%	0	.0%	291	100.0%

Study * Operation Crosstabulation

			Potential operation disturbance impacts?		
			Yes	No	Total
Study	Thompson *et al*. 1997	Count	25	154	179
		Expected	41.2	137.8	179.0
	Current Review	Count	42	70	112
		Expected	25.8	86.2	112.0
Total		Count	67	224	291
		Expected	67.0	224.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	21.529[a]	1	.000	.000	.000	
Continuity Correction[b]	20.221	1	.000			
Likelihood Ratio	21.079	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	21.455[c]	1	.000	.000	.000	.000
N of Valid Cases	291					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 25.79.

b. Computed only for a 2x2 table

c. The standardized statistic is -4.632.

5.10.6 Dust Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Dust	306	100.0%	0	.0%	306	100.0%

Study * Dust Crosstabulation

			Potential dust impacts?		Total
			Yes	No	
Study	Treweek & Thompson 1997	Count	19	175	194
		Expected	29.2	164.8	194.0
	Current Review	Count	27	85	112
		Expected	16.8	95.2	112.0
Total		Count	46	260	306
		Expected	46.0	260.0	306.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.389[a]	1	.001	.001	.001	
Continuity Correction[b]	10.296	1	.001			
Likelihood Ratio	10.962	1	.001	.001	.001	
Fisher's Exact Test				.001	.001	
Linear-by-Linear Association	11.352[c]	1	.001	.001	.001	.001
N of Valid Cases	306					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.84.

b. Computed only for a 2x2 table

c. The standardized statistic is -3.369.

5.10.7 Light Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Light	306	100.0%	0	.0%	306	100.0%

Study * Light Crosstabulation

			Potential lighting impacts		Total
			Yes	No	
Study	Treweek & Thompson 1997	Count	1	193	194
		Expected	17.1	176.9	194.0
	Current Review	Count	26	86	112
		Expected	9.9	102.1	112.0
Total		Count	27	279	306
		Expected	27.0	279.0	306.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	45.476[a]	1	.000	.000	.000	
Continuity Correction[b]	42.698	1	.000			
Likelihood Ratio	48.737	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	45.327[c]	1	.000	.000	.000	.000
N of Valid Cases	306					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 9.88.

b. Computed only for a 2x2 table

c. The standardized statistic is -6.733.

6 IMPACT ASSESSMENT – SIGNIFCIANTLY AFFECTED RECEPTORS

7.1 SPECIES IMPACTS

7.1.1 Impacts On Badger

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Badger	152	100.0%	0	.0%	152	100.0%

Study * Badger Crosstabulation

			Potential impacts on badger?		
			Yes	No	Total
Study	Byron *et al*. 2000	Count	22	18	40
		Expected	10.0	30.0	40.0
	Current Review	Count	16	96	112
		Expected	28.0	84.0	112.0
Total		Count	38	114	152
		Expected	38.0	114.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	26.057[a]	1	.000	.000	.000	
Continuity Correction[b]	23.931	1	.000			
Likelihood Ratio	24.033	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	25.886[c]	1	.000	.000	.000	.000
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 10.00.

b. Computed only for a 2x2 table

c. The standardized statistic is 5.088.

7.1.2 Impacts On Otter

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Otter	152	100.0%	0	.0%	152	100.0%

Study * Otter Crosstabulation

			Potential impacts on otter?		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	8	32	40
		Expected	4.5	35.5	40.0
	Current Review	Count	9	103	112
		Expected	12.5	99.5	112.0
Total		Count	17	135	152
		Expected	17.0	135.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.247[a]	1	.039	.047	.043	
Continuity Correction[b]	3.128	1	.077			
Likelihood Ratio	3.835	1	.050	.075	.043	
Fisher's Exact Test				.075	.043	
Linear-by-Linear Association	4.219[c]	1	.040	.047	.043	.031
N of Valid Cases	152					

a. 1 cells (25.0%) have Expected less than 5. The minimum Expected is 4.47.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.054.

7.1.3 Impacts On Bats

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Bats	152	100.0%	0	.0%	152	100.0%

Study * Bats Crosstabulation

			Potential impacts on bats?		Total
			Yes	No	
Study	Byron *et al*. 2000	Count	16	24	40
		Expected	15.5	24.5	40.0
	Current Review	Count	43	69	112
		Expected	43.5	68.5	112.0
Total		Count	59	93	152
		Expected	59.0	93.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.032[a]	1	.858	1.000	.501	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.032	1	.858	1.000	.501	
Fisher's Exact Test				.853	.501	
Linear-by-Linear Association	.032[c]	1	.858	1.000	.501	.147
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 15.53.

b. Computed only for a 2x2 table

c. The standardized statistic is .178.

7.2 TERRESTRIAL HABITAT IMPACTS

7.2.1 Woodland Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Woodland	562	100.0%	0	.0%	562	100.0%

Study * Woodland Crosstabulation

			Potential impacts on woodland?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	27	10	37
		Expected	16.3	20.7	37.0
	Thompson *et al*. 1997	Count	88	91	179
		Expected	78.7	100.3	179.0
	Treweek & Thompson 1997	Count	80	114	194
		Expected	85.3	108.7	194.0
	Byron *et al*. 2000	Count	35	5	40
		Expected	17.6	22.4	40.0
	Current Review	Count	17	95	112
		Expected	49.2	62.8	112.0
Total		Count	247	315	562
		Expected	247.0	315.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	83.638[a]	4	.000	.000		
Likelihood Ratio	91.101	4	.000	.000		
Fisher's Exact Test	89.483			1.000		
Linear-by-Linear Association	30.130[b]	1	.000	.000	.000	.000
N of Valid Cases	562					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.26.

b. The standardized statistic is 5.489.

7.2.2 Scrub Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Scrub	368	100.0%	0	.0%	368	100.0%

Study * Scrub Crosstabulation

			Potential impacts on scrub?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	8	29	37
		Expected	10.3	26.7	37.0
	Thompson *et al*. 1997	Count	48	131	179
		Expected	49.6	129.4	179.0
	Byron *et al*. 2000	Count	19	21	40
		Expected	11.1	28.9	40.0
	Current Review	Count	27	85	112
		Expected	31.0	81.0	112.0
Total		Count	102	266	368
		Expected	102.0	266.0	368.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	9.301[a]	3	.026	.002		
Likelihood Ratio	8.584	3	.035	.003		
Fisher's Exact Test	8.567			1.000		
Linear-by-Linear Association	.216[b]	1	.642	.668	.334	.028
N of Valid Cases	368					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 10.26.

b. The standardized statistic is -.465.

7.2.3 Hedgerows Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Hedgerows	562	100.0%	0	.0%	562	100.0%

Study * Hedgerows Crosstabulation

			Potential impacts on hedgerows?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	18	19	37
		Expected	11.7	25.3	37.0
	Thompson *et al*. 1997	Count	68	111	179
		Expected	56.7	122.3	179.0
	Treweek & Thompson 1997	Count	41	153	194
		Expected	61.4	132.6	194.0
	Byron *et al*. 2000	Count	29	11	40
		Expected	12.7	27.3	40.0
	Current Review	Count	22	90	112
		Expected	35.5	76.5	112.0
Total		Count	178	384	562
		Expected	178.0	384.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	56.482[a]	4	.000	.000		
Likelihood Ratio	54.691	4	.000	.000		
Fisher's Exact Test	54.305			1.000		
Linear-by-Linear Association	6.732[b]	1	.009	.010	.005	.001
N of Valid Cases	562					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 11.72.

b. The standardized statistic is 2.595.

7.2.4 Grassland Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Grassland	562	100.0%	0	.0%	562	100.0%

Study * Grassland Crosstabulation

			Potential impacts on grassland?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	26	11	37
		Expected	17.8	19.2	37.0
	Thompson *et al*. 1997	Count	140	39	179
		Expected	86.3	92.7	179.0
	Treweek & Thompson 1997	Count	50	144	194
		Expected	93.5	100.5	194.0
	Byron *et al*. 2000	Count	34	6	40
		Expected	19.3	20.7	40.0
	Current Review	Count	21	91	112
		Expected	54.0	58.0	112.0
Total		Count	271	291	562
		Expected	271.0	291.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	171.472[a]	4	.000	.000		
Likelihood Ratio	182.351	4	.000	.000		
Fisher's Exact Test	180.420			1.000		
Linear-by-Linear Association	72.201[b]	1	.000	.000	.000	.000
N of Valid Cases	562					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 17.84.

b. The standardized statistic is 8.497.

7.2.5 Heathland Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Heathland	152	100.0%	0	.0%	152	100.0%

Study * Heathland Crosstabulation

			Potential impacts on heathland?		
			Yes	No	Total
Study	Byron *et al*. 2000	Count	5	35	40
		Expected	1.6	38.4	40.0
	Current Review	Count	1	111	112
		Expected	4.4	107.6	112.0
Total		Count	6	146	152
		Expected	6.0	146.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.473[a]	1	.001	.005	.005	
Continuity Correction[b]	7.635	1	.006			
Likelihood Ratio	8.976	1	.003	.005	.005	
Fisher's Exact Test				.005	.005	
Linear-by-Linear Association	10.404[c]	1	.001	.005	.005	.005
N of Valid Cases	152					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is 1.58.

b. Computed only for a 2x2 table

c. The standardized statistic is 3.226.

7.2.6 Ruderals Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Ruderals	152	100.0%	0	.0%	152	100.0%

Study * Ruderals Crosstabulation

			Potential impacts on ruderals?		
			Yes	No	Total
Study	Byron *et al.* 2000	Count	12	28	40
		Expected	5.5	34.5	40.0
	Current Review	Count	9	103	112
		Expected	15.5	96.5	112.0
Total		Count	21	131	152
		Expected	21.0	131.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.942[a]	1	.001	.001	.001	
Continuity Correction[b]	10.168	1	.001			
Likelihood Ratio	10.579	1	.001	.002	.001	
Fisher's Exact Test				.002	.001	
Linear-by-Linear Association	11.863[c]	1	.001	.001	.001	.001
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 5.53.

b. Computed only for a 2x2 table

c. The standardized statistic is 3.444.

7.3 AQUATIC/MARINE HABITAT IMPACTS

7.3.1 Open Water Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Open_Water	383	100.0%	0	.0%	383	100.0%

Study * Open Water Crosstabulation

			Potential impacts on open water?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	7	30	37
		Expected	6.6	30.4	37.0
	Treweek & Thompson 1997	Count	25	169	194
		Expected	34.4	159.6	194.0
	Byron *et al*. 2000	Count	22	18	40
		Expected	7.1	32.9	40.0
	Current Review	Count	14	98	112
		Expected	19.9	92.1	112.0
Total		Count	68	315	383
		Expected	68.0	315.0	383.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	43.300[a]	3	.000	.000		
Likelihood Ratio	33.801	3	.000	.000		
Fisher's Exact Test	33.879			1.000		
Linear-by-Linear Association	.065[b]	1	.799	.823	.423	.043
N of Valid Cases	383					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 6.57.

b. The standardized statistic is -.254.

7.3.2 Flowing Water Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Flowing_Water	189	100.0%	0	.0%	189	100.0%

Study * Flowing_Water Crosstabulation

			Potential impacts on flowing water?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	25	12	37
		Expected	16.2	20.8	37.0
	Byron *et al*. 2000	Count	38	2	40
		Expected	17.6	22.4	40.0
	Current Review	Count	20	92	112
		Expected	49.2	62.8	112.0
Total		Count	83	106	189
		Expected	83.0	106.0	189.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	81.664[a]	2	.000	.000		
Likelihood Ratio	91.591	2	.000	.000		
Fisher's Exact Test	89.415			1.000		
Linear-by-Linear Association	27.894[b]	1	.000	.000	.000	.000
N of Valid Cases	189					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.25.

b. The standardized statistic is 5.281.

7.3.3 Saltmarsh/Intertidal Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Saltmarsh	291	100.0%	0	.0%	291	100.0%

Study * Saltmarsh Crosstabulation

			Potential impacts on saltmarsh or intertidal habitats?		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	13	166	179
		Expected	12.3	166.7	179.0
	Current Review	Count	7	105	112
		Expected	7.7	104.3	112.0
Total		Count	20	271	291
		Expected	20.0	271.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.110[a]	1	.740	.816	.469	
Continuity Correction[b]	.009	1	.925			
Likelihood Ratio	.112	1	.738	.816	.469	
Fisher's Exact Test				.816	.469	
Linear-by-Linear Association	.110[c]	1	.740	.816	.469	.180
N of Valid Cases	291					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 7.70.

b. Computed only for a 2x2 table

c. The standardized statistic is .332.

7.3.4 Estuary Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Estuary	291	100.0%	0	.0%	291	100.0%

Study * Estuary Crosstabulation

			Potential impacts on estuaries?		Total
			Yes	No	
Study	Thompson *et al*. 1997	Count	9	170	179
		Expected	6.8	172.2	179.0
	Current Review	Count	2	110	112
		Expected	4.2	107.8	112.0
Total		Count	11	280	291
		Expected	11.0	280.0	291.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.991[a]	1	.158	.213	.135	
Continuity Correction[b]	1.199	1	.273			
Likelihood Ratio	2.210	1	.137	.213	.135	
Fisher's Exact Test				.213	.135	
Linear-by-Linear Association	1.984[c]	1	.159	.213	.135	.100
N of Valid Cases	291					

a. 1 cells (25.0%) have Expected less than 5. The minimum Expected is 4.23.

b. Computed only for a 2x2 table

c. The standardized statistic is 1.409.

7.4 DESIGNATED SITE IMPACTS

7.4.1 SSSI Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * SSSI	189	100.0%	0	.0%	189	100.0%

Study * SSSI Crosstabulation

			Potential impacts on SSSIs?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	20	17	37
		Expected	9.0	28.0	37.0
	Byron *et al*. 2000	Count	16	24	40
		Expected	9.7	30.3	40.0
	Current Review	Count	10	102	112
		Expected	27.3	84.7	112.0
Total		Count	46	143	189
		Expected	46.0	143.0	189.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	37.512[a]	2	.000	.000		
Likelihood Ratio	37.484	2	.000	.000		
Fisher's Exact Test	37.270			1.000		
Linear-by-Linear Association	36.163[b]	1	.000	.000	.000	.000
N of Valid Cases	189					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 9.01.

b. The standardized statistic is 6.014.

7.4.2 SINC / Equivalent Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * SINC	189	100.0%	0	.0%	189	100.0%

Study * SINC Crosstabulation

			Potential impacts on SINCs or their equivalent?		
			Yes	No	Total
Study	Treweek *et al*. 1993	Count	10	27	37
		Expected	11.0	26.0	37.0
	Byron *et al*. 2000	Count	16	24	40
		Expected	11.9	28.1	40.0
	Current Review	Count	30	82	112
		Expected	33.2	78.8	112.0
Total		Count	56	133	189
		Expected	56.0	133.0	189.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.618[a]	2	.270	.120		
Likelihood Ratio	2.516	2	.284	.166		
Fisher's Exact Test	2.574			1.000		
Linear-by-Linear Association	.198[b]	1	.657	.690	.362	.071
N of Valid Cases	189					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 10.96.

b. The standardized statistic is .444.

7.4.3 Ramsar Site Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Ramsar	189	100.0%	0	.0%	189	100.0%

Study * Ramsar Crosstabulation

			Potential impacts on Ramsar sites?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	1	36	37
		Expected	1.0	36.0	37.0
	Byron *et al*. 2000	Count	1	39	40
		Expected	1.1	38.9	40.0
	Current Review	Count	3	109	112
		Expected	3.0	109.0	112.0
Total		Count	5	184	189
		Expected	5.0	184.0	189.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.004[a]	2	.998	.762		
Likelihood Ratio	.004	2	.998	.762		
Fisher's Exact Test	.329			1.000		
Linear-by-Linear Association	.000[b]	1	.993	1.000	.624	.209
N of Valid Cases	189					

a. 3 cells (50.0%) have Expected less than 5. The minimum Expected is .98.

b. The standardized statistic is -.009.

7.4.4 SPA Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * SPA	189	100.0%	0	.0%	189	100.0%

Study * SPA Crosstabulation

			Potential impacts on SPAs?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	1	36	37
		Expected	1.2	35.8	37.0
	Byron *et al*. 2000	Count	1	39	40
		Expected	1.3	38.7	40.0
	Current Review	Count	4	108	112
		Expected	3.6	108.4	112.0
Total		Count	6	183	189
		Expected	6.0	183.0	189.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.143[a]	2	.931	.757		
Likelihood Ratio	.147	2	.929	.757		
Fisher's Exact Test	.211			1.000		
Linear-by-Linear Association	.104[b]	1	.747	.807	.497	.196
N of Valid Cases	189					

a. 3 cells (50.0%) have Expected less than 5. The minimum Expected is 1.17.

b. The standardized statistic is -.322.

7.4.5 National Park Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * National_Park	152	100.0%	0	.0%	152	100.0%

Study * National_Park Crosstabulation

			Potential impacts on National Parks?		
			Yes	No	Total
Study	Byron *et al*. 2000	Count	2	38	40
		Expected	.5	39.5	40.0
	Current Review	Count	0	112	112
		Expected	1.5	110.5	112.0
Total		Count	2	150	152
		Expected	2.0	150.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.675[a]	1	.017	.068	.068	
Continuity Correction[b]	2.477	1	.116			
Likelihood Ratio	5.415	1	.020	.068	.068	
Fisher's Exact Test				.068	.068	
Linear-by-Linear Association	5.637[c]	1	.018	.068	.068	.068
N of Valid Cases	152					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is .53.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.374.

7.4.6 National Nature Reserve Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * NNR	152	100.0%	0	.0%	152	100.0%

Study * NNR Crosstabulation

			Potential impacts on National Nature Reserves? Yes	No	Total
Study	Byron *et al.* 2000	Count	2	38	40
		Expected	.5	39.5	40.0
	Current Review	Count	0	112	112
		Expected	1.5	110.5	112.0
Total		Count	2	150	152
		Expected	2.0	150.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.675[a]	1	.017	.068	.068	
Continuity Correction[b]	2.477	1	.116			
Likelihood Ratio	5.415	1	.020	.068	.068	
Fisher's Exact Test				.068	.068	
Linear-by-Linear Association	5.637[c]	1	.018	.068	.068	.068
N of Valid Cases	152					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is .53.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.374.

7.4.7 Local Wildlife Trust Site Impacts

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * LWT	152	100.0%	0	.0%	152	100.0%

Study * LWT Crosstabulation

			Potential impacts on Local Wildlife Trust sites?		Total
			Yes	No	
Study	Byron *et al.* 2000	Count	5	35	40
		Expected	1.3	38.7	40.0
	Current Review	Count	0	112	112
		Expected	3.7	108.3	112.0
Total		Count	5	147	152
		Expected	5.0	147.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	14.476[a]	1	.000	.001	.001	
Continuity Correction[b]	10.814	1	.001			
Likelihood Ratio	13.837	1	.000	.001	.001	
Fisher's Exact Test				.001	.001	
Linear-by-Linear Association	14.381[c]	1	.000	.001	.001	.001
N of Valid Cases	152					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is 1.32.

b. Computed only for a 2x2 table

c. The standardized statistic is 3.792.

8 MITIGATION

8.1 MITIGATION DESCRIPTIONS INCLUDED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Mitigation descriptions included?	562	100.0%	0	.0%	562	100.0%

Study * Mitigation descriptions included? Crosstabulation

			Mitigation descriptions included?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	18	19	37
		Expected	28.1	8.9	37.0
	Thompson *et al*. 1997	Count	89	90	179
		Expected	136.0	43.0	179.0
	Treweek & Thompson 1997	Count	169	25	194
		Expected	147.4	46.6	194.0
	Byron *et al*. 2000	Count	40	0	40
		Expected	30.4	9.6	40.0
	Current Review	Count	111	1	112
		Expected	85.1	26.9	112.0
Total		Count	427	135	562
		Expected	427.0	135.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	141.416[a]	4	.000	.000		
Likelihood Ratio	159.776	4	.000	.000		
Fisher's Exact Test	153.250			1.000		
Linear-by-Linear Association	111.087[b]	1	.000	.000	.000	.000
N of Valid Cases	562					

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	141.416[a]	4	.000	.000		
Likelihood Ratio	159.776	4	.000	.000		
Fisher's Exact Test	153.250			1.000		
Linear-by-Linear Association	111.087[b]	1	.000	.000	.000	.000
N of Valid Cases	562					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 8.89.

b. The standardized statistic is -10.540.

8.2 MITIGATION RECOMMENDED DESPITE LACK OF IMPACTS PREDICTED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Mitigation measures recommended despite no impacts predicted?	306	100.0%	0	.0%	306	100.0%

Study * Mitigation measures recommended despite no impacts predicted? Crosstabulation

			Mitigation measures recommended despite no impacts predicted?		
			Yes	No	Total
Study	Treweek & Thompson 1997	Count	25	169	194
		Expected	19.0	175.0	194.0
	Current Review	Count	5	107	112
		Expected	11.0	101.0	112.0
Total		Count	30	276	306
		Expected	30.0	276.0	306.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.696[a]	1	.017	.027	.012	
Continuity Correction[b]	4.783	1	.029			
Likelihood Ratio	6.358	1	.012	.017	.012	
Fisher's Exact Test				.017	.012	
Linear-by-Linear Association	5.677[c]	1	.017	.027	.012	.008
N of Valid Cases	306					

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.696[a]	1	.017	.027	.012	
Continuity Correction[b]	4.783	1	.029			
Likelihood Ratio	6.358	1	.012	.017	.012	
Fisher's Exact Test				.017	.012	
Linear-by-Linear Association	5.677[c]	1	.017	.027	.012	.008
N of Valid Cases	306					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 10.98.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.383.

8.3 DETAILED MITIGATION DESCRIPTIONS

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Detailed mitigation descriptions provided?	368	100.0%	0	.0%	368	100.0%

Study * Detailed mitigation descriptions provided? Crosstabulation

			Detailed mitigation descriptions provided?		
			Yes	No	Total
Study	Treweek *et al.* 1993	Count	3	34	37
		Expected	5.5	31.5	37.0
	Thompson *et al.* 1997	Count	20	159	179
		Expected	26.8	152.2	179.0
	Byron *et al.* 2000	Count	11	29	40
		Expected	6.0	34.0	40.0
	Current Review	Count	21	91	112
		Expected	16.7	95.3	112.0
Total		Count	55	313	368
		Expected	55.0	313.0	368.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	9.599[a]	3	.022	.004		
Likelihood Ratio	9.101	3	.028	.003		
Fisher's Exact Test	9.037			1.000		
Linear-by-Linear Association	6.191[b]	1	.013	.014	.008	.002
N of Valid Cases	368					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 5.53.

b. The standardized statistic is -2.488.

8.4 LIKELY SUCCESS OF MITIGATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Likely success of mitigation measures stated?	562	100.0%	0	.0%	562	100.0%

Study * Likely success of mitigation measures stated? Crosstabulation

			Likely success of mitigation measures stated?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	0	37	37
		Expected	1.6	35.4	37.0
	Thompson *et al*. 1997	Count	4	175	179
		Expected	7.6	171.4	179.0
	Treweek & Thompson 1997	Count	8	186	194
		Expected	8.3	185.7	194.0
	Byron *et al*. 2000	Count	5	35	40
		Expected	1.7	38.3	40.0
	Current Review	Count	7	105	112
		Expected	4.8	107.2	112.0
Total		Count	24	538	562
		Expected	24.0	538.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.176[a]	4	.025	.003		
Likelihood Ratio	10.816	4	.029	.001		
Fisher's Exact Test	9.362			1.000		
Linear-by-Linear Association	6.327[b]	1	.012	.012	.009	.003
N of Valid Cases	562					

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.176[a]	4	.025	.003		
Likelihood Ratio	10.816	4	.029	.001		
Fisher's Exact Test	9.362			1.000		
Linear-by-Linear Association	6.327[b]	1	.012	.012	.009	.003
N of Valid Cases	562					

a. 3 cells (30.0%) have Expected less than 5. The minimum Expected is 1.58.

b. The standardized statistic is -2.515.

8.5 DURATION TO MITIGATION SUCCESS

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Duration to mitigation effectiveness given?	306	100.0%	0	.0%	306	100.0%

Study * Duration to mitigation effectiveness given? Crosstabulation

			Duration to mitigation effectiveness given?		Total
			Yes	No	
Study	Treweek & Thompson 1997	Count	0	194	194
		Expected	14.6	179.4	194.0
	Current Review	Count	23	89	112
		Expected	8.4	103.6	112.0
Total		Count	23	283	306
		Expected	23.0	283.0	306.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	43.077[a]	1	.000	.000	.000	
Continuity Correction[b]	40.174	1	.000			
Likelihood Ratio	49.545	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	42.936[c]	1	.000	.000	.000	.000
N of Valid Cases	306					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 8.42.

b. Computed only for a 2x2 table

c. The standardized statistic is -6.553.

8.6 MITIGATION MODIFICATIONS PROPOSED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Modifications for unsuccessful mitigation proposed?	522	100.0%	0	.0%	522	100.0%

Study * Modifications for unsuccessful mitigation proposed? Crosstabulation

			Modifications for unsuccessful mitigation proposed?		Total
			Yes	No	
Study	Treweek *et al*. 1993	Count	0	37	37
		Expected	.4	36.6	37.0
	Thompson *et al*. 1997	Count	0	179	179
		Expected	1.7	177.3	179.0
	Treweek & Thompson 1997	Count	2	192	194
		Expected	1.9	192.1	194.0
	Current Review	Count	3	109	112
		Expected	1.1	110.9	112.0
Total		Count	5	517	522
		Expected	5.0	517.0	522.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.595[a]	3	.133	.056		
Likelihood Ratio	6.518	3	.089	.024		
Fisher's Exact Test	4.548			1.000		
Linear-by-Linear Association	5.361[b]	1	.021	.025	.022	.014
N of Valid Cases	522					

a. 4 cells (50.0%) have Expected less than 5. The minimum Expected is .35.

b. The standardized statistic is -2.315.

8.7 DURATION TO MITIGATION EFFECTIVENESS

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Time to mitigation effectiveness given?	306	100.0%	0	.0%	306	100.0%

Study * Time to mitigation effectiveness given? Crosstabulation

			Duration to mitigation effectiveness given?		Total
			Yes	No	
Study	Treweek & Thompson 1997	Count	0	194	194
		Expected	14.6	179.4	194.0
	Current Review	Count	23	89	112
		Expected	8.4	103.6	112.0
Total		Count	23	283	306
		Expected	23.0	283.0	306.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	43.077[a]	1	.000	.000	.000	
Continuity Correction[b]	40.174	1	.000			
Likelihood Ratio	49.545	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	42.936[c]	1	.000	.000	.000	.000
N of Valid Cases	306					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 8.42.

b. Computed only for a 2x2 table

c. The standardized statistic is -6.553.

8.8 DEVELOPER COMMITMENT TO MITIGATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Indications of developer commitment to at least one mitigation measure?	149	100.0%	0	.0%	149	100.0%

Study * Indications of developer commitment to at least one mitigation measure? Crosstabulation

			Indications of developer commitment to at least one mitigation measure?		
			Yes	No	Total
Study	RSPB 1995	Count	4	33	37
		Expected	22.6	14.4	37.0
	Current Review	Count	87	25	112
		Expected	68.4	43.6	112.0
Total		Count	91	58	149
		Expected	91.0	58.0	149.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	52.308[a]	1	.000	.000	.000	
Continuity Correction[b]	49.533	1	.000			
Likelihood Ratio	54.908	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	51.957[c]	1	.000	.000	.000	.000
N of Valid Cases	149					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 14.40.

b. Computed only for a 2x2 table

c. The standardized statistic is -7.208.

8.9 LANDSCAPING AS MITIGATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Landscaping included as an ecological mitigation measure?	562	100.0%	0	.0%	562	100.0%

Study * Landscaping included as an ecological mitigation measure? Crosstabulation

			Landscaping included as an ecological mitigation measure?		Total
			Yes	No	
Study	Treweek *et al.* 1993	Count	17	20	37
		Expected	23.3	13.7	37.0
	Thompson *et al.* 1997	Count	57	122	179
		Expected	112.8	66.2	179.0
	Treweek & Thompson 1997	Count	182	12	194
		Expected	122.2	71.8	194.0
	Byron *et al.* 2000	Count	26	14	40
		Expected	25.2	14.8	40.0
	Current Review	Count	72	40	112
		Expected	70.5	41.5	112.0
Total		Count	354	208	562
		Expected	354.0	208.0	562.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	158.314[a]	4	.000	.000		
Likelihood Ratio	177.864	4	.000	.000		
Fisher's Exact Test	176.474			1.000		
Linear-by-Linear Association	26.335[b]	1	.000	.000	.000	.000
N of Valid Cases	562					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 13.69.

b. The standardized statistic is -5.132.

8.10 TRANSLOCATION / RELOCATION AS MITIGATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Translocation / relocation included as an ecological mitigation measure?	328	100.0%	0	.0%	328	100.0%

Study * Translocation / relocation included as an ecological mitigation measure? Crosstabulation

			Translocation / relocation included as an ecological mitigation measure?		Total
			Yes	No	
Study	Treweek *et al.* 1993	Count	5	32	37
		Expected	6.7	30.3	37.0
	Thompson *et al.* 1997	Count	18	161	179
		Expected	32.2	146.8	179.0
	Current Review	Count	36	76	112
		Expected	20.1	91.9	112.0
Total		Count	59	269	328
		Expected	59.0	269.0	328.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	23.348[a]	2	.000	.000		
Likelihood Ratio	22.329	2	.000	.000		
Fisher's Exact Test	22.044			1.000		
Linear-by-Linear Association	18.474[b]	1	.000	.000	.000	.000
N of Valid Cases	328					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 6.66.

b. The standardized statistic is -4.298.

9 MONITORING

9.1 REFERENCE TO MONITORING

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Reference made to monitoring?	644	100.0%	0	.0%	644	100.0%

Study * Reference made to monitoring? Crosstabulation

			Reference made to monitoring?		
			Yes	No	Total
Study	Spellerberg & Minshull 1992	Count	6	39	45
		Expected	5.5	39.5	45.0
	Treweek *et al.* 1993	Count	0	37	37
		Expected	4.5	32.5	37.0
	RSPB 1995	Count	14	23	37
		Expected	4.5	32.5	37.0
	Thompson *et al.* 1997	Count	9	170	179
		Expected	21.7	157.3	179.0
	Treweek & Thompson 1997	Count	1	193	194
		Expected	23.5	170.5	194.0
	Byron *et al.* 2000	Count	4	36	40
		Expected	4.8	35.2	40.0
	Current Review	Count	44	68	112
		Expected	13.6	98.4	112.0
Total		Count	78	566	644
		Expected	78.0	566.0	644.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	138.973[a]	6	.000	.000		
Likelihood Ratio	131.057	6	.000	.000		
Fisher's Exact Test	125.796			1.000		
Linear-by-Linear Association	22.633[b]	1	.000	.000	.000	.000
N of Valid Cases	644					

a. 3 cells (21.4%) have Expected less than 5. The minimum Expected is 4.48.

b. The standardized statistic is -4.757.

9.2 COMMITMENT TO MONITORING

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Commitment made to monitoring?	599	100.0%	0	.0%	599	100.0%

Study * Commitment made to monitoring? Crosstabulation

			Commitment made to monitoring?		Total
			Yes	No	
Study	Treweek *et al.* 1993	Count	0	37	37
		Expected	1.5	35.5	37.0
	RSPB 1995	Count	2	35	37
		Expected	1.5	35.5	37.0
	Thompson *et al.* 1997	Count	0	179	179
		Expected	7.5	171.5	179.0
	Treweek & Thompson 1997	Count	0	194	194
		Expected	8.1	185.9	194.0
	Byron *et al.* 2000	Count	2	38	40
		Expected	1.7	38.3	40.0
	Current Review	Count	21	91	112
		Expected	4.7	107.3	112.0
Total		Count	25	574	599
		Expected	25.0	574.0	599.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	77.566[a]	5	.000	.000		
Likelihood Ratio	68.221	5	.000	.000		
Fisher's Exact Test	60.221			1.000		
Linear-by-Linear Association	43.055[b]	1	.000	.000	.000	.000
N of Valid Cases	599					

a. 4 cells (33.3%) have Expected less than 5. The minimum Expected is 1.54.

b. The standardized statistic is -6.562.

9.3 MONITORING PROGRAMME PROVISION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Monitoring programme included?	149	100.0%	0	.0%	149	100.0%

Study * Monitoring programme included? Crosstabulation

			Monitoring programme included?		
			Yes	No	Total
Study	RSPB 1995	Count	1	36	37
		Expected	1.2	35.8	37.0
	Current Review	Count	4	108	112
		Expected	3.8	108.2	112.0
Total		Count	5	144	149
		Expected	5.0	144.0	149.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.065[a]	1	.799	1.000	.636	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.068	1	.795	1.000	.636	
Fisher's Exact Test				1.000	.636	
Linear-by-Linear Association	.064[c]	1	.800	1.000	.636	.402
N of Valid Cases	149					

a. 2 cells (50.0%) have Expected less than 5. The minimum Expected is 1.24.

b. Computed only for a 2x2 table

c. The standardized statistic is -.254.

9.4 RESIDUAL IMPACTS ASSESSED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Residual impacts assessed?	147	100.0%	0	.0%	147	100.0%

Study * Residual impacts assessed? Crosstabulation

			Residual impacts assessed?		Total
			Yes	No	
Study	Matrunola 2007	Count	31	9	40
		Expected	34.3	5.7	40.0
	Current Review	Count	95	12	107
		Expected	91.7	15.3	107.0
Total		Count	126	21	147
		Expected	126.0	21.0	147.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.028[a]	1	.082	.111	.073	
Continuity Correction[b]	2.177	1	.140			
Likelihood Ratio	2.810	1	.094	.111	.073	
Fisher's Exact Test				.111	.073	
Linear-by-Linear Association	3.008[c]	1	.083	.111	.073	.048
N of Valid Cases	147					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 5.71.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.734.

9.5 CUMULATIVE IMPACTS

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Cumulative impacts assessed?	368	100.0%	0	.0%	368	100.0%

Study * Cumulative impacts assessed? Crosstabulation

			Cumulative impacts assessed?		
			Yes	No	Total
Study	Treweek *et al.* 1993	Count	0	37	37
		Expected	7.9	29.1	37.0
	Thompson *et al.* 1997	Count	20	159	179
		Expected	38.4	140.6	179.0
	Byron *et al.* 2000	Count	1	39	40
		Expected	8.6	31.4	40.0
	Current Review	Count	58	54	112
		Expected	24.0	88.0	112.0
Total		Count	79	289	368
		Expected	79.0	289.0	368.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	90.967[a]	3	.000	.000		
Likelihood Ratio	92.964	3	.000	.000		
Fisher's Exact Test	87.397			1.000		
Linear-by-Linear Association	71.615[b]	1	.000	.000	.000	.000
N of Valid Cases	368					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 7.94.

b. The standardized statistic is -8.463.

10 PRESENTATION

10.1 NON-TECHNICAL SUMMARY INCLUDED

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Non-technical summary included?	212	100.0%	0	.0%	212	100.0%

Study * Non-technical summary included? Crosstabulation

			Non-technical summary included?		Total
			Yes	No	
Study	Jones *et al*. 1991	Count	67	33	100
		Expected	83.5	16.5	100.0
	Current Review	Count	110	2	112
		Expected	93.5	18.5	112.0
Total		Count	177	35	212
		Expected	177.0	35.0	212.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	37.344[a]	1	.000	.000	.000	
Continuity Correction[b]	35.114	1	.000			
Likelihood Ratio	43.060	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	37.168[c]	1	.000	.000	.000	.000
N of Valid Cases	212					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 16.51.

b. Computed only for a 2x2 table

c. The standardized statistic is -6.097.

10.2 DESIGNATED SITES MAPS OVER TIME

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Designated sites maps included?	152	100.0%	0	.0%	152	100.0%

Study * Designated sites maps included? Crosstabulation

			Designated sites maps included?		Total
			1.00	2.00	
Study	Byron *et al.* 2000	Count	27	13	40
		Expected	24.2	15.8	40.0
	Current Review	Count	65	47	112
		Expected	67.8	44.2	112.0
Total		Count	92	60	152
		Expected	92.0	60.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.105[a]	1	.293	.348	.195	
Continuity Correction[b]	.744	1	.388			
Likelihood Ratio	1.123	1	.289	.348	.195	
Fisher's Exact Test				.348	.195	
Linear-by-Linear Association	1.098[c]	1	.295	.348	.195	.088
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 15.79.

b. Computed only for a 2x2 table

c. The standardized statistic is 1.048.

10.3 DESIGNATED SITES MAP VS PRESENCE OF DESIGNATED SITES

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Are there designated sites at least contiguous with the proposed development site? * Is a designated sites map included in the EcIA?	112	100.0%	0	.0%	112	100.0%

Are there designated sites at least contiguous with the proposed development site? * Is a designated sites map included in the EcIA? Crosstabulation

			Is a designated sites map included in the EcIA?		
			Yes	No	Total
Are there designated sites at least contiguous with the proposed development site?	Yes	Count	41	17	58
		Expected	36.8	21.2	58.0
	No	Count	30	24	54
		Expected	34.2	19.8	54.0
Total		Count	71	41	112
		Expected	71.0	41.0	112.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.760[a]	1	.097	.118	.071	
Continuity Correction[b]	2.146	1	.143			
Likelihood Ratio	2.769	1	.096	.118	.071	
Fisher's Exact Test				.118	.071	
Linear-by-Linear Association	2.735[c]	1	.098	.118	.071	.040
N of Valid Cases	112					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 19.77.

b. Computed only for a 2x2 table

c. The standardized statistic is 1.654.

10.4 HABITAT MAPS OVER TIME

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Study * Habitat map/s present?	152	100.0%	0	.0%	152	100.0%

Study * Habitat map/s present? Crosstabulation

			Habitat map/s present?		
			Yes	No	Total
Study	Byron *et al*. 2000	Count	20	20	40
		Expected	30.0	10.0	40.0
	Current Review	Count	94	18	112
		Expected	84.0	28.0	112.0
Total		Count	114	38	152
		Expected	114.0	38.0	152.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	18.095[a]	1	.000	.000	.000	
Continuity Correction[b]	16.331	1	.000			
Likelihood Ratio	16.747	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	17.976[c]	1	.000	.000	.000	.000
N of Valid Cases	152					

a. 0 cells (.0%) have Expected less than 5. The minimum Expected is 10.00.

b. Computed only for a 2x2 table

c. The standardized statistic is -4.240.

10.5 REPLICABILITY STUDY

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)	Exact Sig. (1-tailed)
EcIA_1	Group 1	Same	362	.97	.95	.020	.020
	Group 2	Different	10	.03			
	Total		372	1.00			

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)	Exact Sig. (1-tailed)
EcIA_2	Group 1	Same	361	.97	.95	.038	.038
	Group 2	Different	11	.03			
	Total		372	1.00			

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)	Exact Sig. (1-tailed)
EcIA_3	Group 1	Same	363	.98	.95	.010	.010
	Group 2	Different	9	.02			
	Total		372	1.00			

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)	Exact Sig. (1-tailed)
EcIA_4	Group 1	Same	364	.98	.95	.004	.004
	Group 2	Different	8	.02			
	Total		372	1.00			

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)	Exact Sig. (1-tailed)
EcIA_5	Group 1	Same	361	.97	.95	.038	.038
	Group 2	Different	11	.03			
	Total		372	1.00			

EcIA name	Development category	Competent Planning Authority	Year of Submission
Canley Regeneration Area	Mixed development	Coventry City Council	2009
Charlestown Riverside	Mixed development	Salford City Council	2010
Charlton Road Food Store	Other	Bath and North East Somerset	2008
Coolgardie Keighley Road	Other	City of Bradford Metropolitan District Council	2006
Corby Northern Orbital Road	Roads	Northamptonshire County Council	2007
Docklands Light Railway	Other	Tower Hamlets Borough Council	2006
Drakelow CCGT	Power stations	Secretary of State for Trade and Industry	2005
East Cowes	Mixed development	Isle of Wight Council	2006
East of Kettering	Mixed development	East Kettering Borough Council	2008

EcIA name	Development category	Competent Planning Authority	Year of Submission
Edingale to Drakelow Gas Pipeline	Pipelines	South Derbyshire District Council	2008
Enderby Park & Ride	Other	Leicestershire County Council	2006
Essex University Research Park Extension	Mixed development	Colchester Borough Council	2005
Exeter Gateway	Other	East Devon District Council	2000
Exeter Science Park	Other	East Devon District Council	2009
Fairfield School Sports Pitches	Leisure	Bristol City Council	2005
Fairford Lakes	Mixed development	Cotswold District Council	2009
Felixstowe South Reconfiguration	Port & harbour	Suffolk Coastal District Council	2003
Fullabrook Wind Farm	Wind farms	North Devon District Council	2004
Glyndebourne Wind Turbine	Wind farms	Lewes District Council	2007
Great Western Park	Mixed development	South Oxordshire District Council	2005
Guest and Chrimes Remediation	Other	Rotherham Metropolitan Borough Council	2007

EcIA name	Development category	Competent Planning Authority	Year of Submission
Hartland Park	Other	Hart District Council	2007
Heart of East Greenwich	Mixed development	London Borough of Greenwich	2008
Heartwood Forest	Other	Forestry Commission	2009
Hellrigg Wind Farm	Wind farms	Allerdale Borough Council	2007
Hewlett Packard	Mixed development	South Gloucestershire District Council	2004
Houghton Quarry	Mixed development	Central Bedfordshire Borough Council	2007
Humber Gateway Onshore Cable	Pipelines	East Riding of Yorkshire	2008
Humber Gateway Substation	Other	East Riding of Yorkshire	2009
Huntsman Drive	Power stations	Stockton-on-Tees Borough Council	2011
Isham Bypass	Roads	Northamptonshire County Council	2005

EcIA name	Development category	Competent Planning Authority	Year of Submission
Jeskyn's Farm	Other	Forestry Commission	2006
King Alfred Sports Centre	Mixed development	Brighton & Hove City Council	2006
King's Cross Central	Mixed development	Camden Borough Council Islington Borough Council	2004
King's Cross Enhancement	Other	Camden Borough Council	2006
Lakeside, Scunthorpe	Mixed development	North Lincolnshire District Council	2003
Land at Hill Top Farm	Other	Cheshire County Council	2007
Land West of Becklees Farm	Other	Cumbria County Council	2010
Lewisham Gateway	Mixed development	London Borough of Lewisham	2006
Little Cheyne Court Wind Farm	Wind farms	Shepway District Council	2002
Loampit Vale	Mixed development	London Borough of Lewisham	2009
London Cable Car	Other	Greenwich Borough Council	2010
London Park Hotel	Mixed development	Southwark Borough Council	2007
London Road, Amesbury	Other	Wiltshire County Council	2008

EcIA name	**Development category**	**Competent Planning Authority**	**Year of Submission**
London Wall Place	Other	City of London	2010
Lower Broughton Regeneration	Mixed development	Salford City Council	2006
Lower Broughton Reserved Matters	Mixed development	Salford City Council	2008
Lower Clarence Wharf	Power stations	Stockton-on-Tees Borough Council	2009
Marriott's Walk	Mixed development	West Oxfordshire District Council	2006
Merevale Lane	Power stations	Warwickshire County Council	2008
Mersey Gateway	Roads	Halton Borough Council	2008
Monksmoor Farm	Mixed development	Daventry District Council	2007
New Albion Wind Farm	Wind farms	Kettering Borough Council	2009
North Quay Road	Power stations	East Sussex County Council	2005
Northside Bridge	Roads	Cumbria County Council	2010
Olympic Park Site Preparation	Other	Olympic Delivery Planning Authority	2007

EcIA name	Development category	Competent Planning Authority	Year of Submission
Pebsham HWRS	Waste treatment	East Sussex County Council	2008
Polwell Lane	Mixed development	Kettering Borough Council	2008
Prospect Business Park	Other	Purbeck District Council	2007
Quest Pit	Other	Bedfordshire County Council	2006
Ramada Deansgate	Mixed development	Manchester City Council	2008
Regent's Place	Mixed development	Camden Borough Council	2007
Riverbank House	Other	City of London	2007
Salisbury Park & Ride	Other	Wiltshire County Council	2006
Seager Distillery	Mixed development	Lewisham Borough Council	2008
Second Opening Bridge, Poole	Roads	Secretary of State for Transport	2004
Shepperton Studios	Mixed development	Spelthorne Borough Council	2004
South Winchester Park and Ride	Other	Hampshire County Council	2007
Southall Gas Works	Mixed development	Ealing Borough Council	2008
St Mary Axe	Other	City of London	2008

EcIA name	Development category	Competent Planning Authority	Year of Submission
Stone House	Mixed development	City of London	2010
Teal Park	Other	North Kestevan District Council	2009
Teesside Gas Processing Plant	Pipelines	Stockton-on-Tees Borough Council	2010
The Avenue	Other	Derbyshire County Council	2007
Town Farm Quarry	Mineral extraction	Devon County Council	2009
Victoria Station Upgrade	Other	Secretary of State for Transport	2007
Vopak Terminal	Power stations	Stockton-on-Tees Borough Council	2006
Walton Bridge	Roads	Surrey County Council	2007
Warwick Campus Extension	Other	Warwick District Council	2009
Watchet East Wharf	Mixed development	West Somerset Council	2008
Watermark Place	Other	City of London	2005

EcIA name	Development category	Competent Planning Authority	Year of Submission
Wave Hub	Other	Penwith District Council	2006
Weirside	Waste treatment	West Berkshire District Council	2005
West Quay Marina	Mixed development	Borough of Poole Council	2008
Westgate Centre	Mixed development	Oxford City Council	2006
White Moss Quarry	Other	Cheshire County Council	2008
Whitemoor Phase 2	Other	Cambridgeshire County Council	2009
Wigmore Employment Area	Other	Luton Borough Council	2009
Winchester Silver Hill	Mixed development	Winchester City Council	2006
Wycombe Marsh Paper Mills	Mixed development	Wycombe District Council	2002
Yelvertoft	Wind farms	Daventry District Council	2009

Appendix 6.1: Biodiversity Assessment Index Questions

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
1	Design	Were alternative sites considered with reference to ecology?	p14	Article 5, Annex IV	The EIA Directive includes a requirement to provide "An outline of the main alternatives studied by the developer… taking into account the environmental effects." Consideration of alternative sites was not always possible but it was felt that attempts to do so should be recognised. As a result, two questions regarding alternatives were included.	✓	✗
2	Design	Were alternative processes / designs / methods considered with reference to ecology?	p14	Article 5, Annex IV		✓	✗

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
3	Baseline	Was the size of the site given?	p14	Article 5	Whilst explicitly included in Article 5, site size is also indirectly included under Annex IV's requirement to provide "a description of the physical characteristics of the whole project".	✓	×
4	Baseline	Was the ecology for any off-site construction areas described?	p14-15	Annex IV	This comes under the EIA Directive's requirement to provide "a description of the physical characteristics of the whole project" but is considered sufficiently important and poorly addressed to warrant a separate question.	✓	×
5	Baseline	Was the Phase I survey conducted according to named guidelines?	p18	N/A	"[A habitat survey] should use established methodologies"	×	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
6	Baseline	Did all surveys acknowledge limitations?	p6, p32	Annex IV	The EIA Directive requires that "difficulties (technical deficiencies or lack of know-how)" should be stated.	✓	✗
7	Baseline	Was the precautionary method, or worst-case scenario, stated as used?	p13	N/A	The EcIA Guidelines state that "best and worst-case operating conditions" should be considered and that "In cases of reasonable doubt…a precautionary view should always be taken".	✗	✓
8	Baseline	Was the proposed timescale of construction activities given?	p14	N/A	The EcIA Guidelines state that the "lifetime of [the] project" is required to be able to carry out effective EcIA. Given that construction and operation activities may	✗	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
9	Baseline	Is the proposed timescale of operation activities given?	p14	N/A	be conducted over different time frames, these should be stated.	✗	✓
10	Baseline	Were records from Local Records Centre/s obtained?	p17	N/A	The EcIA Guidelines state that "Contextual information is essential to confirm spatial and temporal scope." Such information can be obtained readily from these sources.	✗	✓
11	Baseline	Were records from Local Wildlife Groups obtained?	p17	N/A		✗	✓
12	Baseline	Were records from the NBN Gateway obtained?	p17	N/A		✗	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
13	Baseline	Was the Zone of Influence (ZoI) identified?	p13	N/A	The EcIA Guidelines define the ZoI as “areas and resources that may be affected by the biophysical changes caused by the identified activities, however remote from the project site”.	✗	✓
14	Baseline	Were the habitats and species within the ZoI been characterised?		N/A		✗	✓
15	Evaluation	Was the conservation status of habitats explicitly given?	p37	N/A	Whilst primarily mentioned within the EcIA Guidelines with regard to determining the significance of an impact, conservation status is also important in the evaluation of a receptor.	✗	✓
16	Evaluation	Was the conservation status of species explicitly given?		N/A		✗	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
17	Evaluation	Were habitats given a geographical context (e.g. locally important, etc.)?	p20-21	N/A	The EcIA Guidelines provide a frame of reference for this assessment of value.	✗	✓
18	Evaluation	Were species given a geographical context (e.g. locally important, etc.)?		N/A		✗	✓
19	Impact Assessment	Were ecological impacts described within the EcIA chapter?	p8, p30	Article 5 Annex IV	The EIA Directive requires “A description of the likely significant effects of the proposed project on the environment”, which includes ecology.	✓	✗

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
20	Impact Assessment	Was any mention made of population dynamics?	p31	N/A	All of these are given as “examples of aspects of ecological structure and function to consider when predicting impacts.”	×	✓
21	Impact Assessment	Was any mention made of vegetation dynamics?		N/A		×	✓
22	Impact Assessment	Was any mention made of ecological relationships?		N/A		×	✓
23	Impact Assessment	Was any mention made of ecological roles?		N/A		×	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
24	Impact Assessment	Was any mention made of ecosystem properties?		N/A		✗	✓
25	Impact Assessment	Was any mention made of genetic biodiversity?	p31, p41, p44	N/A	Whilst genetic biodiversity is not used as a term in the EcIA Guidelines, several references to the impacts of development on genetics are made as part of a case study example.	✗	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
26	Impact Assessment	Were economic and social consequences of biodiversity loss considered in the assessment of the project's impacts?	P18, p20, p27-28	Annex IV	This is indirectly included within the EIA Directive as a requirement to consider "aspects of the environment likely to be significantly affected by the proposed project, including…population, fauna, flora, soil, water, air…and the inter-relationship between the above factors."	✓	×
27	Impact Assessment	Were complex / interactive / cumulative impacts considered?	p30-31	Annex IV	Secondary and cumulative impacts are specified for inclusion within the "description of the likely significant effects of the proposed project on the environment" required in the EIA Directive.	✓	×

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
28	Impact Assessment	Was any reference made to climate change / global warming (with regard to ecology)?	p23, p30-31, p34	Annex IV	This has been considered in this study to be similar to the assessment of 'cumulative, complex and interactive effects' but worth a separate question due to its importance as an impact on ecology. In addition, a consideration of "climatic factors" and their interaction with, for example, flora and fauna are included in Annex IV.	✓	✗
29	Impact Assessment	Was an explicit distinction between operational and construction impacts made?	p9, p13-15	N/A	The EcIA Guidelines state that the "assessment process…should cover construction, operation and any decommissioning stages of any project"	✗	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
30	Impact Assessment	Were decommissioning impacts explicitly identified?		N/A		×	✓
31	Impact Assessment	Was at least one ecological impact quantified?	p5, p10, p33	N/A	The EcIA Guidelines state that the "assessment process…should…quantify the extent, magnitude, duration, timing and frequency of the impacts" and that "When describing changes/activities and impacts on ecosystem structure and function, reference should be made to the following parameters… • positive or negative; • magnitude;	×	✓
32	Impact Assessment	Were all impacts identified as positive, neutral or negative?		N/A		×	✓
33	Impact Assessment	Was the magnitude of all impacts identified?		N/A		×	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
34	Impact Assessment	Was the physical extent of all impacts identified?		N/A	• extent; • duration; • reversibility; and • timing and frequency.”	×	✓
35	Impact Assessment	Was the duration of all impacts given?		N/A		×	✓
36	Impact Assessment	Was the reversibility of all impacts considered?		N/A		×	✓
37	Impact Assessment	Were the timing and frequency of all impacts given?		N/A		×	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
38	Impact Assessment	Were direct versus indirect impacts explicitly identified?	p17	Annex IV	Indirect effects are specified for inclusion within the “description of the likely significant effects of the proposed project on the environment” required in the EIA Directive.	✓	✗
39	Impact Assessment	Was the significance of all impacts stated?	p5, p35	N/A	The EcIA Guidelines state that “The purpose of EcIA is to provide decision-makers with clear and concise information about the likely significant ecological effects associated with a project.”	✗	✓
40	Impact Assessment	Was the level of confidence in all impact predictions provided?	p10, p32	N/A	The EcIA Guidelines state that “the degree of confidence in the assessment of the impact on ecological structure and function” should be considered.	✗	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
41	Impact Assessment	Was there a summary/table of the assessment of biodiversity impacts in the report?	p46	N/A	Whilst not explicitly stated as required in the EcIA Guidelines, a summary table is provided in a worked example and is considered useful.	✗	✓
42	Mitigation	Was ecological mitigation of impacts described?	P47-48	Article 5 Annex IV	The EIA Directive requires a "description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment", all of which is classified as mitigation.	✓	✗

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
43	Mitigation	Was the likely success of all mitigation measures indicated?	p47	N/A	The EcIA Guidelines state that "evidence should be provided of the effectiveness of recommended mitigation, compensation and enhancement measures and to what extent their success can be guaranteed."	×	✓
44	Mitigation	Was the time required until any mitigation would likely become effective given?	P48	N/A	Whilst not specifically recommended for inclusion, the EcIA Guidelines state that "there may be a temporary or permanent loss of ecological value due to a time lag between damage occurring and the new habitat becoming fully functional" and it is considered that this is applicable to, and should therefore be acknowledged in, the majority of EcIAs.	×	✓

Question Number	EcIA Stage	Current EcIA Review Question	EcIA Guidelines Reference	EIA Directive Reference	Comments	Used in BAI Calculation?	
						Legislation BAI	Guidance BAI
45	Mitigation	Was there any evidence of commitment from the developer that mitigation would take place in the EcIA?	p47	N/A	The EcIA Guidelines state that “A shopping list of ‘proposed mitigation’ at the end of an EcIA is of very little value as it requires the competent authority to enter into discussion with the proponent to agree what will be implemented.”	✗	✓
46	Monitoring	Was any mention made of monitoring?	p48	N/A	The EcIA Guidelines state that “it is good practice to monitor the success of mitigation or compensation measures that are proposed as part of an EcIA”.	✗	✓
47	Monitoring	Was there a commitment from the developer that monitoring would take place?				✗	✓

Appendix 6.2: EcIA Chapter Biodiversity Assessment Index Scores

EcIA name	Legislation BAI	Guidance BAI
Battersea Power Station	0.78	0.78
Bathside Bay	0.75	0.61
Humber Gateway Onshore Cable	0.73	0.61
A23 Handcross toWarninglid	0.73	0.83
Ramada Deansgate	0.70	0.53
New Albion Wind Farm	0.70	0.58
Pebsham HWRS	0.70	0.46
Warwick Campus Extension	0.70	0.65
Humber Gateway Substation	0.68	0.68
Hellrigg Wind Farm	0.67	0.67
Watermark Place	0.67	0.31
Charlestown Riverside	0.67	0.71
Southall Gas Works	0.67	0.54
Fairfield School Sports Pitches	0.65	0.39
Yelvertoft	0.65	0.57
Fullabrook Wind Farm	0.65	0.50
Mersey Gateway	0.64	0.75
Second Opening Bridge, Poole	0.64	0.42
Edingale to Drakelow Gas Pipeline	0.64	0.47
Exeter Gateway	0.61	0.49
The Avenue	0.60	0.68
Whitemoor Phase 2	0.60	0.61
Billingham Biomass Plant	0.60	0.50
West Quay Marina	0.60	0.39
Huntsman Drive	0.60	0.68
Felixstowe South Reconfiguration	0.60	0.50
Lower Broughton Reserved Matters	0.60	0.57

EcIA name	Legislation BAI	Guidance BAI
Teesside Gas Processing Plant	0.59	0.75
South Winchester Park and Ride	0.59	0.57
Canley Regeneration Area	0.59	0.74
30 Old Bailey	0.56	0.40
Lower Clarence Wharf	0.55	0.27
Salisbury Park & Ride	0.55	0.50
Exeter Science Park	0.55	0.63
Drakelow CCGT	0.55	0.40
London Wall Place	0.55	0.44
Cambridge Biomedical Centre Expansion	0.55	0.54
Lower Broughton Regeneration	0.55	0.59
Shepperton Studios	0.50	0.44
Quest Pit	0.50	0.32
Walton Bridge	0.50	0.44
Isham Bypass	0.50	0.37
Winchester Silver Hill	0.50	0.26
Teal Park	0.50	0.49
Little Cheyne Court Wind Farm	0.50	0.47
Houghton Quarry	0.50	0.51
Broadgate	0.50	0.39
Jeskyn's Farm	0.50	0.51
London Park Hotel	0.50	0.24
Riverbank House	0.50	0.35
King's Cross Central	0.50	0.40
Olympic Park Site Preparation	0.50	0.61
Northside Bridge	0.50	0.51
Wave Hub	0.45	0.60
21 Wapping Lane	0.45	0.59
Westgate Centre	0.45	0.49
Loampit Vale	0.45	0.26
Bent Farm Quarry	0.45	0.48

EcIA name	Legislation BAI	Guidance BAI
Lewisham Gateway	0.45	0.37
Monksmoor Farm	0.45	0.50
A11 Fiveways to Thetford	0.45	0.69
London Cable Car	0.45	0.54
King Alfred Sports Centre	0.45	0.29
St Mary Axe	0.45	0.33
Stone House	0.45	0.40
Coolgardie Keighley Road	0.45	0.40
Billingham Mine Waste Management Facility	0.45	0.44
Brent Cross	0.45	0.53
20 Fenchurch Street	0.44	0.40
Heartwood Forest	0.44	0.61
Wigmore Employment Area	0.44	0.37
Guest and Chrimes Remediation	0.44	0.43
Heart of East Greenwich	0.41	0.47
Addenbrookes Access Road	0.41	0.25
East Cowes	0.41	0.53
Essex University Research Park Extension	0.41	0.25
399 Edgware Road	0.40	0.29
Broom Hill Quarry	0.40	0.41
Burton Wold Wind Farm Extension	0.40	0.69
Polwell Lane	0.40	0.57
Land at Hill Top Farm	0.40	0.57
Hartland Park	0.40	0.65
London Road, Amesbury	0.40	0.29
Town Farm Quarry	0.40	0.27
Fairford Lakes	0.40	0.34
East of Kettering	0.40	0.41
Bishopsgate Tower	0.40	0.27
North Quay Road	0.40	0.49
White Moss Quarry	0.39	0.41

EcIA name	Legislation BAI	Guidance BAI
110 Bishopsgate (Heron Tower)	0.38	0.37
Glyndebourne Wind Turbine	0.36	0.28
Charlton Road Food Store	0.36	0.21
Watchet East Wharf	0.36	0.24
Weirside	0.36	0.29
Land West of Becklees Farm	0.36	0.49
Blackburn Meadows	0.35	0.47
Blackstone Edge	0.35	0.34
Seager Distillery	0.35	0.41
Regent's Place	0.35	0.20
Prospect Business Park	0.35	0.58
King's Cross Enhancement	0.33	0.21
Merevale Lane	0.32	0.34
Hewlett Packard	0.32	0.25
Lakeside, Scunthorpe	0.32	0.26
Victoria Station Upgrade	0.30	0.40
Great Western Park	0.30	0.40
Docklands Light Railway	0.30	0.29
Enderby Park & Ride	0.27	0.41
Marriott's Walk	0.27	0.32
Wycombe Marsh Paper Mills	0.27	0.37
Vopak Terminal	0.27	0.44
Corby Northern Orbital Road	0.23	0.36

APPENDIX 8.1 – STATISTICS OUTPUTS

1 RELATIONSHIP BETWEEN ECIA CHAPTER QUALITY AND MITIGATION IMPLEMENTATION

1.1 RELATIONSHIP BETWEEN LEGISLATION BAI AND MITIGATION MEASURE IMPLEMENTATION

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	202	84.9
	Missing Cases	36	15.1
	Total	238	100.0
Unselected Cases		0	.0
Total		238	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes & Partial	0
No	1

1.1.1 Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Ecological mitigation measure implemented in the completed development?		
	Observed		Yes & Partial	No	Percentage Correct
Step 0	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

Classification Table[a,b]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	No	Percentage Correct
Step 0	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.670	.193	75.113	1	.000	.188

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Legislation_BAI	4.561	1	.033
	Overall Statistics		4.561	1	.033

1.1.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	4.711	1	.030
	Block	4.711	1	.030
	Model	4.711	1	.030

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	171.851[a]	.023	.040

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	Predicted: Ecological mitigation measure implemented in the completed development? No	Predicted: Percentage Correct
Step 1	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Legislation_BAI	-5.036	2.398	4.409	1	.036	.007
	Constant	.092	.833	.012	1	.912	1.096

a. Variable(s) entered on step 1: Legislation_BAI.

1.2 RELATIONSHIP BETWEEN GUIDANCE BAI AND MITIGATION IMPLEMENTATION

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	202	84.9
	Missing Cases	36	15.1
	Total	238	100.0
Unselected Cases		0	.0
Total		238	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes & Partial	0
No	1

1.2.1 Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Ecological mitigation measure implemented in the completed development?		
	Observed		Yes & Partial	No	Percentage Correct
Step 0	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.670	.193	75.113	1	.000	.188

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Guidance_BAI	2.432	1	.119
	Overall Statistics		2.432	1	.119

1.2.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	2.434	1	.119
	Block	2.434	1	.119
	Model	2.434	1	.119

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	174.128[a]	.012	.021

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	No	Percentage Correct
Step 1	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Guidance_BAI	-2.220	1.435	2.395	1	.122	.109
	Constant	-.772	.593	1.693	1	.193	.462

a. Variable(s) entered on step 1: Guidance_BAI.

2 RELATIONSHIP BETWEEN LEGISLATION BAI SCORE AND INCLUSION OF MITIGATION MEASURES IN THE EcMP

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	214	89.9
	Missing Cases	24	10.1
	Total	238	100.0
Unselected Cases		0	.0
Total		238	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes	0
No	1

2.1.1 Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Ecological mitigation measure included in the EcMP?		Percentage Correct
	Observed		Yes	No	
Step 0	Ecological mitigation measure included in the EcMP?	Yes	144	0	100.0
		No	70	0	.0
	Overall Percentage				67.3

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.721	.146	24.508	1	.000	.486

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Legislation_BAI	3.511	1	.061
	Overall Statistics		3.511	1	.061

2.1.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	3.537	1	.060
	Block	3.537	1	.060
	Model	3.537	1	.060

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	267.006[a]	.016	.023

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted: Ecological mitigation measure included in the EcMP? Yes	No	Percentage Correct
Step 1	Ecological mitigation measure included in the EcMP?	Yes	144	0	100.0
		No	70	0	.0
	Overall Percentage				67.3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Legislation_BAI	-3.192	1.713	3.473	1	.062	.041
	Constant	.426	.626	.463	1	.496	1.531

a. Variable(s) entered on step 1: Legislation_BAI.

3 RELATIONSHIP BETWEEN YEAR AND MITIGATION IMPLEMENTATION

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	202	84.9
	Missing Cases	36	15.1
	Total	238	100.0
Unselected Cases		0	.0
Total		238	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes & Partial	0
No	1

3.1.1 Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Ecological mitigation measure implemented in the completed development?		
	Observed		Yes & Partial	No	Percentage Correct
Step 0	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

Classification Table[a,b]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	No	Percentage Correct
Step 0	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.670	.193	75.113	1	.000	.188

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Year	3.394	1	.065
	Overall Statistics		3.394	1	.065

3.1.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	3.363	1	.067
	Block	3.363	1	.067
	Model	3.363	1	.067

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	173.199[a]	.017	.028

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	No	Percentage Correct
Step 1	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Year	.116	.064	3.316	1	.069	1.123
	Constant	-234.651	127.960	3.363	1	.067	.000

a. Variable(s) entered on step 1: Year.

4 RELATIONSHIP BETWEEN LEGAL INSTRUMENTS AND MITIGATION IMPLEMENTATION

4.1 RELATIONSHIP BETWEEN PLANNING CONDITIONS AND MITIGATION IMPLEMENTATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Ecological mitigation measure included as a planning condition? * Ecological mitigation measure implemented in the completed development?	202	84.9%	36	15.1%	238	100.0%

Ecological mitigation measure included as a planning condition? * Ecological mitigation measure implemented in the completed development? Crosstabulation

			Ecological mitigation measure implemented in the completed development?		
			Yes & Partial	No	Total
Ecological mitigation measure included as a planning condition?	Yes & Partial	Count	24	0	24
		Expected Count	20.2	3.8	24.0
	No	Count	146	32	178
		Expected Count	149.8	28.2	178.0
Total		Count	170	32	202
		Expected Count	170.0	32.0	202.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.127[a]	1	.024	.031	.012	
Continuity Correction[b]	3.867	1	.049			
Likelihood Ratio	8.867	1	.003	.013	.012	
Fisher's Exact Test				.017	.012	
Linear-by-Linear Association	5.101[c]	1	.024	.031	.012	.012
N of Valid Cases	202					

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.80.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.259.

4.2 RELATIONSHIP BETWEEN PLANNING OBLIGATIONS AND MITIGATION IMPLEMENTATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Ecological mitigation measure included as a planning obligation? * Ecological mitigation measure implemented in the completed development?	119	50.0%	119	50.0%	238	100.0%

Ecological mitigation measure included as a planning obligation? * Ecological mitigation measure implemented in the completed development? Crosstabulation

			Ecological mitigation measure implemented in the completed development?		
			Yes & Partial	No	Total
Ecological mitigation measure included as a planning obligation?	Yes	Count	40	2	42
		Expected Count	35.3	6.7	42.0
	No	Count	60	17	77
		Expected Count	64.7	12.3	77.0
Total		Count	100	19	119
		Expected Count	100.0	19.0	119.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	6.073[a]	1	.014	.017	.010	
Continuity Correction[b]	4.851	1	.028			
Likelihood Ratio	7.132	1	.008	.017	.010	
Fisher's Exact Test				.017	.010	
Linear-by-Linear Association	6.022[c]	1	.014	.017	.010	.009
N of Valid Cases	119					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.71.

b. Computed only for a 2x2 table

c. The standardized statistic is 2.454.

4.3 RELATIONSHIP BETWEEN LEGAL INSTRUMENTS AND MITIGATION IMPLEMENTATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Ecological mitigation measure included as a planning condition or a planning obligation? * Ecological mitigation measure implemented in the completed development?	202	84.9%	36	15.1%	238	100.0%

Ecological mitigation measure included as a planning condition or a planning obligation? * Ecological mitigation measure implemented in the completed development? Crosstabulation

			Ecological mitigation measure implemented in the completed development?		
			Yes & Partial	No	Total
Ecological mitigation measure included as a planning condition or a planning obligation?	Yes	Count	63	2	65
		Expected Count	54.7	10.3	65.0
	No	Count	107	30	137
		Expected Count	115.3	21.7	137.0
Total		Count	170	32	202
		Expected Count	170.0	32.0	202.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.713[a]	1	.001	.001	.000	
Continuity Correction[b]	10.344	1	.001			
Likelihood Ratio	14.681	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	11.655[c]	1	.001	.001	.000	.000
N of Valid Cases	202					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.30.

b. Computed only for a 2x2 table

c. The standardized statistic is 3.414.

4.4 RELATIONSHIP BETWEEN EcMP AND MITIGATION IMPLEMENTATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Ecological mitigation measure included in the EcMP? * Ecological mitigation measure implemented in the completed development?	182	76.5%	56	23.5%	238	100.0%

Ecological mitigation measure included in the EcMP? * Ecological mitigation measure implemented in the completed development? Crosstabulation

			Ecological mitigation measure implemented in the completed development?		
			Yes & Partial	No	Total
Ecological mitigation measure included in the EcMP?	Yes	Count	117	16	133
		Expected Count	109.6	23.4	133.0
	No	Count	33	16	49
		Expected Count	40.4	8.6	49.0
Total		Count	150	32	182
		Expected Count	150.0	32.0	182.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.509[a]	1	.001	.002	.002	
Continuity Correction[b]	9.134	1	.003			
Likelihood Ratio	9.593	1	.002	.004	.002	
Fisher's Exact Test				.002	.002	
Linear-by-Linear Association	10.452[c]	1	.001	.002	.002	.001
N of Valid Cases	182					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.62.

b. Computed only for a 2x2 table

c. The standardized statistic is 3.233.

4.5 RELATIONSHIP BETWEEN FOLLOW-UP AND MITIGATION IMPLEMENTATION

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Was an ecological follow-up programme implemented? * Ecological mitigation measure implemented in the completed development?	202	84.9%	36	15.1%	238	100.0%

Was an ecological follow-up programme implemented? * Ecological mitigation measure implemented in the completed development? Crosstabulation

			Ecological mitigation measure implemented in the completed development?		
			Yes & Partial	No	Total
Was an ecological follow-up programme implemented?	Yes	Count	110	11	121
		Expected Count	101.8	19.2	121.0
	No	Count	60	21	81
		Expected Count	68.2	12.8	81.0
Total		Count	170	32	202
		Expected Count	170.0	32.0	202.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.315[a]	1	.001	.002	.001	
Continuity Correction[b]	9.090	1	.003			
Likelihood Ratio	10.130	1	.001	.003	.001	
Fisher's Exact Test				.002	.001	
Linear-by-Linear Association	10.263[c]	1	.001	.002	.001	.001
N of Valid Cases	202					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.83.

b. Computed only for a 2x2 table

c. The standardized statistic is 3.204.

5 RELATIONSHIP BETWEEN INCONVENIENCE AND MITIGATION IMPLEMENTATION

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	202	84.9
	Missing Cases	36	15.1
	Total	238	100.0
Unselected Cases		0	.0
Total		238	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes & Partial	0
No	1

5.1.1 Block 0: Beginning Block

Classification Table[a,b]

	Observed		Predicted		
			Ecological mitigation measure implemented in the completed development?		Percentage Correct
			Yes & Partial	No	
Step 0	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.670	.193	75.113	1	.000	.188

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Incon_Index	.412	1	.521
	Overall Statistics		.412	1	.521

5.1.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	.416	1	.519
	Block	.416	1	.519
	Model	.416	1	.519

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	176.145[a]	.002	.004

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	No	Percentage Correct
Step 1	Ecological mitigation measure implemented in the completed development?	Yes & Partial	170	0	100.0
		No	32	0	.0
	Overall Percentage				84.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Incon_Index	.899	1.402	.411	1	.521	2.457
	Constant	-2.203	.861	6.547	1	.011	.111

a. Variable(s) entered on step 1: Incon_Index.

6 RELATIONSHIP BETWEEN LEGAL REQUIREMENT AND INCONVENIENCE

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	238	100.0
	Missing Cases	0	.0
	Total	238	100.0
Unselected Cases		0	.0
Total		238	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes	0
No	1

6.1.1 Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Ecological mitigation measure included as a planning condition or a planning obligation?		Percentage Correct
	Observed		Yes	No	
Step 0	Ecological mitigation measure included as a planning condition or a planning obligation?	Yes	0	83	.0
		No	0	155	100.0
	Overall Percentage				65.1

Classification Table[a,b]

Observed			Predicted: Ecological mitigation measure included as a planning condition or a planning obligation? Yes	No	Percentage Correct
Step 0	Ecological mitigation measure included as a planning condition or a planning obligation?	Yes	0	83	.0
		No	0	155	100.0
	Overall Percentage				65.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.625	.136	21.087	1	.000	1.867

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Incon_Index	26.878	1	.000
	Overall Statistics		26.878	1	.000

6.1.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	27.442	1	.000
	Block	27.442	1	.000
	Model	27.442	1	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	280.370[a]	.109	.150

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted: Ecological mitigation measure included as a planning condition or a planning obligation? Yes	No	Percentage Correct
Step 1	Ecological mitigation measure included as a planning condition or a planning obligation?	Yes	44	39	53.0
		No	29	126	81.3
	Overall Percentage				71.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Incon_Index	5.136	1.033	24.733	1	.000	170.082
	Constant	-2.274	.588	14.935	1	.000	.103

a. Variable(s) entered on step 1: Incon_Index.

7 VARIABLES WITH THE GREATEST EXPLANATORY POWER

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	182	76.5
	Missing Cases	56	23.5
	Total	238	100.0
Unselected Cases		0	.0
Total		238	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes & Partial	0
No	1

Categorical Variables Codings

		Frequency	Parameter coding
			(1)
Was an ecological follow-up programme implemented?	Yes	111	1.000
	No	71	.000
Ecological mitigation measure included in the EcMP?	Yes	133	1.000
	No	49	.000
Ecological mitigation measure included as a planning condition or a planning obligation?	Yes	45	1.000
	No	137	.000

7.1.1 Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	Predicted: Ecological mitigation measure implemented in the completed development? No	Percentage Correct
Step 0	Ecological mitigation measure implemented in the completed development?	Yes & Partial	150	0	100.0
		No	32	0	.0
	Overall Percentage				82.4

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.545	.195	62.946	1	.000	.213

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Legal_comb(1)	7.121	1	.008
		EcMP_mit(1)	10.509	1	.001
		Follow_up(1)	11.559	1	.001
		Legislation_BAI	4.711	1	.030
		Guidance_BAI	3.222	1	.073
		Incon_Index	.002	1	.965
		Year	4.840	1	.028
	Overall Statistics		22.729	7	.002

7.1.2 Block 1: Method = Backward Stepwise (Likelihood Ratio)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	23.780	7	.001
	Block	23.780	7	.001
	Model	23.780	7	.001
Step 2[a]	Step	-.303	1	.582
	Block	23.477	6	.001
	Model	23.477	6	.001
Step 3[a]	Step	-1.300	1	.254
	Block	22.176	5	.000
	Model	22.176	5	.000
Step 4[a]	Step	-.763	1	.383
	Block	21.414	4	.000
	Model	21.414	4	.000
Step 5[a]	Step	-1.318	1	.251
	Block	20.096	3	.000
	Model	20.096	3	.000
Step 6[a]	Step	-2.039	1	.153
	Block	18.057	2	.000
	Model	18.057	2	.000

a. A negative Chi-squares value indicates that the Chi-squares value has decreased from the previous step.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	145.481[a]	.122	.202
2	145.784[a]	.121	.200
3	147.084[a]	.115	.189
4	147.847[a]	.111	.183
5	149.165[a]	.105	.173
6	151.204[b]	.094	.156

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

b. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	10.368	8	.240
2	9.947	8	.269
3	11.500	8	.175
4	11.540	8	.173
5	3.780	4	.437
6	4.726	2	.094

Contingency Table for Hosmer and Lemeshow Test

		Ecological mitigation measure implemented in the completed development? = Yes & Partial		Ecological mitigation measure implemented in the completed development? = No		
		Observed	Expected	Observed	Expected	Total
Step 1	1	19	18.537	0	.463	19
	2	20	20.115	1	.885	21
	3	17	16.871	1	1.129	18
	4	15	13.794	0	1.206	15
	5	17	16.679	2	2.321	19
	6	14	15.030	4	2.970	18
	7	13	13.196	4	3.804	17
	8	9	13.501	9	4.499	18
	9	15	12.349	3	5.651	18
	10	11	9.928	8	9.072	19
Step 2	1	24	24.336	1	.664	25
	2	22	21.808	1	1.192	23
	3	23	21.295	0	1.705	23
	4	13	12.265	1	1.735	14
	5	13	12.947	2	2.053	15
	6	10	13.149	6	2.851	16
	7	10	11.414	5	3.586	15
	8	13	14.094	6	4.906	19
	9	12	9.448	2	4.552	14
	10	10	9.243	8	8.757	18
Step 3	1	24	24.364	1	.636	25
	2	16	15.126	0	.874	16

	3	11	11.159	1	.841	12
	4	18	16.694	0	1.306	18
	5	14	12.962	1	2.038	15
	6	14	17.476	7	3.524	21
	7	10	12.219	5	2.781	15
	8	8	7.270	1	1.730	9
	9	13	13.990	6	5.010	19
	10	22	18.740	10	13.260	32
Step 4	1	24	24.221	1	.779	25
	2	14	13.356	0	.644	14
	3	15	15.013	1	.987	16
	4	18	16.219	0	1.781	18
	5	11	13.147	4	1.853	15
	6	11	9.409	0	1.591	11
	7	10	12.132	5	2.868	15
	8	12	13.241	5	3.759	17
	9	13	14.277	6	4.723	19
	10	22	18.984	10	13.016	32
Step 5	1	38	37.557	1	1.443	39
	2	5	5.443	1	.557	6
	3	46	44.155	3	4.845	49
	4	31	33.470	12	9.530	43
	5	13	14.664	6	4.336	19
	6	17	14.712	9	11.288	26
Step 6	1	84	81.461	4	6.539	88
	2	16	18.539	7	4.461	23
	3	33	35.539	12	9.461	45
	4	17	14.461	9	11.539	26

Classification Table[a]

Observed			Predicted: Ecological mitigation measure implemented in the completed development? Yes & Partial	No	Percentage Correct
Step 1	Ecological mitigation measure implemented in the completed development?	Yes & Partial	146	4	97.3
		No	31	1	3.1
	Overall Percentage				80.8
Step 2	Ecological mitigation measure implemented in the completed development?	Yes & Partial	150	0	100.0
		No	32	0	.0
	Overall Percentage				82.4
Step 3	Ecological mitigation measure implemented in the completed development?	Yes & Partial	148	2	98.7
		No	25	7	21.9
	Overall Percentage				85.2
Step 4	Ecological mitigation measure implemented in the completed development?	Yes & Partial	150	0	100.0
		No	32	0	.0
	Overall Percentage				82.4
Step 5	Ecological mitigation measure implemented in the completed development?	Yes & Partial	150	0	100.0
		No	32	0	.0
	Overall Percentage				82.4
Step	Ecological mitigation	Yes & Partial	150	0	100.0

6	measure implemented in the completed development?	No	32	0	.0
	Overall Percentage				82.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Legal_comb(1)	-1.138	.831	1.873	1	.171	.320
	EcMP_mit(1)	-1.019	.434	5.524	1	.019	.361
	Follow_up(1)	-2.806	1.254	5.003	1	.025	.060
	Legislation_BAI	10.961	6.362	2.968	1	.085	57570.212
	Guidance_BAI	-2.942	2.303	1.632	1	.201	.053
	Incon_Index	-.961	1.738	.305	1	.580	.383
	Year	-.153	.129	1.403	1	.236	.858
	Constant	304.641	257.794	1.396	1	.237	2.014E132
Step 2[a]	Legal_comb(1)	-1.096	.827	1.753	1	.185	.334
	EcMP_mit(1)	-1.052	.430	5.990	1	.014	.349
	Follow_up(1)	-2.721	1.239	4.822	1	.028	.066
	Legislation_BAI	10.885	6.347	2.941	1	.086	53351.265
	Guidance_BAI	-2.802	2.296	1.489	1	.222	.061
	Year	-.143	.127	1.261	1	.261	.867
	Constant	284.416	254.347	1.250	1	.263	3.315E123
Step 3[a]	Legal_comb(1)	-1.097	.828	1.754	1	.185	.334
	EcMP_mit(1)	-1.039	.428	5.889	1	.015	.354
	Follow_up(1)	-1.594	.686	5.401	1	.020	.203
	Legislation_BAI	5.947	4.326	1.890	1	.169	382.644
	Guidance_BAI	-1.850	2.135	.751	1	.386	.157
	Constant	-1.244	1.247	.995	1	.319	.288
Step 4[a]	Legal_comb(1)	-1.208	.814	2.202	1	.138	.299
	EcMP_mit(1)	-1.043	.428	5.949	1	.015	.352
	Follow_up(1)	-1.535	.716	4.597	1	.032	.215
	Legislation_BAI	4.801	4.329	1.230	1	.267	121.677
	Constant	-1.599	1.252	1.632	1	.201	.202
Step 5[a]	Legal_comb(1)	-1.049	.804	1.702	1	.192	.350
	EcMP_mit(1)	-.991	.422	5.510	1	.019	.371
	Follow_up(1)	-.954	.443	4.634	1	.031	.385

	Constant	-.265	.352	.567	1	.451	.767
Step 6[a]	EcMP_mit(1)	-1.098	.419	6.879	1	.009	.334
	Follow_up(1)	-1.199	.421	8.118	1	.004	.302
	Constant	-.226	.350	.415	1	.519	.798

a. Variable(s) entered on step 1: Legal_comb, EcMP_mit, Follow_up, Legislation_BAI, Guidance_BAI, Incon_Index, Year.

Model if Term Removed

Variable		Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Step 1	Legal_comb	-73.842	2.203	1	.138
	EcMP_mit	-75.491	5.501	1	.019
	Follow_up	-75.551	5.622	1	.018
	Legislation_BAI	-74.364	3.248	1	.072
	Guidance_BAI	-73.567	1.652	1	.199
	Incon_Index	-72.892	.303	1	.582
	Year	-73.466	1.451	1	.228
Step 2	Legal_comb	-73.919	2.055	1	.152
	EcMP_mit	-75.872	5.960	1	.015
	Follow_up	-75.587	5.391	1	.020
	Legislation_BAI	-74.498	3.213	1	.073
	Guidance_BAI	-73.647	1.510	1	.219
	Year	-73.542	1.300	1	.254
Step 3	Legal_comb	-74.570	2.055	1	.152
	EcMP_mit	-76.470	5.855	1	.016
	Follow_up	-76.659	6.234	1	.013
	Legislation_BAI	-74.507	1.930	1	.165
	Guidance_BAI	-73.923	.763	1	.383
Step 4	Legal_comb	-75.258	2.669	1	.102
	EcMP_mit	-76.878	5.910	1	.015
	Follow_up	-76.716	5.586	1	.018
	Legislation_BAI	-74.583	1.318	1	.251
Step 5	Legal_comb	-75.602	2.039	1	.153
	EcMP_mit	-77.309	5.453	1	.020
	Follow_up	-77.015	4.864	1	.027
Step 6	EcMP_mit	-78.978	6.752	1	.009
	Follow_up	-79.834	8.463	1	.004

Variables not in the Equation

			Score	df	Sig.
Step 2[a]	Variables	Incon_Index	.306	1	.580
	Overall Statistics		.306	1	.580
Step 3[b]	Variables	Incon_Index	.154	1	.695
		Year	1.279	1	.258
	Overall Statistics		1.577	2	.455
Step 4[c]	Variables	Guidance_BAI	.762	1	.383
		Incon_Index	.106	1	.744
		Year	.548	1	.459
	Overall Statistics		2.340	3	.505
Step 5[d]	Variables	Legislation_BAI	1.254	1	.263
		Guidance_BAI	.152	1	.697
		Incon_Index	.233	1	.629
		Year	.021	1	.884
	Overall Statistics		3.663	4	.453
Step 6[e]	Variables	Legal_comb(1)	1.830	1	.176
		Legislation_BAI	.658	1	.417
		Guidance_BAI	.620	1	.431
		Incon_Index	.099	1	.753
		Year	.003	1	.956
	Overall Statistics		5.546	5	.353

a. Variable(s) removed on step 2: Incon_Index.

b. Variable(s) removed on step 3: Year.

c. Variable(s) removed on step 4: Guidance_BAI.

d. Variable(s) removed on step 5: Legislation_BAI.

e. Variable(s) removed on step 6: Legal_comb.

APPENDIX 9.1 – STATISTICS OUTPUTS

1 RELATIONSHIP BETWEEN ECIA CHAPTER QUALITY AND HABITAT MITIGATION IMPLEMENTATION EFFECTIVENESS

1.1 RELATIONSHIP BETWEEN LEGISLATION BAI AND MITIGATION MEASURE IMPLEMENTATION EFFECTIVENESS

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	10	66.7
	Missing Cases	5	33.3
	Total	15	100.0
Unselected Cases		0	.0
Total		15	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes	0
No	1

1.1.1 Block 0: Beginning Block

Classification Table[a,b]

	Observed		Predicted: Was the EcIA chapter or EcMP habitat description target met? Yes	Predicted: Was the EcIA chapter or EcMP habitat description target met? No	Predicted: Percentage Correct
Step 0	Was the EcIA chapter or EcMP habitat description target met?	Yes	0	3	.0
		No	0	7	100.0
	Overall Percentage				70.0

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.847	.690	1.508	1	.220	2.333

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Legislation_BAI	.104	1	.747
	Overall Statistics		.104	1	.747

1.1.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	.108	1	.743
	Block	.108	1	.743
	Model	.108	1	.743

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	12.110[a]	.011	.015

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			Was the EcIA chapter or EcMP habitat description target met?		Percentage Correct
	Observed		Yes	No	
Step 1	Was the EcIA chapter or EcMP habitat description target met?	Yes	0	3	.0
		No	0	7	100.0
	Overall Percentage				70.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Legislation_BAI	2.973	9.277	.103	1	.749	19.545
	Constant	-.119	3.059	.002	1	.969	.888

a. Variable(s) entered on step 1: Legislation_BAI.

1.2 RELATIONSHIP BETWEEN GUIDANCE BAI AND MITIGATION IMPLEMENTATION EFFECTIVENESS

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	10	66.7
	Missing Cases	5	33.3
	Total	15	100.0
Unselected Cases		0	.0
Total		15	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Yes	0
No	1

1.2.1 Block 0: Beginning Block

Classification Table[a,b]

	Observed		Predicted		
			Was the EcIA chapter or EcMP habitat description target met?		Percentage Correct
			Yes	No	
Step 0	Was the EcIA chapter or EcMP habitat description target met?	Yes	0	3	.0
		No	0	7	100.0
	Overall Percentage				70.0

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.847	.690	1.508	1	.220	2.333

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Guidance_BAI	.152	1	.696
	Overall Statistics		.152	1	.696

1.2.2 Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	.153	1	.696
	Block	.153	1	.696
	Model	.153	1	.696

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	12.065[a]	.015	.021

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			Was the EcIA chapter or EcMP habitat description target met?		Percentage Correct
	Observed		Yes	No	
Step 1	Was the EcIA chapter or EcMP habitat description target met?	Yes	0	3	.0
		No	0	7	100.0
	Overall Percentage				70.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Guidance_BAI	2.255	5.825	.150	1	.699	9.533
	Constant	-.076	2.451	.001	1	.975	.927

a. Variable(s) entered on step 1: Guidance_BAI.

2 RELATIONSHIP BETWEEN FOLLOW-UP AND HABITAT MITIGATION IMPLEMENTATION EFFECTIVENESS

2.1 RELATIONSHIP BETWEEN ANY FORM OF FOLLOW-UP AND MITIGATION IMPLEMENTATION EFFECTIVENESS

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Was the EcIA chapter or EcMP habitat description target met? * Was follow-up conducted?	10	66.7%	5	33.3%	15	100.0%

Was the EcIA chapter or EcMP habitat description target met? * Was follow-up conducted? Crosstabulation

			Was follow-up conducted?		
			Yes	No	Total
Was the EcIA chapter or EcMP habitat description target met?	Yes	Count	2	1	3
		Expected Count	1.2	1.8	3.0
	No	Count	2	5	7
		Expected Count	2.8	4.2	7.0
Total		Count	4	6	10
		Expected Count	4.0	6.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.270[a]	1	.260	.500	.333	
Continuity Correction[b]	.179	1	.673			
Likelihood Ratio	1.265	1	.261	.500	.333	
Fisher's Exact Test				.500	.333	
Linear-by-Linear Association	1.143[c]	1	.285	.500	.333	.300
N of Valid Cases	10					

a. 4 cells (100.0%) have expected count less than 5. The minimum expected count is 1.20.

b. Computed only for a 2x2 table

c. The standardized statistic is 1.069.

2.2 RELATIONSHIP BETWEEN HABITAT MEASURE FOLLOW UP AND MITIGATION IMPLEMENTATION EFFECTIVENESS

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Was the EcIA chapter or EcMP habitat description target met? * Was follow-up of the habitat mitigation measures conducted?	10	66.7%	5	33.3%	15	100.0%

Was the EcIA chapter or EcMP habitat description target met? * Was follow-up of the habitat mitigation measures conducted? Crosstabulation

			Was follow-up of the habitat mitigation measures conducted?		
			Yes	No	Total
Was the EcIA chapter or EcMP habitat description target met?	Yes	Count	1	2	3
		Expected Count	.9	2.1	3.0
	No	Count	2	5	7
		Expected Count	2.1	4.9	7.0
Total		Count	3	7	10
		Expected Count	3.0	7.0	10.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.023[a]	1	.880	1.000	.708	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.022	1	.881	1.000	.708	
Fisher's Exact Test				1.000	.708	
Linear-by-Linear Association	.020[c]	1	.886	1.000	.708	.525
N of Valid Cases	10					

a. 4 cells (100.0%) have expected count less than 5. The minimum expected count is .90.

b. Computed only for a 2x2 table

c. The standardized statistic is .143.